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The Underfoot
*An exploration into eco-fiction
character toy design*



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dissertation presented by Tanya Marriott in partial
fulfilment of the requirements for the degree of
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Abstract Children engage in less outdoor play than previous generations. This global trend has impacted on a child's ability to understand and form a relationship with the natural world. Described as "nature deficit disorder", the decline in nature play can affect a child's ability to self-actualise and develop relationships with non-human living beings. This practice-led creative research used eco-fiction design criteria to develop The Underfoot range of five-character toys and a pitch document that encourages Aotearoa New Zealand children aged between five and seven years old to engage with environmental narratives while playing with the toys in nature.

The Underfoot character toys are themed around the nitrogen cycle system and focus on character play in outdoor spaces. A core design feature is the integration of natural materials such as soil, leaves and water during play as part of each toy's character. The pitch document describes the toys' story world, the characters' motivations and their ecosystem. The Underfoot toys demonstrate how eco-fiction character toys can enhance a child's relationship with the natural world, as evidenced by appraisal by industry experts and playtesting with child user groups.

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In memory of Dave Marriott.

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- Glossary**
- **Action Figures** are plastic character figure toys (human and monster) with articulated joints that are generally marketed to boys.
 - **Biotic and abiotic** are the natural elements that substantiate an ecosystem: biotic entails living entities, such as plants, fungi and animals; abiotic entails conditions such as atmosphere, water and soil.
 - **Brand guidelines** are design guidelines used by a brand's founder or licensor for a set of rules and criteria for how the brand is presented to the public; they are applied across other products in the brand.
 - **Character licensing** was first initiated by Disney studios for their cartoon characters and is defined by the **World Intellectual Property Organisation (6)** as the secondary use of a fictional character in relation to developing further goods and services. From the 1980s, this included animation and game extensions of popular character toys, or toys based on popular media licences. It enables more diverse coverage of the character and their narrative through play, which can enable an emotional connection with the character and its use as an “interface to a world of motivations and values” (Leclerc 1).
 - **Character licensed toys** are doll and action-figure toys derived from or aligned to an accompanying animation or game licence; they are commonly used by children in imaginative play.
 - **Cycles in nature** include the cycle of matter or biogeochemical cycles, and are the transference of chemical elements between biotic and abiotic elements. The core cycles in nature are nitrogen, oxygen, carbon and hydrologic.
 - **Dolls** are plastic or plush character figure toys (both human and animal), often with brushable hair and less articulated limbs, that are generally marketed to girls.
 - **Eco-fiction** is defined within literary texts, animation and film; it explores the relationships between humans and the environment and privileges the other.
 - **Imaginative play** is make-believe or pretend play where children role-play areas of interest. It can take the form of mimicry of real-life or fantasy-based imaginative play where the child invents or redefines their reality.
 - **Nature deficit disorder** is a term defined by Richard Louv as a way to describe what he saw as increasing alienation from Nature (Louv “**What Is**”). It is now used to motivate a societal shift towards a more conscious connection with nature.
 - **Nitrogen cycle** is one of the most crucial natural cycles enabling our planet to function. It transfers nutrients via decomposition into both the soil and the atmosphere through a breakdown and reconfiguring of nitrogen molecules. Nitrogen makes up 78% of the earth's atmosphere and its availability can indicate the health of an ecosystem (**Nitrogen Cycle**). See **Figure 30**.

- **Nature play** is any form of play in a natural or wild environment such as a park or forest.
- **Organisms** are defined as plants, animals or single-celled life-forms, and include producers, consumers and decomposers. In a successive chain, organisms may eat other organisms or be eaten.
- **Outdoor toys** are toys designed for play primarily outdoors, defined by the toy industry as ride ons, water guns and seasonal toys.
- **Pitch bibles** are a standard form of media to demonstrate a speculative entertainment licence's core story principles, characters, environment and plotline.
- **Trophic levels** indicate the position within the food web of organisms within an ecosystem. Trophic levels are shown in succession to demonstrate the flow of energy and feeding relationships within the ecosystem.
- **Toy quarters** are the price points for toys as they are released throughout the year. The first quarter toy is the entry product, whereas the fourth quarter toy is the more expensive Christmas product.
- **Small world play** is a mode of imaginative play where children use their imagination and props in their local surroundings to create detailed playworlds.

Preface

I have designed toys my whole life. The daughter of an engineer and a textile artist and dressmaker, my parents encouraged my “making” activities from a very young age. Even then, my work focused on environmental storytelling and advocacy for animal narratives. My parents were not environmentalists; this was purely my interest that I cultivated as a child. I was inspired by the media I consumed and the environment outside that I played in. I was empowered by constantly making things—whether with cardboard, clay or paper—to extend the world of my toys.

My creative practice sits at the intersection of toy design and doll design, both within the commercial toy industry and as a designer toy artist with a 30-plus-year legacy as an art doll and toy designer. Within my creative practice, I am known for my anthropomorphic work, depicting animals in a human world, and, increasingly, for my art doll designs, a fantastical depiction of the animal kingdom. My designer toys are themed around environmental narratives of guardianship and the ability of animal characters to reclaim agency in their world.

Environmental narratives heavily influenced licensed toys in the 1980s. As the product was designed as a toy first, with a licence applied as a marketing tool, the environmental focus is embodied in both the product and the licence. I developed my environmental understanding through those fundamental childhood interactions with my toys. As a child, my brother and I played with the first generation (G1) of My Little Pony toys in the garden. I remember how we would build the ponies’ houses within the ivy hedge bordering my parents’ property in suburban Wellington, Aotearoa New Zealand. The ponies were the protagonists and heroes in the play world of eco-fiction narratives,

encompassing environmental disasters, epic journeys through uncharted lands, wildlife poaching, family, displacement and disaster, collectively developing an understanding of climate change and species decline. This rhetoric was prevalent in my 1980s childhood and continues to challenge today’s children.

My work as a toy designer in the commercial toy industry in the early 2000s inspired this doctoral research, which focused on developing toys in an increasingly consumer-based world of play. I found this profoundly demoralising and felt that the products I was working on were missing the connection between the story and play, with the focus more on a need to fit into the consumer culture model of quick sales and inbuilt obsolescence. When I visited the Toy Fairs in London and New York, very few character licensed toys had an environmental story-driven focus, and these toys lacked the design versatility that was core to my childhood toys that made them viable for outdoor play. The commercial toy industry defines outdoor toys as seasonal and action- and activity-based ones used during summer, but these toys are not character or story-focused.

The contemporary proliferation of streaming channels like Netflix and Amazon has democratised the media market and enabled more diverse entertainment media for children, including a steady lineup of eco-fiction shows. Furthermore, with the climate crisis still looming, this media gives children an outlet to explore their concerns about our changing world; however, play and toy play, specifically, is the outlet they use to mediate these experiences and feelings. But where are the toys? Many of these licences have meaningful environmental narratives; however, only some are translated into toys. This leaves a potential for a new

toy genre of character licensed toys—enriched by environmentally focused narratives that are activated through play in nature.

This research started at the beginning of the pandemic in 2020 when Aotearoa New Zealand went into lockdown. Our local community turned to greenspaces in our wider backyard as an outlet from social-distancing restrictions; children, in particular, were encouraged to find alternatives to digital devices. In my neighbourhood, we became more aware of the natural world and our relationship with it. Post-pandemic, as we slide back into our familiar routines, this study looks to character licensed toy design as a mode to reconnect children with nature as a vehicle to make meaning in their rapidly changing worlds.

I. Introduction

As a doll and toy designer who has been working in the field for many years, personal experience has shown me that well-designed toys can be powerful pervasive agents for environmental awareness and interconnectedness with the natural environment. It was this observation that led me to research toys as a way to instil a deep ecological understanding and relationship with natural spaces and other species in the next generation. Here, my specific interest was character licensed toys (dolls and action figures), which bring the story and a specific worldview to play. However, character toys are not usually designed for outdoor play, which seems to miss the opportunity to use them as agents to empower nature play and develop environmental awareness.

In response, this research looked to address this opportunity by developing eco-fiction character licensed toys for outdoor play that encouraged children aged five to seven to engage with ecological principles during play. The method of design, which used an eco-fiction framework to enable the cohesive integration of an environmental narrative between the media licence and the toys themselves, enabled the research to embody ecological principles and systems within all aspects of the design. The eco-fiction narrative framework thus guided the design process for the character toys, which are designed as an ecosystem of interlinked products that utilise natural materials and environments as an extension of the play product. Using an eco-fiction framework during the design process enabled the design of more ecologically embodied toys and allowed me to question the current design process for developing character toys.

The research process outlined in this thesis defines and documents a cyclic design methodology that enables

the toy designer to action a cohesive environmental narrative from media licence, in the form of a pitch bible for The Underfoot character toy range. Real biotic and abiotic species within living soil ecosystems influenced the design of the final five toy characters. For example, the character Oke Velvet Worm was inspired by a “missing link” creature from Aotearoa New Zealand and was used as a key character due to its ecological uniqueness and potential for characterisation.

Several innovation points included using an eco-fiction narrative to define an ecosystem of toys, where each toy in the range influences the following toy. Using an eco-fiction criterion for the design of the toys ensured there was a consistent and cohesive environmental framework used within the entire design process. The Underfoot toys incorporate natural materials such as dirt, water, leaves and sticks into the design, making natural elements integral to play. The toy range is designed with attributes from dolls and action figures, such as articulated joints and soft materials (Leary). The character toys are a hybrid between character dolls and action figures, so they appeal to all children.

Children aged five to seven play tested the toy prototypes over several sessions in a public wilderness park. This age range was chosen as this is a crucial age when children develop their imagination, communication and social skills (Genius of Play) and engage in more independent interaction with the natural world (Raising Children Network). Observations indicated high levels of environmental immersion through play with the toys. The young respondents used the toys to explore the natural environment and interact with other species and plants, and to engage in nature and form connections



Figure 1: Diagram of the challenges precluding nature play, representing the culmination of several research projects conducted by the Disney Foundation, Child and Nature Network and the Association of Zoos and Aquariums. Diagram by Children & Nature Network, from https://www.childrenandnature.org/wp-content/uploads/Pathways-to-Play-AZA_23-2-20.pdf.

within the natural world. Following play testing, the Underfoot toys were exhibited at Spielwarenmesse 2023 (the Nuremberg Toy Fair) and reviewed by toy industry experts.

1.1 Research Context

The research context will be outlined in detail in the literature review offered in chapter 2, which sets out the meaning and state of research on the concepts of imaginative play with character toys (2.1), eco-play (2.2), eco-fiction (2.3), character toy design (2.4) and small world play (2.5). First, however, it is useful to outline three key areas that provide wider motivating

factors and frame the research contexts. This includes a general decline in childhood outdoor play, changing trends in media licensing and character toy design and a shift to sustainability in toys.

First, much of my initial research indicated a decline in childhood outdoor play. This will be addressed in more detail in 2.2, but the literature review highlighted a steady decline in time engaged in outdoor play for children, both in Aotearoa New Zealand (Witten et al. 215; Walters et al.) and as a global trend (Cleland et al. 400; Gray 443). For instance, a 2016 study revealed that children in the United Kingdom were better able to identify Pokémon characters¹ than local flora and fauna (Robinson et al.). In the United States, the Child and Nature Network, an organisation undertaking research into the effects of alienation from nature, proposed an umbrella term for these negative impacts, “nature deficit disorder” (Louv *Last Child*), which is caused by a lack of outdoor play and, in turn, impacts broader emotional well-being. Key areas relevant to this research include the impact on a child’s ability to imaginatively and creatively play and the relationship children form with the natural world through these modes of play. Richard Louv’s critical text from 2008, *Last Child in the Woods: Nature Deficit Disorder*, documents various reasons for the decline in nature play. Similarly, the Child and Nature Network international research body, founded on Louv’s work, indicates some key reasons for the decline in nature play, including busy lifestyles, lack of time, aversion to dirt, challenges with weather and a fear of strangers encountering unsupervised children. Figure 1 synthesises findings in this area to overcome barriers to nature play.

There has also been a specific decline in unstructured free play (Fisher et al. 306), which is where children

¹ Pokémon is a Japanese media franchise across playing cards, digital games and the popular Pokémon Go AR game. The focus is on collecting, training and battling species of creatures with magical powers called Pokémon.

engage in self-actualised play separate from parental supervision, and small world play (Sobel 45), where children are based in one (often seated) location, making unstructured and unsupervised play more likely to occur and where children can engage more imaginatively at their own pace. Character toy play is an invaluable way for children to engage in imaginative play. As this play mode is often unstructured and un-monitored, children have creative opportunities to develop their own play worlds and narratives with their toys.

Several studies in Aotearoa New Zealand indicate a decline in outdoor play. For instance, an Auckland University study (Witten et al.) looking at outdoor risky play in slightly older children identified a lack of knowledge of neighbourhood safety and connection with the community, time scarcity and busy parents as key reasons they did not encourage children to play outside. A majority of participants in a 2014 Victoria University Wellington study, *Perceptions of Child-Nature Relationships in Wellington City*, agreed that “children today are becoming alienated from nature and that this is impacting negatively on their health and well-being” (Rolfe et al. 8). Sport Nxsew Zealand Ihi Aotearoa conducted a 2022 study into the perceptions and impact of play in the greater Wellington region (Brocklesby et al.), whose authors observed that it “can be hard to communicate to many parents and teachers why play is important, especially where there is no clear link to productivity” (20).²

Children are spending much of their time invested in digital media: games, TV, animation and online content (Brocklesby et al. 21; Larson et al. 968). However, children can use digital media to engage environmental narratives when eco-fiction animation

or games are linked to character toys and play objects. Animation and games can be valuable tools to inspire children about animal narratives and ecology. Alenda Chang’s 2019 book *Playing Nature: Ecology in Video Games* describes the permeability between game environments and real environments, indicating a level of transference between the real and digital worlds. In Aotearoa New Zealand, the game company Runaway Play focuses on game design that realises real-world ecological spaces within a game environment. Their game Flutter Away takes players on a “five-day trip to the Amazon rainforest as a butterfly researcher” (Runaway Play).

The early education provider Little Kiwis Nature Play suggests these early meanderings in nature with toys as agents of play enable children to build personal resilience, a connection to place and a stronger sense of identity and belonging (Little Kiwis Nature Play). If children are not engaging in imaginative and small world play with their toys outdoors, then the relationship between the child and the natural world is in jeopardy of not being formed. However, this research has observed through interaction with nature advocates and parents that character toys are low on the list for nature advocacy; being defined by a media licence, bright colours and materiality, they are, by their very nature, framed as the antithesis of the natural world. Conversely, if parents let their children play with their toys outside, there is concern about damage and loss.

Children who play outdoors with their toys learn how to respond, feel confident in those spaces and find familiarity within the environment. Localised toy play enables children to experience living creatures, like insects, fungi or velvet worms, and elements of

² I remember that as a young child, my brother and I were sent outside to play whenever we claimed boredom. We used our toys as agents of play in imaginative and small world play by taking them on adventures in the overgrown pumpkin vine. Action figure Big Jim lost his arm to Dad’s lawnmower and wore it as a badge of honour during our imaginative play. Children like me used this as an opportunity to learn about the surrounding environment, including the many other creatures and species that inhabit these spaces. Such activity promotes how we are all interconnected in a rich natural ecosystem.

the natural world that do not exist in a sanitised, house-bound domestic interior world. Through interactions outdoors, children are unmediated and learn to love/appreciate dirt and mud, wind and dampness, and how these environmental factors affect the living creatures within the space.

A second wider context for this research involves changing trends in media licensing. Today, most character toys are linked to a media licence in the form of an animation or game that provides the toy with narrative context, with character licensed toys comprising 31% of all toy sales in 2023 (Lynch). This media link also drives product sales and therefore toy design companies seek new methods to acquire potential character properties from online media, popular digital games, comic books and children's literature. Global toy expert Richard Gottlieb states, "You can't just make media content and put it up online and assume people will see it, the same as you can't just make a toy – put it on the shelf and expect people to see it" ("Changing Entertainment"). With the proliferation of online streamers, there has been a power shift for accessing media intellectual property. Animation companies and toy designers can now work directly with digital platforms to produce content with international reach.

A third contextual frame involves post-pandemic toy industry trends, which have moved towards a desire for nature-connected and sustainable toys. As of 2020, Lego, Mattel and Hasbro are phasing out plastic in their packaging (Katanich), and LEGO plans to make all of its products from sustainable materials by 2030. Spielwarenmesse 2022 (the Nuremberg Toy Fair) announced a mega trend, Toys Go Green, with four specific design categories: Made by Nature, Inspired by Nature, Recycle & Create, and Discover Sustainability

(Michalik). Sustainable and nature-based toy design was still considered a Mega trend at Spielwarenmesse 2023. However, none of the showcased designs looked at taking the toys outside, to be played with in the natural world; instead they mimicked a version of the natural world for inside play.

Bringing these three contexts together, this research argues that character licensed toys designed specifically with nature engagement and integrating natural materials are core to innovative designs and that children's play patterns must shift to accommodate outdoor play better. The Underfoot toys embrace the "licence" aspect of the toy design process and the design of an eco-fiction toy from the conception of the ecologically focused animated story world to character toy design. This research encouraged children to take toys outside and play with them in a natural environment such as a garden, park or forest, and in turn, suggested that they bring aspects of the natural ecosystem back into the home.

Finally, it is worth noting that some contextual aspects are outside the scope of this investigation. First, the materials selection and manufacturing processes required in production to provide an authentic engagement with the moral and ethical issues of an eco-fiction toy range presents significant product development challenges and are thus outside this investigation's scope. Second, although there are various implications and intersections with gendered play, and LEGO, for instance, is moving towards removing gender bias from their toys (Russell), this aspect was outside this study's scope. The toy product design process was constructed from a non-binary position. Socioeconomic access to outdoor play is also out of scope, as this is an area researched extensively by the Child in Nature network.

1.2 Situating the Research

Drawing on the triangulated methods of storytelling, worldbuilding and product design, the resulting toy designs define a new genre of character licensed toys for outdoor play. The research is situated primarily in the field of commercial toy design through the creative practice of the toy designer on character licensed toy design, more specifically, and the toy design process, more generally. Secondary research that influences the creative practice includes exploring how children play with character toys in nature outdoors, their understanding and incorporation of nature systems and ecosystems through this play and how they respond to the mode of character toy play.

This research asked the following questions.

1. How can character toys such as dolls and action figures be designed to embody an ecosystem narrative (“eco-fiction”) and, as inanimate objects, become reflexive of ecology?
2. What observations can be made and learning concluded from observing eco-fiction character toy play in natural environments for Aotearoa New Zealand children aged five to seven?
3. How can creative research explore a cyclic design process between toys, media and the toy designer’s role as a world-builder, storyteller and play object creator?

This research is pivotal in the resurgence of nature play and the desire for outdoor toy design, and as such, hypothesises that well-designed character toys

embodied with eco-fiction narratives and explicitly designed for outdoor play should offer children a better opportunity to immerse themselves in nature play and all its benefits. For more immersive nature play, character toys must be designed with the natural world as an extended playset core to the design criteria, so children will want to play with the toys outside. Using well-defined and believable character narratives, this form of imaginative outdoor play might help children process climate anxiety and enable them to form a relationship with natural spaces.

Furthermore, the research also hypothesises that designing character toys with a consistent vision from licence to play can help reinforce environmental narratives. Character toys with ecological systems embodied within the design can help children see nature as a system of interactions and cause and effect.

This study sits between the conception of a character licence (which informs the environmental narrative for the toys) and the toy itself and its packaging. The research examines the definition of an eco-fiction toy design framework and integrates knowledge applied to a character-based toy range. The eco-fiction narrative explored ecology, the environment and how to embody environmental narratives within character toys. The Underfoot design methodology established a design framework for a new toy genre, a hybrid of action figure doll licence-based toys specifically designed, enhanced and activated in and through outdoor play.

The Underfoot toys are the conduit between these two spaces, with both aspects of the design seeking to move the play forward and enhance an understanding

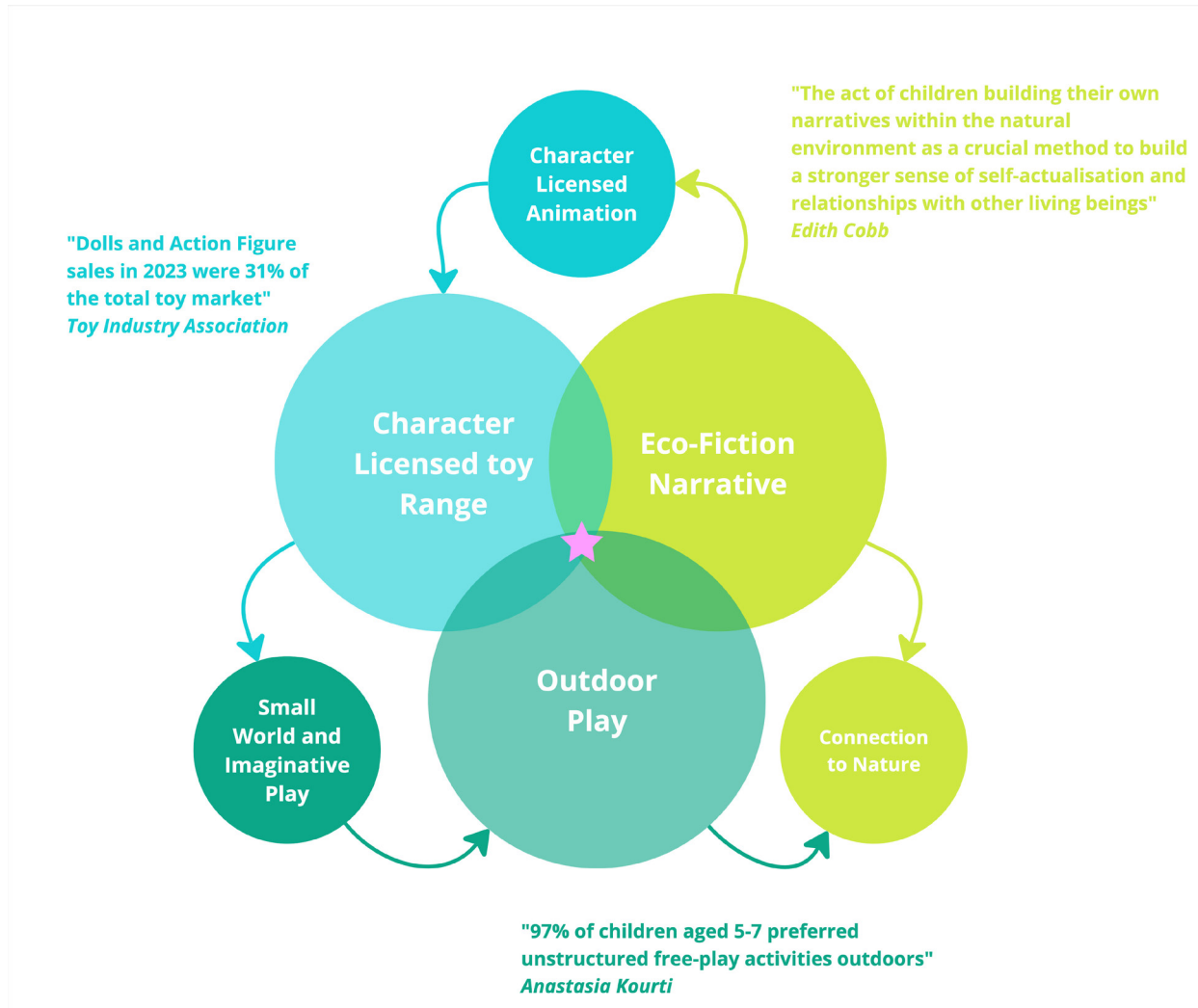


Figure 2: The Underfoot eco-fiction toy design framework, showing the key areas of research influence and the design lens. The star in the centre is where the final design is defined. Diagram by Tanya Marriott.

of natural ecology. The aim was to re-engage children with the outdoor environment around them and, through their toy play, form an understanding of their world's ecosystems. Figure 2 visualises the intersecting areas of influence.

The research used Christopher Frayling's "into, through and for" design methodology as a framing device for the entire research project and the framework developed by Nigel Cross in his text *Designing Ways of Knowing* for the specific cyclic design process for the development of each of The Underfoot toys. The methodology defined by Cross explores the tacit knowledge of first principles within the design process, which is a methodology aligned to unpacking the design process of established designers.

The research findings are based on various appraisal methods, including playtesting and industry expert feedback. The eco-fiction framework enabled an ecological message to be integrated cohesively into the design. Integrating an ecological system within the toy range design enabled each toy to become part of this system and tangentially enabled the children to learn about decomposition cycles. The cohesive integration of the story world narrative from pitch bible to toy design enables the character's purposes to have real-world consequences. It brings real-world ecology to the toy world.

The toy playtesting sessions demonstrated that children actively engaged in play with the toys and integrated natural materials with the toys during play. The toy industry (Spielwarenmesse attendees, LEGO, toy industry expert review) found the designs unique and fresh and appreciated the integration of natural cycles within the product. The findings suggest a gap in the

market for a product such as this.

The written exegesis is structured as follows. Chapter 2, the literature review, is focused on Frayling's research "into design". Specifically, it examines current research into the decline of imaginative outdoor play, eco-fiction narratives and character toy design, framing the issue of a decline in nature play. Chapter 3, on design process and experimentation, uses Frayling's research "through design". It explores the design methods used to develop the eco-fiction framework for designing the eco-fiction character toy range The Underfoot. Chapter 4 covers the design development process; that is, Frayling's research "as design". Chapter 5 covers the final design package. Chapter 6 evaluates the final character toy designs, with conclusions offered in Chapter 7.

2. Literature Review: Research into Design

This chapter explores the design challenges for creating an eco-fiction character toy by surveying the relevant literature. This survey first focuses on imaginative play, one of the fundamental play constructs that children engage in when playing with character toys, before looking at character toy play and the ways children engage with character toys, as well as how this mode of toy play provides a tangential development tool during a child's formative years. Section 2.2 surveys the literature to examine the modes of eco-play that children engage in with their toys and children's awareness of the environment during play, while section 2.3 considers aspects of eco-fiction. Section 2.4 addresses the character toy design process itself, before section 2.5 considers small world play

2.1 Imaginative Play and the Dual Role of Toys

Children use toy play as a way to build an understanding of their surrounding world. Play theorist Brian Sutton-Smith describes toys as “exemplars of imaginative activity” (*Toys as Culture* 239). Well-designed toys used within play are thus the agents for whatever the child wishes to explore, enabling them to form an understanding of the world around them through active exploration, mimicry and imagination.

What this brief account highlights is the power of imaginative play, fantasy play or “pretend” play as a mode of recreation that involves the child acting out scenarios and themes that they have either seen or wish to explore. This form of play can take on aspects of real-world roleplay, or the creation of original narratives and worlds for play experience to be enacted. Imaginative play is the overarching term for both fantasy and “pretend” play and is the primary mode of play forming the focus of this research.

Lev Vygotsky was one of the earliest theorists to explain the importance of pretend or imaginative play (*Bodrova* 371). Daniel Elkonin and Alexi Leontiev expanded on Vygotsky's research to define how imaginative play generates a “model of reality” (*qtd. in Bodrova* 379) where children create imaginary and fantasy situations derived from real life and assign roles and meanings to objects and spaces to project an understanding of the real world. In other words, children use pretend play to project how they might engage with the object, even if they have never used the actual object in real life. Children associate a symbolic function with a play object or space, but this function needs to be linked to the modality of the object. For example, children will use a hoop as a stand-in for a car steering wheel, or a cotton reel as a miniature car.

Researchers in child psychology and development, including Vygotsky, Vivian Paley, Jean Piaget, Dorothy and Jerome Singer, Friedrich Froebel and Sutton-Smith, agree that imaginative play is crucial to a child's development. These researchers recognise that it offers an opportunity for children to creatively "play out" scenarios of interest that produce "a feeling that they can contribute to their surroundings and give them a sense of control by being the co-creators of their world" (Moller 322). Imaginative play is at its height for children aged five to seven (*Genius of Play*), where they develop their imaginative and communication skills.

Sandra Russ and Claire Wallace describe imaginative play as a way for children to gain "practice with problem solving and practice with processing emotions" (139). When a child engages in imaginative play, they enact a form of creative problem-solving and environmental response to their current situation. Russ and Wallace define a key part of this as symbolic play, where children use play to synthesise the world around them, which they describe as "cognitive, affective and interpersonal processes" (136). Through these activities, children build a cognitive understanding of how to derive meaning in their world, and how to continue defining meaning as they grow and develop. Imaginative play can begin within any physical context; however, it is the way the child establishes intentional rules and behaviours (Bodrova 380) that define the play.

2.1.1 Imaginative narrative play

In her book *A Child's Work: The Importance of Fantasy Play* (2009), Paley documents her decades-long work with imaginative play in the preschool classroom. In an interview for the *American Journal of Play*, Paley

states that "fantasy play is a curriculum filled with the potential for rich language and social experiences bound together by the structure of story" (128). She indicates that it is through imaginary play that children develop their own logic and system for how they perceive their world to function. This cognitive processing that adults use to apply reason and perception is first developed through play.

In an article for the BBC entitled "Playtime: Is It Time We Took 'Play' More Seriously?", Stefan Powell quotes Sam Wass, a child psychologist and neuroscientist, who describes the repeat patterns children engage in through play as a way to make "connections between different parts of the brain which haven't necessarily been connected before". This enables children to learn and retain knowledge regarding what they are doing and experiencing. Paley explains that through imaginative or fantasy play "children begin with their own set of premises and learn to follow through, step-by-step, scene by scene in the complex process of creating a logical and literary dramatic project of their own" (123). These narrative framings can come from their personal experiences, peer influences, known social roles and constructs, such as playing the role of a parent, or the difference between a doctor and a princess. Piaget and Vygotsky see imaginative play as a developmental phase, whereas Singer and Singer propose imaginative play as a method of "cognitive mastery of [children's] perceptual world" (*Preschoolers' Imaginative Play* 98). Imaginative play is enhanced by what children absorb: the more stimulated they are by stories and the world around them, the more developed their imaginative play becomes.

The play narratives used within imaginative play can also be influenced by the animation and game

worlds that frame the story-world for the toys, but these narratives serve to enhance imaginative play as a “jumping off” point, rather than to dictate the narrative. Gilles Brougère suggests television (animation and game content) is not a stand-in for play, “instead it fosters it, influences it, structures it, in so far as play must have a source” (5). This would mean, for instance, that a child playing with a toy linked to Disney Junior’s *Doc McStuffins* television

activity into an extremely elaborate world of their own design” (4), and that the development of imaginative worlds in childhood has been linked to creativity in adults by providing “an early apprenticeship in absorption and persistence, discovery, synthesis, and modelling” (1). Once an imaginary world has been created, children will often return to this narrative to continue to develop further stories and play opportunities. Nevertheless, imaginative play has become devalued (Singer and Singer “Preschoolers’ Imaginative Play”) and, as Sutton-Smith asserts, has become one of the most “neglected ...and most exploited areas of child life” (*Toys as Culture* 9).

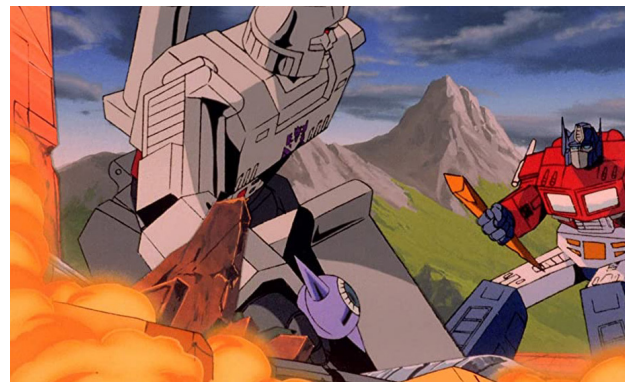


Figure 3: Examples of character toys: left, promotional photo of Disney’s *Doc McStuffins* (c. 2020), and right, still from Marvel’s 1986 animated film linked with Hasbro’s *Transformers* toys. Photograph from <https://justplayproducts.com/brands/doc-mcstuffins/>, accessed 2 May 2024; still from *The Transformers: The Movie* (at 20:57).

2.1.2 Character toy play

The story worlds children create for their imaginative toy play can be based on aspects of reality or the toy stories within games or animated series (Brougère), but are extended by the child and their playmates. Sutton-Smith was one of the earliest play researchers to also include the design of toys in his research in the 1970s. His work is still pivotal today.

series takes on the role of animal rescuer and nurturer,³ whereas playing with Hasbro’s *Transformers* toys might initiate a narrative around saving the world linked to the animated movie *The Transformers: The Movie*⁴ (see Fig. 4).

Sutton-Smith explains that “as children grow beyond the ages of 2–3 years, they increasingly use objects to supplement their imaginative programs” (“Ambiguity”). In Sutton-Smith’s “seven rhetorics of play”, he considers transformation as core to children’s imaginative toy play, as this mode of play “is the act of making what is present absent or what is absent present” as a form of “creative romanticism” (“Ambiguity” 127). In the 1986 text *Toys as Culture*, he asserts that when children describe their toys, “it is usually a part of some invented or imaginative domain” (92).

In her blog on creating fantasy worlds, Lisa Natcharian references creativity scholar Root-Bernstein, who notes that “pretend play begins around age two, typically with dolls and figures at its core” (4), with children using their toys as starting points for the creation of new worlds and narratives. The same source notes that “about 1 in 30 children will continue to develop this

However, despite today’s toy shelves bursting with enticing products, play is in decline. Children are

³ See Jim McQuarrie’s interview with the series’ creator Chris Nee on the personal medical history behind the series.

⁴ As Mercedes Milligan explains, *The Transformers: The Movie* was released in 1986, but it was re-released by Fathom Events and Hasbro in 2021 in a 35th Anniversary edition.

otherwise occupied in more structured Froebelian play (Froebel), where all engagement is geared towards objective learning through “freedom with guidance”. This is coupled with after-school classes, homework and sports activities, which have merit in terms of the overall cognitive development of the child, but also need to be balanced with opportunities to play more independently. Luisa Magalhães and Jeffrey Goldstein, in their book *Toys and Communication* (2017), describe character toys as “interfaces to a world of motivations [where] the character toys need to be staged in a specific story, purposely written for the toy” (291). Amanda Gummer, founder of The Good Toy Guide, describes children’s play with character toys, noting that as “children will usually begin by imitating the character, scripted play soon turns into imaginative play as their story develops” (Mauthoor 2). Elena Smirnova defines character toys as psychological tools, further observing that the “play activity of children has a twofold result: by transforming toys, children transform their own feelings, consciousness and self-consciousness” (38).

In previous generations, children also took their character toys outside to play. Through their activities they discovered and built hybrid imaginative play worlds that were inhabited by both commercial toys and natural objects. Even though, as Andrew McClary writes, historically children took their dolls everywhere (128), outdoor doll play is not a specific category for design within the toy industry. Imaginative play with outdoor toys has generationally been a natural and free-form way for children to play in natural spaces, and usually goes unsupervised by parents over long periods of time.⁵ Even children in built-up environments and cities find versions of natural spaces on the streets or communal parks to play with

their toys (Louv “Last Child”). Children taking their character toys outside to play is distinct from the toy industry category for outdoor toy play, where ride ons, water guns and seasonal toys reign supreme. At the other end of the outdoor play spectrum are components used in Loose Part Play (LPP), collections of found objects for imaginative and creative play. Both types of toys are devoid of character; if a ride-on toy has a character, it is usually just a sticker on the plastic product. LPP objects generally avoid characterisation, requiring universal material affordance within this play mode (Cankaya et al. 151). Character toys (dolls and action figures) are almost universally absent from the outdoor toy market, and the use of environmental or eco-fiction narratives to advocate for outdoor toy play is also absent within a commercial character toy design framework. Very minimal literature can be found on this subject, which supports my hypothesis that this is a gap in literary discussion.

There needs to be more connection between character toys and nature play. The only tenuous link is within educational toys, where a character can guide a measurable learning experience using a toy and play-based learning framework. Within this research, character toys and their play outside focus on the “child-led free play with voluntary participation, no predetermined instructional aim and no adult intrusion” (Bubikova-Moan et al. 778) end of the play-based learning spectrum and are defined as character toys by the commercial toy industry, and not educational toys. This perspective deepens the outdoor play potential for character toys and demonstrates them as worthy nature play companions.

⁵ As a latch-key child of the 1980s, this was my childhood. Similar to the childhood that my parents and grandparents had, I played in the garden, flower pots and the wider bush beyond my childhood house.

2.2 Eco-Play

Eco-play is a term used to define a mode of outdoor play that is the focus of this research. It combines the terms eco, meaning ecology or ecosystem, and imaginative play, which is the fantasy play that takes place when children engage in play with other living organisms, be they animals, plants, soil, insects or microorganisms, as well as the more invisible natural phenomena such as wind, sun, rain and moisture. Eco-play is a form of imaginative location-based play where children can play freely in natural spaces. Many organisations have developed resources to encourage nature play, both internationally (e.g., [Children & Nature Network](#), [North American Association for Environmental Education](#)) and in Aotearoa New Zealand (e.g., [Little Kiwis Nature Play](#)); this section surveys key literature in the eco-play field with a focus on playing outdoors (2.2.1) and the decline of outdoor play (2.2.2).

For younger children, eco-play often takes the form of small world play ([Sobel](#)), where children settle in localised outdoor spaces and play with the natural elements that are immediately close to hand. These elements and objects are defined as “loose-part” toys ([Daly and Beloglovsky](#)) and comprise or are derived from natural elements themselves, such as sticks and rocks. Simon Nicholson describes these factors as a “playspace” (qtd. in [Louv Last Child 87](#)). Here, play is made and becomes more versatile by the diversity of components available and, crucially, the ambiguity of their use as toys. This resonates with my own childhood play, where I used the ivy hedge to create nests for my ponies to inhabit, and I balanced them in trees and fixed them into branches. This is not to say that it was a conscious decision by a toy designer to make the ponies’ leg gap the perfect size for a tree

branch; rather, this kind of serendipitous design feature can open up a myriad of options for eco-play by making any natural element a playset for the character toy.

2.2.1 Playing outdoors

Outdoor toy play falls into two general categories: that with seasonal toys, which encourages physical activity, and that with loose part toys, which encourages creative play ([Toy Association](#)). Even though children do take their character toys outside, they need to be more fit for purpose. As dolls and action figures are not categorised as outdoor toys, there is limited research on playing with dolls and action figure toys outside in natural spaces, nor is there research on how this could encourage ecological awareness and environmental engagement. No literature explored character toy play outdoors or speculated on its benefits; the closest relational literature was loose-part toys, an emerging and understudied area.

However, when it comes to playing outdoors in general, seminal research has been conducted by clinical researcher Edith Cobb in the late 1970s. Cobb outlined the many benefits of playing outdoors for the imaginative experiences of childhood and realised how the act of children building their own narratives within the natural environment was crucial to a stronger sense of self-actualisation in their relationships with other living beings. Cobb argued that “nature for the child is a sheer sensory experience” (29).

Cobb’s ideas are still fundamental to my motivation as a toy designer in an era of “last generation” free environmental play. As we consider how to educate children about environmental responsibility with the challenges of climate change, building an understanding of the functions of ecosystems is crucial

to forming a concise worldview of how to respect and better nurture the earth. We inhabit different ecosystems. Living in cities and practising widespread consumerism means humans see themselves apart from nature; on the other hand, we also have relationships with all living things and can look to better enhance these. What is impactful about Cobb's findings is her extensive autobiographical research into the stories children enact during nature play. She has also shown that digging in dirt enables a child to not only connect to the land physically but also to discover a microcosm of other beings living in the landscape beneath their feet. Each plays a crucial role in the interconnected life cycle around us and of which we are a part. Cobb's ideas have been critical for this research project when developing characters and world building.

Further literature also addresses the role of understanding ecological interconnectedness. For instance, a 2020 study in Japan (Inoue) indicated a critical deficit in ecological learning within early childcare education, also stating that “university students often report that they have never thought of human beings as part of an ecosystem or as one of the consumers whose lives interconnect with those of the producers and decomposers” (998). In Aotearoa New Zealand, understanding environmental factors from an ecosystem perspective mirrors efforts by the New Zealand Department of Conservation (DoC) as they embolden moves to protect biodiversity rather than preserve a single species: “As a nation, we have tended to focus ‘conservation’ on the pieces—the preferred places and indigenous species that [we] protect” (Park 14). However, an ecosystem is the sum of all elements and species working together in a system rather than a single entity.

Sandra Waxman et al., building on research by Susan Carey, explain that an anthropocentric perspective develops in children between the ages of three and five years old. Waxman et al. caution that the human-centric narratives within children's media can further bias them away from biological reasoning (7). This research supports the age range of choice for the toy designs as being a pivotal time when children can form an understanding of their humanness in an eco-fiction world.

It is also worth noting here that this human-centric narrative applies to most outdoor toys. This includes ride-on vehicles, playground equipment and plastic wendy-house-type toys, all of which reaffirm a human mode of play. Other than having space for a child to move around in the sunshine, many of these toys don't have any direct need to be outside. Seasonal toys such as water play, pools and sand pit play use toys as tools and utensils to manipulate and shape outdoor spaces but do not invoke character or narrative modes of play. Exploration toys that cross over with educational toys, such as insect collection kits, encourage children to collect and study nature by containing it within a terrarium. Loose Parts Play (LPP) is the closest mode of play to eco-fiction toy play, but LPP objects are not regarded as toys, as a core part of the play is the ability to transform the object into anything. Using commercial character toys within LPP is not common, as the more defined the character, the less likely it is to align with affordance theory, which is core to LPP objects (Cankaya et al. 151).

Returning to concepts of interconnectedness, biophilia is the innate desire to connect with other living beings so that we feel a part of the world we live in. Posthumanism proposes a framework that negates hierarchical relationships in the world, whereby

humans are not the dominant species but rather are part of the wider ecosystem, which is subject to change, cause and effect. This embodiment of the environment enables children to see and imagine new realities and subsequently create mutual relations with the total environment. In their book *The Geography of Childhood: Why Children Need Wild Spaces*, Gary Nabhan and Stephen Trimble voice concern that children are growing up in habitats

that are only shaped for and by humans (11) and that play in natural spaces has been replaced with play in playgrounds “dominated by machine-like recreational equipment, structured games and paved-over areas” (8). Nabhan and Trimble’s argument is that stripped bare, structured concrete landscapes provide no opportunity or insight for play into other lives, where “small creatures which stay within reach can capture their attention for hours” (99). This absence of interaction between a child and other aspects of the natural world does little to enhance the individual’s empathy and prevents an ability to achieve a sense of “oneness” with the environment.

The benefits gained from children playing in nature can also be usefully examined in terms of wellbeing. Louise Chawla’s extensive 2020 study (“*Childhood Nature Connection*”) into forming nature connections clearly indicates a child’s physical and mental well-being benefits from engagement within natural spaces (Fig. 4). Children become better socialised, empathetic to other beings and more likely to think of and maintain responsibility for the natural well-being of these spaces. She also indicates that families, caregivers and parents can influence whether a child feels encouraged to engage with nature. Chawla, however, cautions that nature connection may produce anxiety, even in young children, concerning climate effects and the degradation of natural spaces.

Similarly, Glenn Albrecht et al. write of solastalgia, which they define as a fear of mental distress caused by environmental change, and the overwhelming concerns of global warming. Such issues are of ever-increasing concern, with children as young as four and five beginning to demonstrate anxiety induced by a fear that they are unable to control or affect what they perceive will happen. Silvia Collado and Miguel Sorrel

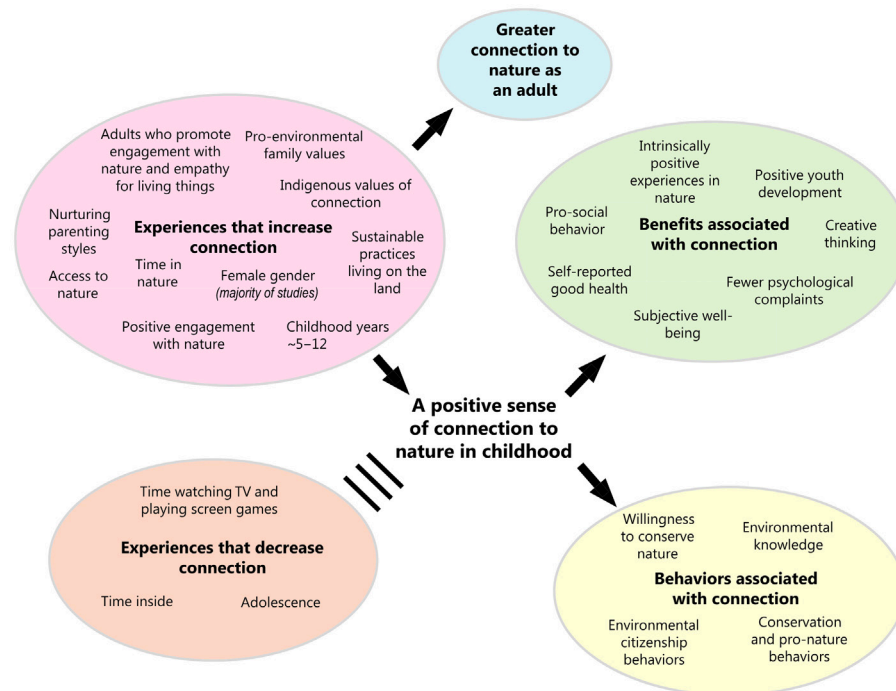


Figure 4: Contributions to nature connection in childhood and associated benefits and behaviours. Diagram by Chawla (“Contributions”).

argue that “human actions are largely responsible for environmental problems such as global warming” and caution that “children will be the ones to grapple with environmental issues in the future” (43). Harriet Shugarman, in her book *How to Talk to Your Kids about Climate Change: Turning Angst into Action* (2020), recommends fostering a “a sense of wonder in nature” (94–96), while Ben Hoare suggests “fiction is a more powerful vehicle for raising environmental awareness” (qtd. in Barkham). Cobb describes the importance of play within natural spaces as a way for children to form an “ability to learn, think and create meaning of their perceived world” (18). Louv also supports this argument: “Natural spaces and materials stimulate children’s limitless imagination and serve as the medium of inventiveness and creativity observable in almost any group of children playing in a natural setting” (*Last Child* 87).

Interestingly, a 2021 study by Samantha Friedman et al. into the effects of the pandemic on children’s play, indicated 54.8% of children had an increased connection to nature. Friedman stated this “included having more time, increased enjoyment of nature and increased awareness or interest in nature” (155). Subsequently, there has been a renewal in the desire for children to engage in unstructured outdoor play, with one study indicating 97% of children aged five to seven preferred unstructured free-play activities (Kourti et al.). The sensory nature of The Underfoot range of toys, which activate when played with outdoors, enables children to engage directly in the natural environment and helps them to form the sense of wonder they need to be best equipped to tackle climate change as they get older.

⁶ *In reference to my own experience, when I was a child, alone time in the outdoors was my favoured and most memorable form of play. The declining trend in outdoor unsupervised play is also prevalent in New Zealand, a country generally thought of as recreationally focused with large outdoor spaces and where the dream of a house and ¼ acre section was, up until the 2000s, still a reasonably achievable aspiration.*

2.2.2 The decline of outdoor play

A key context for this research is the decline in outdoor play. Many of the reviewed sources were discussed in the introduction; however, its importance requires further consideration. This is not least for the rapidity of the decline: within only a generation, the digital age has had an enormous impact on the shift away from imaginative nature play outdoors to predominantly indoor play (*Childhood Nature Connection* 619), with a steady decline in all forms of unstructured play. Louv has observed that “children today play outside less often, and for briefer periods, they have a more restricted home range and have fewer, less diverse playmates” (*Last Child* 34). In a 2022 National Play Day poll carried out in the United Kingdom, “just 27% of children said they regularly play outside their homes, compared to 71% of the baby boomer generation” (*Save the Children UK*).

The Active Kids Global Alliance reports similar findings in the Global Matrix 4.0, a comprehensive global study of children’s mobility and play, which concluded that “physical activity levels are clearly insufficient around the world”. Results from the 2020 British Children’s Play Survey show that on average children living in Britain “play for just over 3 h per day” and that “around half of children’s play happens outdoors” (Dodd et al. 9). However, in her think piece “Time to Go Out and Play”, Hayley Christian indicated a silver lining: “Children will play outdoors more if their parents and carers are positive about physical activity and about being outdoors in nature” (4). Dodd et al. indicates 10 years old is the average age UK children were allowed out alone.⁶

Today, any free playtime children have is carefully bookended by most structured activities and a “scholarisation of childhood” as free play has been

“eroded in favour of academic, sporting and cultural activities” (Weale 1). Moreover, the 2022 report investigating the perceptions and impact of play in the greater Wellington region noted in the introduction, indicated socio-economic disparities, low levels of community connection, misconceptions about play and technology as a rival to play as key barriers to children engaging in outdoor nature play (Brocklesby et al. 20). In regard to the latter, a 2011 study (Takeuchi) into designing media for the digital age shows that parents are concerned about the “displacement effects” of media, where children play on devices rather than engage in other more free-play activities. A 2020 Pew Research Center survey into digital device engagement in young children indicated that 60% of children started engaging with a smartphone before they were five years old. The knock-on effect is the documented decline in the independent freedom to roam and play that children of previous generations experienced.

2.3 Eco-Fiction

Nature literature is a useful tool to frame methods of narrative construction for toy design. In *The Environmental Imagination*, Lawrence Buell has developed a set of narrative criteria, focusing on the literature related to Henry David Thoreau and the nature writing described by Jim Dwyer as “eco-fiction” (1). While based on North American historical models, it is nevertheless useful here. Environmentally significant texts from Thoreau’s *Walden (1854)* to Richard Adam’s *Watership Down (1972)* centralise animals as a defined character within the world they inhabit, exploring the world through their perspective. Of note, in the representation of these worlds, is that humans are part of the ecosystem but not a dominating force.

2.3.1 Eco-fiction narratives

Eco-fiction as a subject of study seeks to define a “new way of seeing and understanding the consequences of the destruction for the natural world, humanity’s impact on the environment, and the possible solutions to environmental degradation” (Baratta 3). Eco-fiction narratives are stories that centre on an environmental theme, where humans are not the central focus of the narrative, but rather play a background role within a wider ecosystem. It seems that such narratives are desirable, with a recent poll of children aged between six and nine run by the website Kids Know Best noting that “nearly a third of all respondents said that they wanted to see environmental themes in their media” (Bharanidharan).

Eco-fiction narratives were particularly prevalent within early licensed toys with a strong emphasis on human-creature hybrids and narratives which advanced an interconnected and magical relationship between

characters and the environment. This was especially evident in 1980s children's animation, although eco-fiction narratives are still in high demand today. Some specific examples drawn from the original 1980s television series *She-Ra*, *The Care Bears* and *My Little Pony 'n Friends* illustrate this point. These series bridge licensed toys with children's play and the environment. The character She-Ra has an ability to communicate and heal animals and the Care Bears' symbols are

and the events in the episode are arguably a metaphor for the effects of climate action against culpable corporations. The way non-human others represent or stand in as agents is not only important in the narrative but also confers social and political commentary. Ellen Seiter describes environmentalist narratives within these cartoons as "prosocial and generally non-violent" (159).



Figure 5: Still showing the Smooze, from Sunbow, Hasbro, and Marvel's 1986 animated movie *My Little Pony: The Movie* (at 1:26:57).

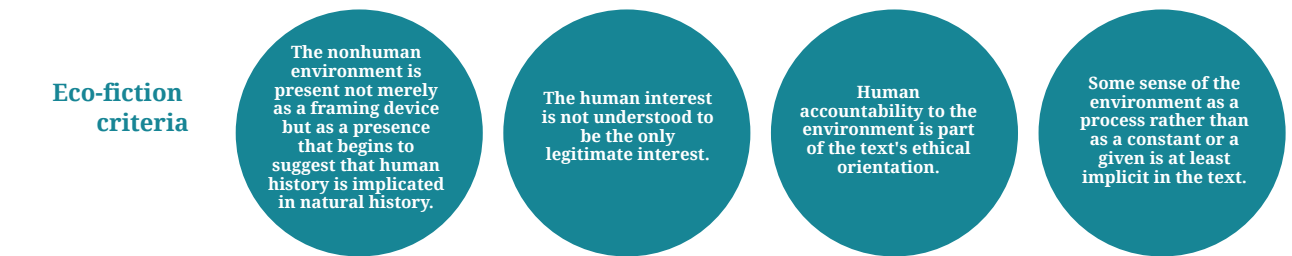


Figure 6: Eco-fiction toy criteria, informed by the media definition of eco-fiction (Dwyer). Diagram by Tanya Marriott.

used to radiate empathy and positive power. The *My Little Pony* (G1) toys included several feature films and an animated TV series where the ponies lived in a guardian relationship with their environment, which was regularly put to the test by other less likeable magical creatures.

In a more specific example, *My Little Pony: The Movie* (1986) sees the ponies mobilise and fight against a toxic waste, called the Smooze (Fig. 5), by encouraging the other creatures to restore balance within the landscape (also see Connelly). In girls' cartoons, the toxic wasteland narrative is a motivating factor for the characters to pull together to save the day (Seiter 159). The ecological balance in the community has tipped,

Environmental narratives within children's media continued through the 1990s (BFI) and with the current threat of the climate crisis, eco-fiction themes continue to be prevalent in children's media. For instance, Sky Kids launched three new climate-change-focused shows in 2021 (Whyte) after a survey they conducted revealed "81% of children wanted to be taught more on the topic" of climate change (Williams 1). Moreover, Disney and Studio Ghibli have long advocated for eco-fiction narratives. Disney films have a focus on the realistic portrayal of nature with films like *Finding Nemo* (2003) promoting specific knowledge of habitat and species (Willoquet-Maricondi 197). Hayao Miyazaki's themes demonstrate a duality with "narratives of adaptation

and accommodation that explore multiple perspectives and fail to finger an explicit villain” (Pike 149).

In his 2010 text *Where the Wild Books Are: A Field Guide to Ecofiction*, Jim Dwyer defines the eco-fiction criteria based on the framework developed by Lawrence Buell, and his own analysis of common themes among hundreds of texts. The four criteria privilege the narratives of the nonhuman “other” as legitimate histories and not just a framing device for human interests. In addition, the criteria emphasise the environment is an evolving process, not a static entity (Woodbury 1).

This research project has taken this framework and adapted it into a toy-centric criteria for an eco-fiction toy design schema (see Fig. 6). The four-part criteria demonstrate fundamental principles for eco-fiction media and are flexible enough to be applied to a variety of literary and media styles and genres. This criteria provides a reference point for measuring how successful The Underfoot design strategy and individual elements of the eco-fiction licence and toys are for engaging children in outdoor imaginative play.

Looking more specifically at the first eco-fiction criteria established by Buell and Dwyer, which states that “the nonhuman environment is present not merely as a framing device but as a presence that begins to suggest that human history is implicated in natural history” (Dwyer 1), it would imply that animal toys living in human worlds would not provide authentic narrative scope for the child to understand the non-human home. Within the design of toys, there is already a growing industry of ecologically focused toys, including building blocks, wooden animals and loose-parts toys. This research meets the challenge to define

eco-fiction toys within contemporary character licensed toys—toys that are overwhelmingly human-centric in their physicality, playset design and the worlds the characters inhabit.

2.3.2 Nature authenticity

Nature literature, while derived from North American historical models, is a useful tool to frame methods of narrative construction for toy design. In *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture*, Buell explores the prominence of colonist narratives within our world histories and the conquering of landscapes, as well as setting out the evolution of the contemporary view of “pastoral landscapes” (62). Any attempts to reconnect with natural spaces are at odds with resource-intense consumerist culture. However, storytelling and narrative creation can help one to better understand the “interconnections between all things, human and non-human, living and dead” (Pike 148).

For Aotearoa New Zealand Pākehā,⁷ the challenges of decolonisation are compounded by the need to relearn cultural connection to the land and to construct authentic relationships with the natural environment. It is important to note that the target audience for this project is children aged five to seven, who have grown up in Aotearoa New Zealand and will have already been introduced to Tikanga Māori,⁸ more specifically Kaitiakitanga,⁹ and a Māori worldview on ecology and guardianship with indigenous perspectives included in early childhood (Ministry of Education) and primary school education.

The Underfoot toys in this research project are based on real-world creatures and environments but employ modes of fantasy and science fiction storytelling to encourage imaginative play to occur. The Underfoot

⁷ Pākehā is a Māori language term for New Zealanders primarily of European descent.

⁸ Tikanga Māori is the overarching concept of Māori customs and practices and how to impart and practice Mātauranga Māori, which is Māori knowledge (Mead and Mead).

⁹ Kaitiakitanga is the Māori perspective of guardianship which holds that “it is our obligation to nurture and protect the physical and spiritual well-being of the natural systems that surround and support us” (Paul-Burke and Rameka). This extends to the protection and management of natural resources for future generations.

toys employ methods of magical realism by using character design to normalise the fantasy within a real ecological context. This enables the magical and romanticised aspects of the characters to aid in engaging the child's empathy and objectivity during play. Thoreau (qtd. in Buell) gives an example where Walden recollects the first instance of gazing at the pond. He doesn't just describe the pond as he sees it, but rather what it represents as part of a wider ecosystem. I would regard this as an emotional or sentimental representation of an environment to connect us sympathetically to the space. Burroughs (qtd. in Buell) however, sees nature differently, stating that he wants the audience to be fully aware that there is a difference between fact and fiction in sympathy to a more objective scientific approach. He believes that a writer needs to stay faithful to what they have witnessed.

¹⁰ *With the opening of Yellowstone National Park, the public were keen to visit and immerse themselves in the natural environment. This inspired a proliferation of nature-focused narratives that anthropomorphised the natural world and the scientific community expressed concern writers were taking liberties with the realistic portrayal of animals. John Burroughs was a staunch advocate for the accurate portrayal of the natural world, stating it was damaging to the general public's understanding of nature (Buell 89). Burrows began a decade-long campaign to silence and disprove authors taking fantasy licence with nature with what they both termed the "Nature Fakers" movement.*

¹¹ *A pivotal text and film from my childhood, Watership Down, an animated children's film about a group of anthropomorphised rabbits in search of a new home echoes Wright's sentiments. Watership Down instilled in me a deep sense of understanding of animal sentience, and the effect humans have on animal habitats. Parents found the "dark and violent sophistication" of Watership Down disturbing: in the USA, the film has a PG rating. Richard Adams wrote the book for his daughters as a raw account of the natural environment, with enough anthropomorphism in the characters to engage his young audience. Juliet Adams defends her father's honesty in his portrayal of the rabbit characters and their plight, writing that "we're destroying the environment and endangering all the animals – I think it would be strange to ignore that" (qtd. in Brown).*

Nature writer, children's author and conservationist Mabel Osgood Wright (qtd. in Perez) was drawn into the contentious Nature Fakers debate with Burroughs.¹⁰ She "believed that infusing nature stories with imagination was acceptable to induce the audience to sympathise with her subject material as long as the natural history element was also factual" (25). Wright felt that science failed to teach morality and ethics, and this was something she could explore through her imaginative treatment of the narratives.¹¹ Although "serious" narratives have consistently seen representation within children's animated media since the 1980s, and even date back to the 1942 film *Bambi*, the metaphors and allegories they employ do not translate through to toy designs. This research suggests that toys with ecological messaging embedded within their core design principles have the potential to be pervasive agents for environmental awareness and interconnectedness with the natural environment.

2.3.3 Anthropomorphism

Anthropomorphism is an epistemology that enables emotional relationships to be formed with objects to give them meaning (Clayton et al.). It is a common form of characterisation within toy design as it enables children to emotionally invest in the toy and within the toy's own world, rather than their own. This research looked at the design of dolls and action figures; more specifically, it looked at the subset within each group of anthropomorphic characters. Most doll and action figure toys are derived from a character property, which establishes a brand for the toy, frames the world the toy inhabits and sets the starting point for worldbuilding play.

Action figures and dolls have specifically unique design guidelines. Most action figures feature a mechanism for play, such as arms that move, weapons that fire and components that fly. Dolls, in comparison, are gendered to offer more passive, domestic play. Action figures go on adventures, and dolls (even animals) stay at home and nurture in domestic bliss.

Anthropomorphic dolls such as Littlest Pet Shop encourage children to "own" the animal and contain it within an elaborate cage, regardless of species, animal habitat and the ecological system that it belongs to. The toy shop provides an almost universal human-centric view of the world. The My Little Pony range, into its fourth iteration or generation (G4), lacks the diversity of pony taxonomy evidenced within the initial generation (G1), privileging playsets for ponies to dress up in runway shows rather than more canonical aspects of the media licence.

In both examples (see Fig. 7), animal dolls are displayed living in human worlds in a mode of anthropocentric bricolage, with human desires and needs, and wearing animal bodies. Character toys such as Sylvanian Families are termed “funny animals” (Williams and Lyons 231), which are anthropomorphic characters that live like humans. They are generally bipedal, wear clothes and live in houses. Another example, Pokémon, evolved from an interest in insect

In a 2019 study published in the *Journal of Environmental Psychology*, Collado and Sorrel state that children play with anthropomorphised animals and plants up until the age of twelve to form an empathetic bond and connection with the “other”. However, children in the study were less likely to anthropomorphise concepts such as ecosystem and environment. They surmise that this could be due to the way ecological systems are presented within



Figure 7: Left, promotional photo of Hasbro’s Littlest Pet Shop playsets (2012), and right, promotional photo of Hasbro’s My Little Pony (G4) Rarity fashion runway playset (2017). Photographs from <https://www.amazon.com/Littlest-Pet-Shop-Playset-Fan-Voted/dp/B07CPGMSW5>, accessed 2 May 2024, and <https://www.amazon.co.uk/My-Little-Pony-B8811-Playset/dp/B01JKAR4TA>, accessed 2 May 2024.

collecting, which executive director Satoshi Tajiri enjoyed as a child (Peckham). Pokémon characters offer diversity in species that “live” both virtually through Pokémon Go, and are implied within toys and card games in specific locations related to their species and the climate of each ecosystem. Although they evolve and adapt, the narratives they inhabit focus on collecting and containing them, only to train and fight them against each other.

children’s media. Human characteristics are given to “animals, plants and trees, but this is less likely to apply to ecosystems as a whole” (43). In a wider study on anthropomorphism and children’s relationships to nature, Ulrich Gebhard et al. surmise that children find it challenging to anthropomorphise entire ecosystems, preferring to focus on the plight of individual species in order to understand the whole (92).

2.4 Character Toy Design

This research project focused on the design of character licensed toys, or a character property. The design of this type of toy (see Fig. 8) is supported by a wider body of media content that provides both a cohesive aesthetic, and a world and context for the toys to be framed. Dolls and action figures are in themselves two separate sub-categories of product within the mainstream toy market, historically aligned by gender as girls' and boys' toys. These categories form the core



Figure 8: Examples of character toys. Image compiled by Tanya Marriott.

pool for character licensed toys and their key attributes are outlined in Figure 10.

Animal characters, such as Hasbro's Littlest Pet Shop and Pokémon (Fig. 9), are also counted as dolls, whereas Bakugan are counted as action figures. In 2022, licensed toys made up 28% of manufactured toys with "more than £1 in every £4 spent on licenced toys" (Symonds). The fastest-growing property in 2021 was Pokémon, with Lego, Barbie and Star Wars in the top ten. Barbie is 62 years old this year, and what

started as the world's first fashion doll for children has evolved into a transmedia empire of toys, films, games, books and more, which all speak to her carefully crafted image.

Character toys have been created from characters from films since the 1960s, with Mego Toys, for instance, creating licensed action figures since the early 1970s. As a result, the toy industry has become "increasingly dependent on cinema and television" (Fleming). Star Wars is generally regarded as where contemporary licensed toys first began, with *Star Wars: Episode IV – A New Hope* (1977) the first film to have an action figure toy line based on the movie (Clark). The action figures were smaller than previous film-based toys, at 10" high which enabled playsets and supporting narrative elements to be designed at a relevant scale. These playsets enabled children to play out scenes from the film and to extend their play because of the accuracy of the way the expansive Star Wars universe was portrayed in the toys and accessories.

In the 1980s, a framework for character licensed toy design was defined further. Both boys' and girls' toys, such as He-Man, She Ra, Transformers, Care Bears, My Little Pony and Strawberry Shortcake, started as "expandable toy lines" (Clark 2039) supported by an immersive backstory and imaginary world that is extendable to service more product development. As Eric Clark points out, it was at this point that the character toy industry shifted away from "standalone toys" (2032) to toy lines. Clark also observes that this has developed further, as contemporary toy companies have "repositioned themselves as entertainment companies" (2901) with key players Mattel and Hasbro solvent enough to purchase substantial rights to film and game franchises to develop characters into toys.

The key difference between the licensing model for Star Wars and My Little Pony is that with the latter, the toy came first with consideration of toy play and an extendable toy line, followed by the animated TV series commissioned to market the toys. This enabled the media content to extend the world of the toy, not define what the toy needed to be within an already defined narrative, as with Star Wars.



Figure 9: Examples of Pokémon toys and playsets on the official Pokémon Website in 2023. Image compiled by Tanya Marriott from <https://www.pokemon.com/us>, accessed 24 July 2023.

Many of the character toy lines developed in the 1980s are still successful today, having gone through numerous reboots, and they not restricted by the next blockbuster film as it is released to the public. This model of design—toy first with the media content used to narrativise and extend the play to retain a core influence within the design—enables toy designers to be more creative with how they extend the toy product line each year. Ellen Seiter describes the purpose of the pony design as “low-tech toys” and observes that “the principle for line extension is based almost entirely on cosmetic changes, on distinctions of appearance and name” (154). This makes them highly collectable, with seemingly infinite pony families to purchase with

Anatomy of a Doll vs Action Figure



Pinkie Pie My Little Pony	Bumble Bee Transformers
Doll Girls	Action Figure Boys
Play actions and values Passive play Reality-based domestic and family-oriented roles Focus on Nurture	Play actions and values Active Play Fantastic, action-oriented, and violent type roles Focus on Adventure
Social themes/ Friendship Low energy and movement	Conflict themes / Conquest High energy and movement.
Design Pink and Purple Simple shapes Patterns and textures Hair/Beauty/Identity play	Design Primary colours + Black Complex shapes Block colours Missions/Exploration/battle
Playsets are usually - house, room spaces.	Playsets are usually - Vehicles, weapons, tools.
Figures are static, and may have hair.	Figures are articulated, and have moulded hair.
Accessories are for adornment or social status.	Accessories are tools for action and strategy

Figure 10: Summary of differences between dolls and action figures. Diagram by Tanya Marriott.

consumerist zeal; however, the accompanying television animation created by Sunbow and Marvel (*My Little Pony 'n Friends*) gave the ponies a more meaningful purpose (Keller), attributing the pony families with ecological purposes as unique species within their pony home.

2.4.1 Character toy narratives

Dan Fleming describes the “narrativisation” of toys as a way of providing a “familiar set of story ideas and character relationships informed by playing with the toy” (102). In the United States of America, the Reagan administration lifted the ban on toy-based programming in 1983 and the time limitation of commercials allowed during children’s programming. In 1983, Mattel subsequently launched a 30-minute animated TV series (*He-Man and the Masters of the Universe*) of their Masters of the Universe product, which Sydney Stern and Ted Schoenhaus describe as an extended advertisement. By 1987, forty character-toy-based shows became on-air marketing licensing products.

The 1980s is regarded by many toy designers as the pinnacle of character toy creativity, with many toy licences still successful today. Character toys of this era—with the notable exception of the Star Wars toys, as explained in the previous section—were designed first as toy objects and then marketed through animated TV series, which expanded on the toy’s world to develop into media licences that placed the character anywhere from lunchboxes to apparel. This marked a transition in the way toy designers developed toy products for children. Character licensed toys are defined by their transmedia ability to provide “entire universes of various products – both utensils and non-utensils – around characters, or narratives, that were originally toys” (Heljakka 155). At their core,

however, character licensed toys are defined by story, which provides a contextual framing defined by the toy designer or producer for the toy backstory and the purpose. As film and network television consumption evolved, the “toy-first” design model shifted to “toys based on media licences” where the consideration of play value within the toy has become secondary to making toys that fit the existing universe of a blockbuster franchise.

Ann Kearns (qtd. in Clark) of Sesame Workshop views the relationship between the workshop and the toy design company as mutually beneficial: “When you have a company like Fisher-Price, which is the master toy licensee for Sesame Street preschool toys, you get the added value of what Sesame Street brings to the table and what Fisher-Price means as a brand to the consumer”. Fleming describes the narrative cohesiveness as a “total strategy”, suggesting that it doesn’t matter what the children encounter first (the toys, books, animation or other media content), with its “success triggering the others” or the “mutually reinforcing effect of simultaneous appearance in several or all of the forms” (103).

In 2019, when this research project began, successful toys were not linked to current high-sales films, but rather, the most successful toys, such as Hasbro’s Peppa Pig and Spinmaster’s Paw Patrol, were derived from smaller-scale TV animation (Gottlieb, “TV Tie-Ins”) or game worlds. Fast forward to 2022, and the post-pandemic environment saw toy design companies seeking new methods to acquire potential character properties from online media, popular digital games or comic books and children’s literature. There were also the issues of how to present a product in a climate absent of bricks-and-mortar toy stores, and with the drought of blockbuster films releases. The toy industry

is still buoyant, as they look to create their own media to narrate their toys, rather than waiting for the media industry to come to them.

Children absorb narratives from all around them, and watching animation, reading books and playing games exposes them to a diverse array of often complex fictional narratives that “describe situations, themes, and characters that take place outside of the child’s realm of experience” (Sandra Chang 16). Sandra Chang contends that this enables children to “begin to abstract an understanding of the basic components of the prototypical story, including characters, setting, a central problem, and the character’s efforts to resolve the problem” (20). Mary Begin describes the importance of storytelling within the current My Little Pony media licence, noting that “narrative is the connective tissue that binds our collective imagination and instils our passionately held beliefs” (11). Each Generation 1 My Little Pony toy featured a personalised story about each pony on the back card of the packaging. The magical realism of the stories provided a character profile and persona for each pony. This story offers not only an insight into the designer’s intention for the pony but how the world of the pony can be extended into the real world through play action.

2.4.2 Narrative play

There has been much parental concern that character toys structure and restrict imaginative play, but research indicates an opposite effect. Katriina Heljakka suggests that “twists and turns occur, as the toy story starts to unfold and develop in play” (115). Brougère, in his paper on the influence of television, explains that a toy “fosters, influences, and structures play” (5). Children use media narratives as a way to reflect on their own experiences and build an understanding

of their world to “organise their imaginations” (Bettelheim; Sandra Chang). Sandra Chang describes the doll as a way for a child to fabricate their own reality by giving the doll “sentience” and its own persona and motivation. A study by Tom Englehardt (qtd. in Kline) suggests only 15% of children engage in fantasy play based directly on the original toy narrative, with most children using the narrative as a framing device for a world context, and a stepping off point for the narrative they want the character toy to play.

Through imaginative play, children develop a variety of skills relevant to the accomplishment of creative thought, such as “cognitive, affective and interpersonal processes” (Russ and Wallace 136). Cobb states that “child’s play includes the effort to be something other than what they actually are to ‘act out’ and ‘dramatise speculation” (29). Character toys facilitate imaginative play which in turn enables children to form a better sense of self and cognitive function. Children can place themselves in the shoes of others by using character toys as agents within their play spaces. During play, the character toy can take on different meanings and evolve to take on different roles, as “can children’s perceptions and use of the objects” (Wartovsky qtd. in Moller). The character toys themselves are signifiers and when played with signify the “representations of player ego” (Magalhães and Goldstein 50), but more importantly, provide the child with an opportunity to use the character toy to process emotions and feelings as the child embodies the character in connotative response.

A pioneering study into the internal state language (ISL) of children when engaging in imaginative play with dolls indicated that children were neurologically more empathetic toward others and used the dolls to “internalise” the thoughts and emotions of the children

they were playing with, as an indicator of their social understanding (Hashmi et al.). Salim Hashmi and his team of toy researchers indicate “that certain kinds of play (i.e., doll play) naturally incline children to engage in social processing”, with their study using a diverse array of doll types and testing both girls and boys, which the researchers suggest indicated that “children of varying backgrounds could identify with the toys and characters” (8).

was the initial development of the My Little Pony (G1) range. Toy designer Bonnie Zacherle (Borgert-Spaniol) wanted the ponies to be coloured similar to real horses, however, the rest of the team was divided. When Hasbro play tested the product the “fantasy colours” made the product a huge success (Stern and Schoenhaus 117). The use of non-realistic colours has arguably enabled the product to lean into the limitless opportunities within the fantasy space.



Figure 11: Left, still showing the Queen Chrysalis character from the 2016 animated episode *To Where and Back Again* (*My Little Pony 'n Friends*), and right, promotional image of Hasbro's *My Little Pony Spike the Dragon Guardians of Harmony Queen Chrysalis* figure (2019). Still from *To Where and Back Again* (at 15:22); photograph from <https://www.amazon.com.au/Little-Guardians-Harmony-Chrysalis-Dragon/dp/B01MZXR0DQ>, accessed 1 December 2023.

Brian Sutton-Smith agrees that character toys do not make “imagination their victim” but are instead the starting point for imaginative play (*Toys as Culture* 204).

2.4.3 Character fantasy or reality

Within the surveyed literature, some question whether realistic character toys are more effective as imaginative play objects than more stylised toys. Examples of the latter do not accurately depict details of real life in favour of other qualities. A good example of this

Ponies can be a winged Pegasus or a sea pony, they can have gossamer wings and translucent glow-in-the-dark bodies. All these features exist in nature and can be seen within the diverse kingdom of insects (see Fig. 12 for an example). Playing with character toys enables children to learn into the speculative and fantastical. Johan Huizinga, in reference to the magic circle, explains that players leave reality behind as they enter the play space, instead allowing opportunities of chance and speculation (10). Pretend play requires children “to hold two realities about the same thing in his mind”, which could suggest that a character toy with a more abstract shape and colour may help the child to step from the “real world” that the toy represents; for example, a doll is a proxy for the human figure. A more stylised version could enable the child to envision the “human” form of the object as something other, or more than it represents. Therefore, in the hands of the child, the narrative world of the toy is extended into a more nuanced iteration of what it tangibly is. Vygotsky believes that children can use these objects to move from a visual to a sensorial meaning (in Bodrova 374). In addition, Sandra Chang’s study into children’s pretend play with television and film-scripted character toys suggests that “low-realism objects elicit more pretend play themes” (12), whereas high-realism toys encouraged make-believe and roleplay play, where children

play out scenarios they know from the real world. Many action figure character toys are based on more realistic themes, designs, textures and proportions, and tend to be more aligned to live-action films such as those of the Star Wars, Avengers and Transformers franchises. In contrast, dolls are often more exaggerated to facilitate removable clothing and accessories, or to make them visually appealing and endearing. Barbie has long received criticism that she promotes

them feel stronger and more dominant (Fig. 13). Toys like Hasbro's Guardians of Harmony range sit somewhere in the middle, with elements of aesthetic exaggeration and detailed articulation and mobility. But exaggeration is potentially another form of realism, and what researchers suggest as low realism is still undefined.



Figure 12: The orchid mantis (*Hymenopus coronatus*), left, shows several colour and shape similarities with the My Little Pony, Generation 1, HoneySuckle Flutter pony (1985-1986), right. Perhaps unconsciously, the toy design mimics natural phenomena. Photographs from <https://www.npr.org/sections/thetwo-way/2016/12/13/505424928/beautiful-huntresses-scientists-explain-why-mantises-evolved-to-resemble-orchids>, accessed 1 December 2024 and by Ponyland Press, from <https://www.ponylandpress.com/us/flutter.shtml>, accessed 1 December 2024.

Figure 13: Action figures and character dolls: left, Hasbro 2022 Star Wars The Black Series Cobb Vanth Toy 6-Inch-Scale Star Wars: The Mandalorian action figure; centre, MacFarlane Toys 2022 The Batman action figure; right, MGA Entertainment 2019 L.O.L. Surprise! O.M.G. Candylicious Fashion Doll. Image compiled by Tanya Marriott with promotional images from <https://www.amazon.com/Star-Wars-6-Inch-Scale-Mandalorian-F5132/dp/B09417T9NL>, accessed 1 December 2024; <https://mcfarlane.com/toys/batman-the-batman-movie>, accessed 11 January 2025; and <https://www.amazon.com/L-L-Surprise-Candylicious-Multicolor/dp/B07XSQ3BYJ>, accessed 1 December 2024.

an unhealthy body image, but her proportions are more defined by the challenges of draping scaled clothing to a diminutive figure using real-world scale fabrics. Bratz dolls were exaggerated for seduction, which simultaneously appealed to their young audience and ostracised parents. Action figures suffer from the “Schwarzenegger” effect with exaggerated muscles, longer bodies and smaller heads to make

2.4.4 Influence from designer toys

As a practising Pop-surreal artist, my work is heavily influenced by the designer toy movement. The commercial toy industry has looked to the designer toy movement in recent years to influence the visual language of toys. Designer toys have evolved from the lowbrow or Pop-surreal art movement, which began in 1970 as an intersection between Los Angeles Street

culture, Japanese folk iconography and surf culture. Artists working within this movement have a practice based on both the commercial arts of illustration and graphic design and subcultures within street art combined with traditional fine arts practice (Bilgi).

Lowbrow art provides a dialogue on everyday society, through humour and sarcasm, while forming a critique of popular culture and social norms. This is an “artistic



Figure 14: Oil paintings from Mark Ryden’s exhibition *The Tree Show* (2007): left, *Californian Brown Bear* (2006), and right, *Yoshi* (2007). Images from <https://www.markryden.com/california-brown-bear> and <https://www.markryden.com/yoshi>.

practice” where “the character became an element of micropolitical subversion” (Steinberg 210). Designer toys initially exist separately from any “world” (unless they are then adapted into a commercial licence). Commercially licensed toys always have a “relation to the ‘world’ to which it belongs” (Steinberg 210).

Artists producing designer toys use a variety of materials, such as plastic, vinyl, wood, metal, latex,

plush and resin to generate limited runs of collectable figures (Atilgan). Figures generally come in themed collectable sets, with a meta-story and visual language that links them. Designer toys are categorised in “family groups” of similar themes and philosophies, using simple strong shape language to define silhouettes and elaborate print and paint-ups to define each character. The narrative of the design toy is often only implied within the design itself and extends to the packaging and accompanying information card.

The designer toy movement also coincided with the development of Pictoplasma, “the world’s leading platform for contemporary character design and art”, which Peter Thaler and Lars Denike founded to “investigate possibilities and limitations of current character representation” (Thaler and Denecke). They were influenced by the web 2.0 era, where a global audience developed character icons as proxies for an online persona, and through innovation within character design which expanded to products and toys (Atilgan).

Many lowbrow and designer toy artists are heavily influenced by environmental issues within their work, seeing it as their responsibility to visually represent the plight of the planet in ways a wider audience can engage with, in a playful disarming tone that encourages empathy. In reference to his *The Tree Show* exhibition in 2007, Mark Ryden noted that “the mysterious spirits and essence of trees, plants and animals have become more and more obscure to us”, and “we look out the window at trees like they are animals in a zoo” (19). One of his oil paintings is of a toy bear jauntily strolling through the forest. While painting the piece, he took his daughter to a local store that had a taxidermied bear. He describes her scared response: “She has been so immersed in a

culture whose concept of ‘Bear-ness’ is a Disneyfied, computer-animated cartoon that she hardly knew what a bear truly was” (Ryden 19) (Fig. 14).

The designer toy movement has now come full circle to define the visual language of mainstream toy design, with the prevalent aesthetic consistent between children’s products, games and animation, including Luke Pearson’s *Hilda*, Pendalton Ward’s *Adventure*

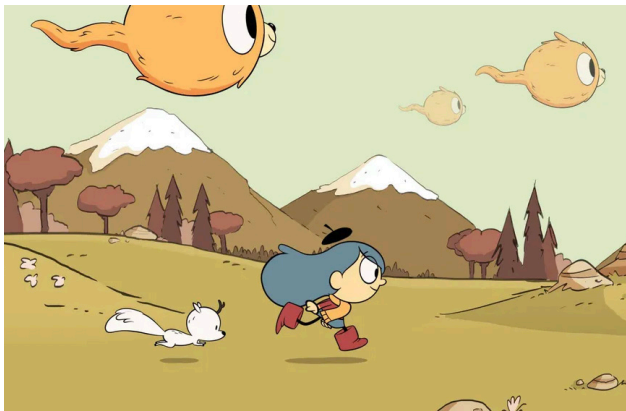


Figure 15: Stills showing characters from the 2018 animated series *Hilda*, left, and the 2010 to 2018 animated series *Adventure Time*, right.

Figure 16: Scarygirl figures (2009), created by Nathan Jurevicius for Kidrobot. Image from <https://www.nathanmakes.com/toys#/scarygirl-mini-figures/>, accessed 1 December 2023.

Time and Lauren Faust’s *My Little Pony: Friendship is Magic* (2010–2020) (Fig. 15). Many designers of Pop-surreal characters also work within mainstream children’s media. For instance, Gary Baseman’s *Teacher’s Pet* (2000–2005) children’s animated television series, about a dog that wanted to be a boy, and Nathan Jurevicius’s Scary Girl (Fig. 16) property, which is currently in development for a younger market.

2.5 Small World Play

Children like to build small worlds for play so that they can control and understand their space in a more intimate context. They can become deeply fascinated by the smallest of ecosystems hidden within a crack in the concrete, details that adults do not observe and are unable to see. Small world play is an intimate form of play, sometimes by one child or small groups, but it is located locally around a space where the child is sitting. It is not an active form of play, but an introspective form of imaginative play where the child breathes in the environment around them and uses this to inform the fantasy play world that they are engaged in.

There are several schools of thought as to why children engage in this form of play. One is that we are programmed, as environmental psychologist Mary Ann Kirby describes, to “take refuge in concealed spaces” as a form of safety (see Nabhan and Trimble 8). Another suggestion is that it can also be due to children’s deep curiosity in their immediate surroundings and that it is a way for them to be “larger” and more dominant in the space than their small stature would normally allow. Kirby confirms “that most preschool children have a predilection for playing in nestlike refuges whenever such microhabitats are available” (qtd. In Nabhan and Trimble 8). Ethnobiologist Gary Nabhan describes his sheer joy as an eight-year-old when he found a pond full of frogs to catch. Beyond the excitement of spending hours catching frogs, being so intimate with their environment in the ditch, he writes, “brought the wildness of other beings into my life” (Nabhan and Trimble 24).¹²

The use of tools and objects within natural spaces enables children to shape and disrupt the landscape to understand their relationship to the land and their

place within the environment. Cobb describes this as “plastic play”. She sees childhood as a combination of both culture, the human world of the child, and biology, their relationship to the natural environment. Cobb suggests the need for children to form “stories” of the landscape, to understand the power of materials as a preliminary to the creation of a higher organisation of meaning. She believes a child’s way of knowing is through becoming, by a literal “fingering over of the textures of the landscape in ‘sensory terms’ and the development of knowledge of patterns and sensorial experiences” (48). Cobb writes that what children want most is “to make a world in which to find a place to discover a self” (29).

David Sobel describes small world play as a way for a child to “grasp the bigger picture” (45) of the terrain they engage in. Small world play includes play with dollhouses, train sets and small-scale worlds. By “creating miniature representations of ecosystems ... we help children conceptually grasp the big picture” (Sobel 5). Small world play can give children a sense of security, and a way to map out the world with a sense of organisation and structure.

Some children go as far as to create elaborate imaginary worlds that they return to time and again to revisit the play. These worlds are known as paracosms, which are elaborate fantasy worlds defined by the child and “serve as vehicles for storytelling and as a way to explore real-life interests” (Taylor et al. 2) with peak development at age nine. Paracosms are influenced by the toys, books or media that the child is consuming. They can also be influenced by alternative fictions and histories from real world places. Authors J. R. R. Tolkien and C. S. Lewis created paracosms that provide the world stories for both Middle Earth and Narnia. Majorie Taylor et al., suggest that in the act of creating

¹² I had a similar experience as a six year old with the pumpkin and zucchini plants that have overgrown our garden. My brother and I played with our toys in the plants for hours, lying underneath them to look up through and take in the twists and turns of the vines and leaves, and the insects and creatures that inhabit this part of the garden.

a paracosm, children are also learning to recognise the nature of what is made up and what may reflect actual events or objectively observable situations.

Furthermore, the creation of paracosms can enable children to explore environmental and ecological conditions during toy play. Where a child may find a sense of wonder in the natural world, the paracosm can serve as the fantastical framing for a play scenario the child can return to and continue to develop a sense of wonder. Connecting imaginative play with toys to elaborate nature-based worldbuilding could enable children to explore complex themes such as climate change on their own terms by forming a meaningful connection with the environment.

Although not all children create elaborate paracosms, most children create “smaller-scale fantasy worlds” (Sobel 27) during toy play. One of the key challenges to small play in the natural world is to overcome what Sobel describes as the “don’t touch attitude when children actually get outside” (31). With some parental concern about illness and bacteria (as evidenced by the numerous television adverts for sanitiser), children are not encouraged to play up close and personal in the dirt as previous generations did. Their small world play tends to be enacted inside in bedrooms and playrooms where the serendipitous chance of encountering another species of flora or fauna is almost non-existent. Engaging in small world play outside enables children to make discoveries under the leaf litter, overcome fears of creepy crawlies and enable us to feel “bonded to the matrix of the earth” (Sobel 30). Children can use their toys and narratives to adjust, disrupt and affect the ecosystem with real-world consequences of cause and effect. This enables children to “facilitate relationships” and “rules for caretaking and sharing” (Sobel 30) that

enable children to see themselves as intrinsically part of the wider ecosystem around them.

3. Design Process and Experimentation: Research through Design

3.1 My Research Design Process

This chapter explores the design research process for The Underfoot range of character toys, whose methods and innovative approach is conveyed by the combination of the textual and graphic interpretation of the methodological process and findings of the project. The research framework is informed by a methodology defined by Christopher Frayling and expanded in design methods for product design by Alex Milton and Paul Rodgers. Frayling's framework encompasses three phases: research into design, research through design and research as design (Fig. 17). Frayling's framework provides an adaptive structure for this study, which straddles interdisciplinary design. Frayling's final phase, research as design, was used as a hybrid method between industrial design and entertainment design, as the research is needed to balance the design of the character licence with the evolution of the tangible toy product and packaging.

This explorative and practice-based research also required a more cyclic and reflective mode of design enquiry. A strategic design approach founded on developing relevant first principles was defined by Nigel Cross in his text *Designerly Ways of Knowing* and is centred on the methodological framework. This was used to develop each of the five toy designs and the pitch document. Cross's design strategy is suited to unpacking the creative process of established designers. In conjunction, a toy design strategy was developed that involved a reflective practice (Schön) and the integration of tacit design knowledge. This provided the opportunity to critically reflect and modify the design process for each iteration of the toy design to enable the ability to develop the character toys in

conjunction with the environmental narrative and the media licence.

Together, the cyclic and reflective approaches enabled the project to engage in a more subjective design development rather than a traditional objective product development process. This design methodology aligns more closely with the creative practice of entertainment concept design, which considers the worldbuilding, narrative and the end product concurrently. This process allowed for creative modelling techniques developed through my experience working as an independent designer in the commercial toy, film and animation industries. In addition, earlier toy prototypes were used to conduct test scenarios to appraise the effectiveness and appropriateness of the methodological framework.

Following Frayling's first phase, my research into design has been outlined in the extensive literature review offered in Chapter 2. This research included an investigation of imaginative play patterns (2.1), an examination of eco-play and the decline of nature play (2.2), a survey of eco-fiction narratives (2.3), a survey of the current design process for character design (2.4) and an analysis of children's small worlds (2.5). This research into design helped me develop the first set of design criteria for the eco-fiction-inspired toys (discussed in this chapter and summarised in 3.7). As this research is based in Aotearoa New Zealand with a focus on its children, this section compared global trends with larger data sets against smaller studies based in this country with similar patterns of outdoor play decline. Frayling's third phase, research as design, is covered in Chapter 4.

Research into Design History, Theory and Context

Research as Design Experimental Practice

Research through Design Innovative Design Methods

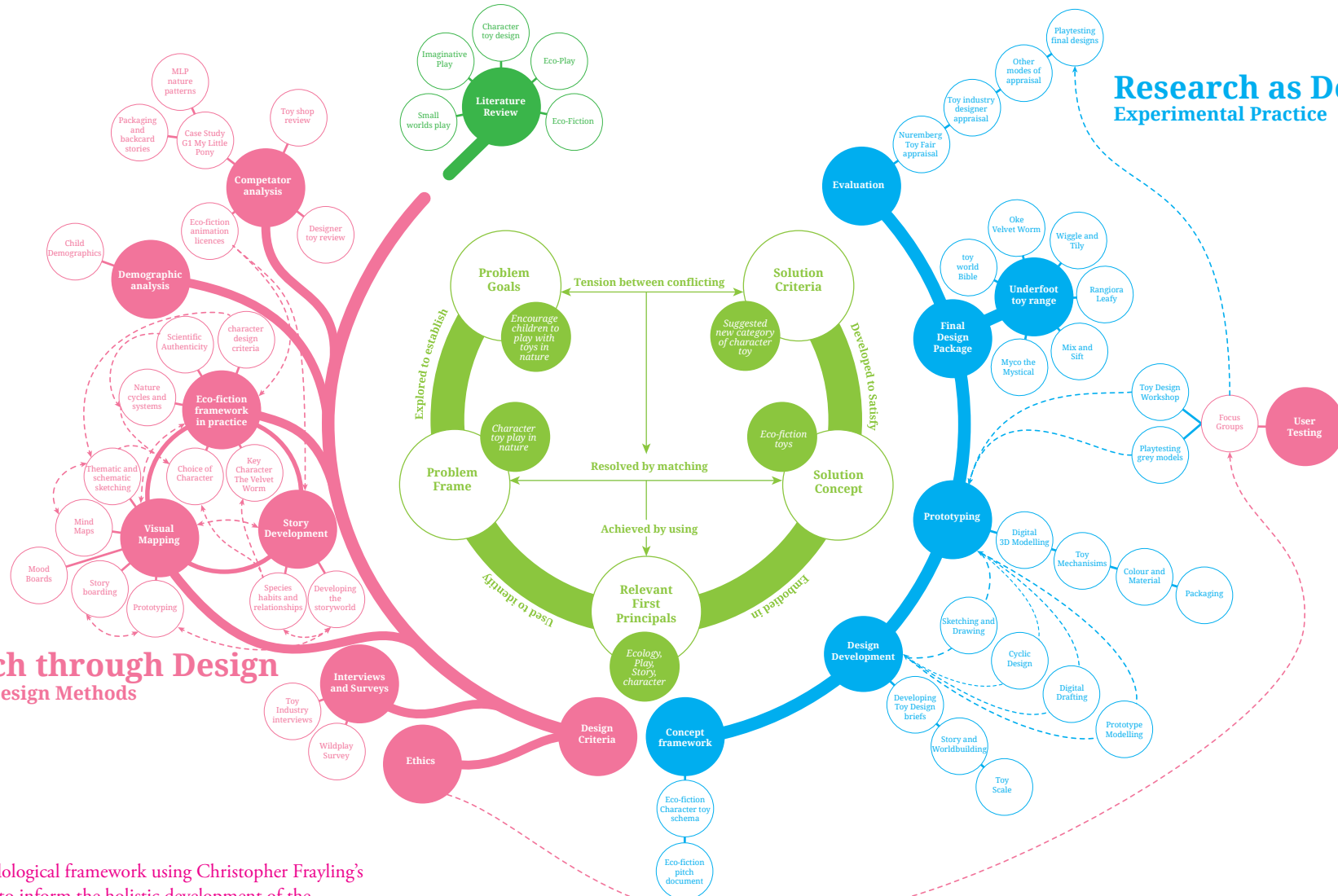


Figure 17: Methodological framework using Christopher Frayling’s design framework to inform the holistic development of the research and Nigel Cross’s methodology to enable reflection and refinement within the design process. Diagram by Tanya Marriott.

The focus here, in Chapter 3, is on Frayling's second phase, research through design. Research through design constituted a large body of exploratory research that helped to unpack the context and establish the parameters and guidelines that enabled me to define the core design criteria for an eco-fiction toy design. The first section (3.2), details the use of product design methods of competitor analysis and case study analysis of existing toy design products to ascertain existing patterns in character toy design. Next, Section 3.3 briefly outlines the demographic analysis. Sections 3.4, on the eco-fiction framework, 3.5, on visual mapping, and 3.6, on story development are all listed sequentially, but the exploratory work in these three sections was developed concurrently.

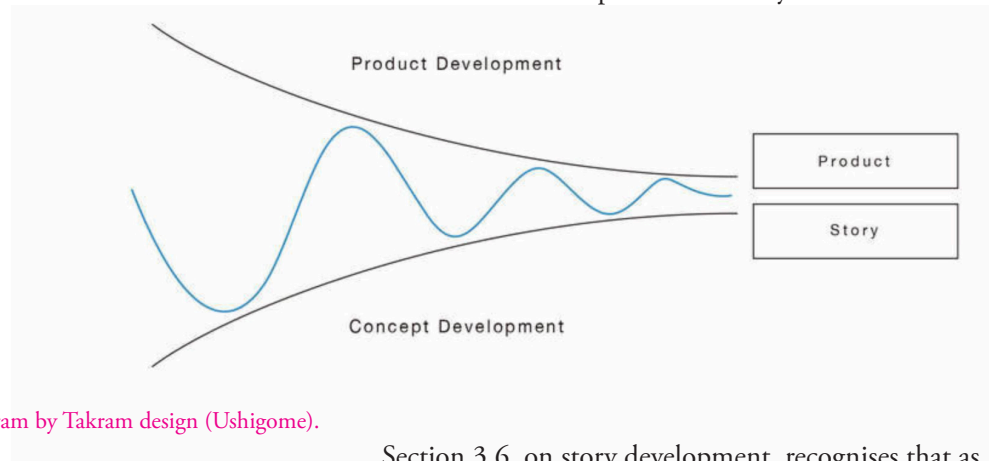


Figure 18: Storyweaving diagram by Takram design (Ushigome).

Section 3.6, on story development, recognises that as a character licensed toy, The Underfoot toy product needed to evolve alongside the story world that defines the toy characters' purpose and interrelationship to the ecological world that defines its environment. The story explains the product's existence to potential investors, developers, distributors and the end user. Storyweaving is also used as a method within product design, as a mode of action (Lupton 19) to transform an object into a dynamic form. Japanese design

consultancy Takram describes this as pendulum thinking (Tagawa), which necessitates a more agile design methodology when the design journey is not linear. They suggest that such compound problems require unique expertise to oscillate comfortably between the different requirements of a project (Fig. 18).

Takram design introduced a method called "Storyweaving", demonstrated in Figure 18, for the way a "story supports the conceptual side of a project, providing meaning and reason to its various constituents" (Ushigome). For a licensed character toy to exist, there also needs to be a media licence. To develop The Underfoot range of toys, a story world guide was concurrently designed in the form of a pitch document to explain the characters' story ecosystem. The following five sections explore the methods used to develop these two design components.

3.2 Competitor Analysis / Product Comparison

3.2.1 Toy shop review of character licensed toys

In 2018, a photographic record was begun of relevant character toys available for purchase in New Zealand toy shops. Three toy shops were visited in Wellington over the course of six months (excluding the time periods in isolation due to the COVID-19 pandemic) and photographs were taken of the merchandise

(Fig. 19). The following toy shops were chosen as they cater to consumers from a broad range of socio-economic backgrounds.

- The Warehouse: Offering a variety of standard products, similar to Target or Walmart.
- Moore Wilsons: High-end conscious toy products, similar to FAO Schwartz.
- Toy World: Standard toy store, similar to Toys R Us.



Figure 19: Results of the 2018 toy shop review of character licensed toys. Each radial diagram shows the corresponding photographed toy assessed on a five-point scale for: character licence, outdoor play, non-human activities, human impact, ecosystem, non-human (qualities). Visualisation by Tanya Marriott.

Additionally, I visited Spielwarenmesse 2023, in Nuremberg, Germany.

Between 2018 and 2023, eight (8) toy product sample reviews were conducted and character licensed toys that fit the project's criterion for an eco-fiction toy were photographed and documented (Fig. 20). I used the following five (5) points of reference based on the eco-fiction toy criteria defined in section 4.2.2

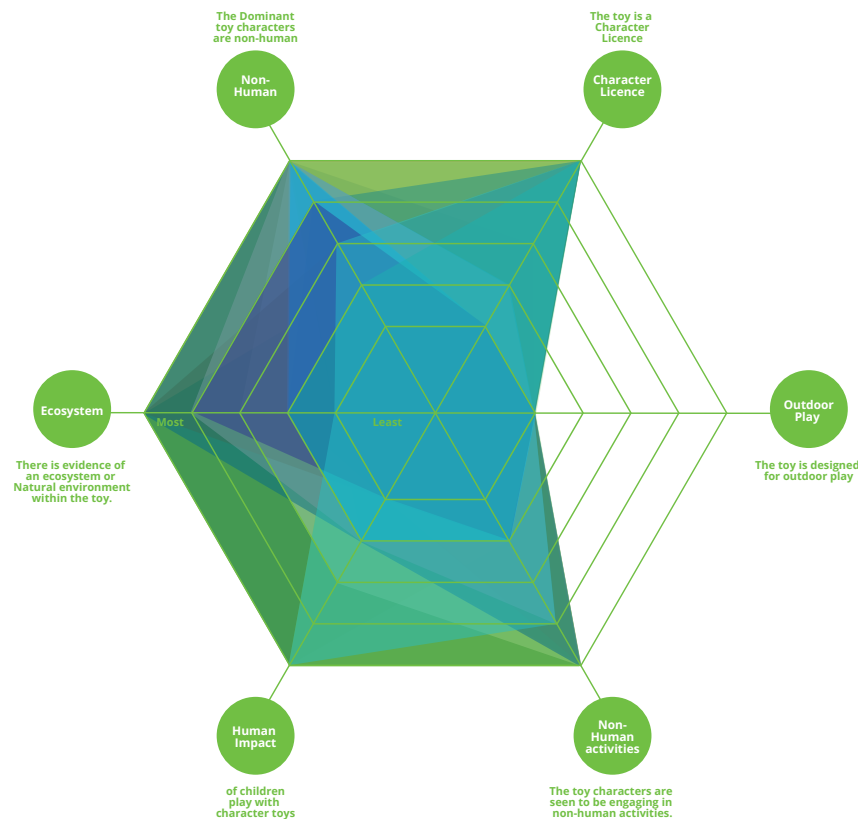


Figure 20: Radial diagram consolidation of all toy appraisal data. Visualisation by Tanya Marriott.

The points of reference are as follows:

1. The toy is a character licence.
2. Dominant non-human characters.
3. Evidence of an ecosystem or environment.
4. Representation of human impact within the toy.
5. Characters are behaving in a non-human way.
6. The toy is designed for outdoor play.

Character toy products were entered in a chart and ranked for their effectiveness in meeting the five criteria; however, no toy met all five. None of the toys met the outdoor play criterion, and very few met the environment or ecosystem play criterion. The most prevalent eco-fiction modes of play were toys that were animals or toys that had a relationship with animals. In this context, the human relationship was overwhelmingly dominant (Fig. 20). The My Little Pony Pinkie Pie Seashell Lagoon came the closest to meeting the eco-fiction criteria. This product was taken directly from a scene from *My Little Pony: The Movie* and consists of a coral reef plastic playset that the sea pony toys inhabit. The characters are sea ponies and other aquatic creatures, and the play narrative explores how they inhabit their own world. The product was not designed for outdoor play or even water play as the aquatic nature of the toy's design suggests. Children could take their Pinkie Pie Seashell Lagoon toy outside, but there would be no added play value in the product to support this change of environment as the product already had the outdoor world replicated in its design.

The diagram in Figure 20, used for the analysis of the research findings, provides a useful dataset that informed the design of The Underfoot toy range. Further information about the process of analysis for both product and animation reviews is in Appendix 3. The most prevalent modes of play and storytelling that

involved animals or a nature focus within the dataset are represented in [Figure 21](#), and were as follows:

1. Hatching an animal.
2. Riding an animal.
3. Protecting an animal.
4. Fighting on or against an animal
5. Catching/keeping an animal.

These are all human-centric modes of interaction with “animal” characters. If character toys included playsets, these products recreated the natural world in plastic within the product. For example, the trees

3.2.2 Eco-fiction animation licences

As identified in the Introduction, there is already a growing industry of ecologically focused toys within the design of commercial toys. This includes building blocks, wooden animals and loose-parts toys. However, the challenge this research considered was how to define eco-fiction toys within contemporary character licensed toys, which are overwhelmingly human-centric in their physicality, playset design and the worlds the characters inhabit.

Part of the design process was to develop a story and world, as described in the toys’ packaging and



Figure 21: Examples of character licensed toys that engage with animals. Photos taken and image compiled by Tanya Marriott.

and flowers in the Playmobil Fairies playset are made of plastic. The playset is self-contained and includes a flat base where children insert the trees. The movie on the Peppa Pig YouTube channel, *Peppa Pig’s Perfect Day at the Zoo*, involves animal characters visiting other animals in captivity. Mattel’s 2022 Jurassic World toy, Dino Escape Kentrosaurus (see [JurassicCollectables for a review](#)), could benefit from outdoor play as the toy itself does not provide an environment for the dinosaurs to inhabit. Other products in this toy range include cages to capture dinosaurs.



Figure 22: Visualisation of Hasbro’s 2016 My Little Pony spin-off range Guardians of Harmony, showing connections between the web game, left, and the product, right. Visualisation by Tanya Marriott.

backcard sections. The story describes the product for point-of-sale content, such as packaging and in-store marketing. Most character licensed toys have a media product attached to the toy; this gives context to any accompanying media product, such as an animation or online web game, which helps immerse children in the world of the toy and promotes product sales. An example is given in [Figure 22](#), which shows the toy characters Spitfire and Spike from Hasbro’s My Little Pony Guardians of Harmony toy range, both in the web-based game (developed by Hasbro to promote the toy) and in character toy form.

3.2.3 Review of eco-fiction animated television shows

In 2021/2022, a further audit of popular children’s television shows was conducted that fit similar eco-fiction criteria to augment and inform my understanding of this genre. The same criteria as the previous competitor analysis study were used; however, “toy” was replaced with “show”.

The list of criteria is as follows:

1. The show is a character licence.
2. Dominant non-human characters.
3. Evidence of an ecosystem or environment.
4. Evidence of human impact within the show.
5. Characters are engaged in non-human activities.

Television network streamers and show guides were chosen to cater for consumers with a wide range of socio-economic backgrounds. The **Common Sense Media** web database was used to specifically search for nature and environmentally focused shows. **Figure 23** details a sample of animated series that fit the criteria, with many children’s animated shows having an eco-fiction focus, while **Figure 24** consolidates these findings.

Television shows ranging in age appropriateness from three to seven-plus years were included in the study so that further analysis could be conducted of the maturity of the narratives and so that age-appropriate themes for the target audience of children aged between five and seven could be gauged. The surveyed shows can be defined as either a narrative with a human lead or narratives with an animal lead. Animation for children younger than five tended to have animal protagonists, such as the television series *The Octonauts* (2010–2021) and *Puffin Rock* (2015–2016), whereas in the target demographic (5–7) the protagonist was predominantly human, and held a leadership role over another animal character, such as *Hilda*, *Hatchimals* (2018–) and *Kipo and the Age of Wonderbeasts* (2020).

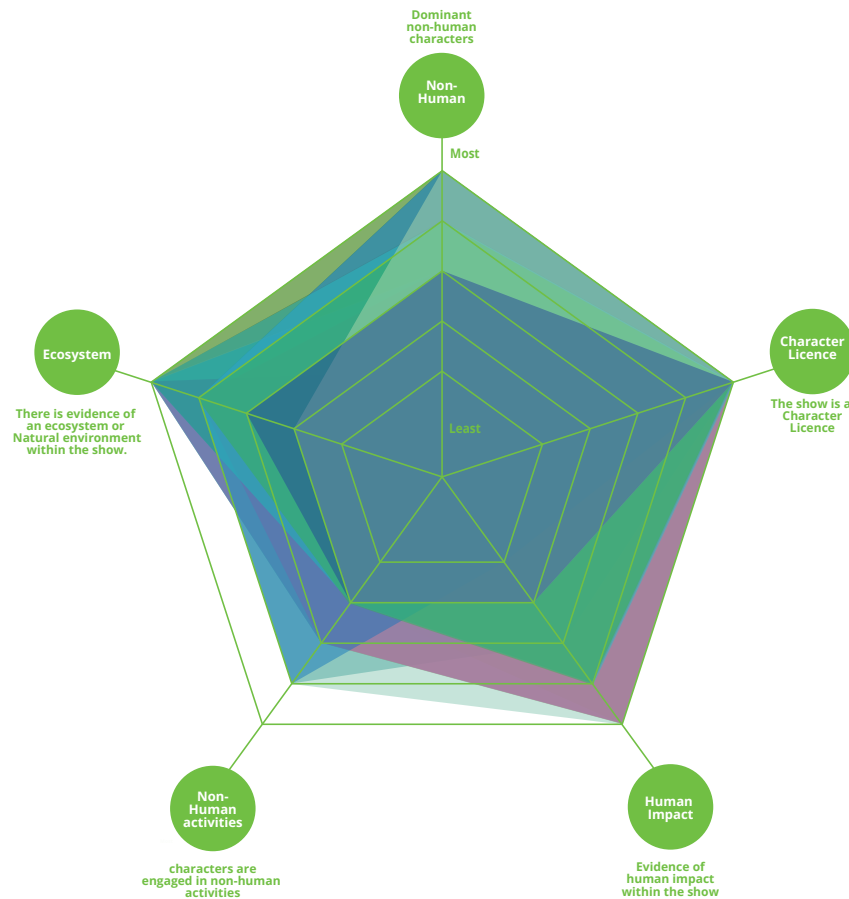
Animal characters tended to be companions and dressed as humans. A notable exception is *Gigantosaurus* (2019–), which follows a group of



Fig 23: Results of the review of children’s animated shows assessed through the eco-fiction criteria. Each radial diagram shows the animated show assessed on a five-point scale for: character licence, human impact, non-human activities, ecosystem, non-human (qualities). Visualisation by Tanya Marriott.

dinosaurs as they explore their world. They never wear clothes or act in ways subservient to humans.¹³ *Fraggle Rock: Back to the Rock* (2022–) and *My Little Pony: Friendship is Magic*, which are based on well-established 1980s character licences, both portray animal characters with some human attributes to make them relatable to children; however, the narrative places the animal characters as guardians of

their habitat against an “other” entity. The research identified many more eco-fiction or potentially eco-fiction-focused narratives, including *The Fungies* (2020–2021) and *Nature Cat* (2015–2024), and, as discussed in section 2.3.1 the literature suggests that environmentally focused animated television programs are in demand.



¹³ An interesting point that the research revealed was that dinosaurs tend never to be portrayed as anything other than the animals they are.

Figure 24: Radial diagram consolidation of children's animated shows in relation to the eco-fiction criteria. Visualisation by Tanya Marriott.

Finally, the analysis exercises described here and in 3.2.1, were taken a step further to see how each of the eco-fiction programmes matched with character-based toys see the how animation is adapted.¹⁴ Although several animated series had very expansive toy ranges,

several only had plush or more action-based toys. Four series, *Kipo and the Wonderbeasts*, *Obki*, *Nature Cat*, and *The Fungies* had no toy product at all. Figure 25 summarises these findings.



¹⁴The Octonauts, Hatchimals (2018–), My Little Pony: Friendship is Magic and Maya the Bee (2012–) have diverse product ranges with characters and playsets. The Octonaut toys focus on undersea rescue and interaction between the animal protagonist character and other animals that they rescue. The Magic Mixies toys do not expand on the ecosystem of the characters but maintain a focus on magic. Many other animated television shows have a limited toy range beyond core characters: there were no toys for Kipo and the Wonderbeasts and only the key character for Hilda. This demonstrated a potential limit in eco-fiction animated series being licensed as character toys. Character licences based on the series Scout and the Gumboot Kids (2015–) and The Wild Kratts (2011) had activity sets that children could use for playing out in nature. They were not character focused, but instead made the child the character and the activity sets tools for the child to explore the natural world.

Figure 25: Children's animated shows divided into those with character toys based on eco-fiction animation licences and those without. Visualisation by Tanya Marriott.

3.2.4 Review of the aesthetic influence of designer toys

The commercial toy industry is influenced by games, media and even the designer toy movement (Atilgan, Steinberg, Thaler and Denecke). The phenomenon of unboxing was instigated by Kidrobot (as part of their blind box designer toy ranges in 2004). This process has become such a commercial success that virtually

every licensed product has a “blind box” or “unboxing” mode of play tied in. The designer toy movement has also indirectly influenced character shapes and colours through the inspiration toy designers and animators draw from this aesthetic as adult collectors of toys. As noted in Section 2.4.4, many designer toy artists also work in the commercial toy and animation industries.

Designer toy designers, such as Nathan Jurevicius (see Jurevicius), OddFauna (see OddFauna), Mumbot (see MUMBOT, also on Twitter, Instagram, Facebook), Faunwood (see Zimmerman), Amanda Visell (see Kidrobot, Visell) and Tara McPherson (see McPherson), all develop characters to work across animation, game and designer toy genres. This type of work has a high prevalence of animal creatures, mainly insects and forest-inspired species, in designer toy products. The shape language of the characters presents them as caricatures of realism but with a conscious consideration of relevant ecology. My research showed that designers often photographed their toys staged in natural spaces and they do not shy away from a cute sensibility towards the quirky and surreal. While these toys are marketed to adult collectors, the character shape language used within them has influenced the visual aesthetics, overall shape language and proportions of contemporary commercial children’s toys (Fig. 26).

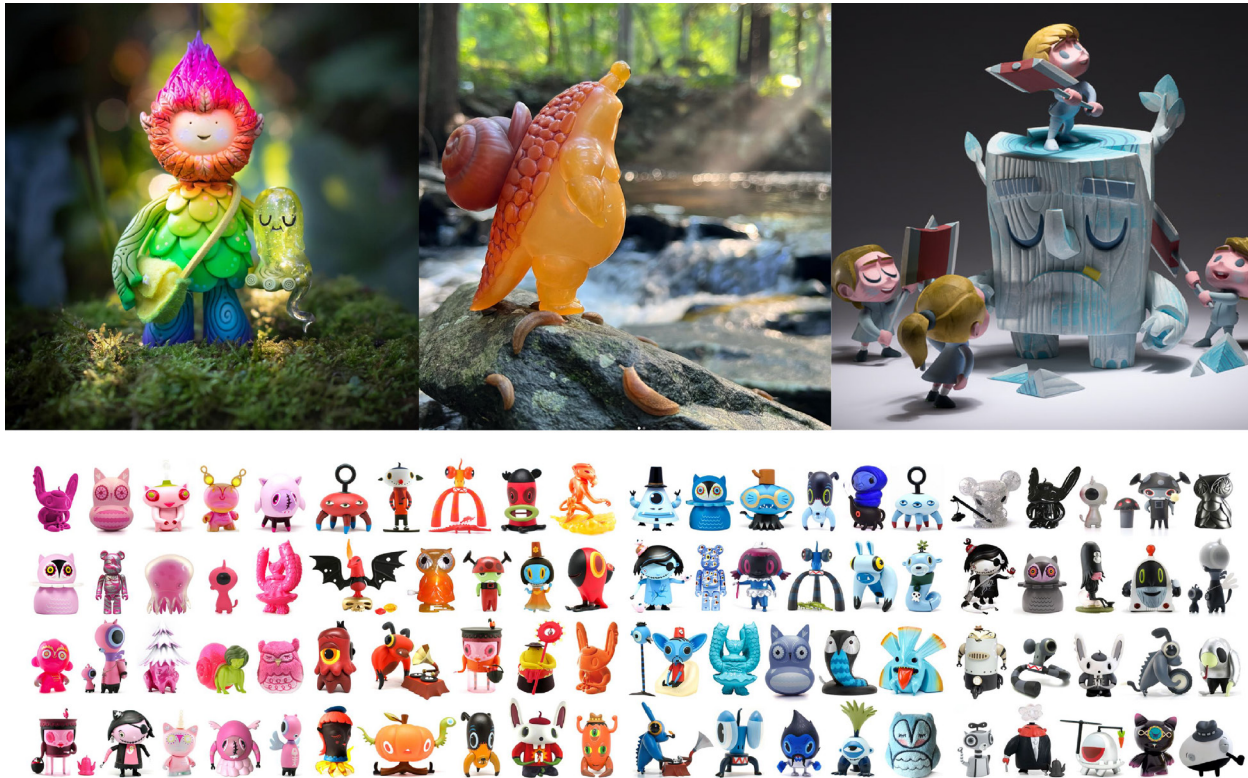


Figure 26: Left, Rainbow Journey Aughostus & Tree Spirit (2022) by Mumbot, Mr Muju and Miss Muju. Image from <https://www.instagram.com/p/ClJViuLWxR>, accessed 5 June 2024. Middle, Baby Mansnail (2022) by Sad Salesman. Image from <https://www.instagram.com/p/CgW6Dweu8TH>, accessed 5 June 2024. Right, The Last Days of Autumn (2015) by Coarse toys and Amanda Visell. Image from <https://www.instagram.com/p/9WtQOOi-to/>, accessed 5 June 2024. Bottom, Toy Lineup (2019) by Nathan Jurevicius. Image from <https://www.nathanmakes.com/toys>, accessed 5 June 2024. Images compiled by Tanya Marriott.



- 67 Flora
- 44 Romance/Love
- 32 Baby
- 27 Household items
- 17 Jewellery
- 8 Vehicles
- 1 Gardening
- 62 Fauna
- 43 Celestial
- 29 Abstract
- 18 Beach
- 14 Music
- 7 Magical items
- 32 Weather
- 29 Clothing / Accessories
- 18 Party
- 10 Sports / Games
- 7 Sleep



Figure 27: My Little Pony, Generation 1 (1982–1992) analysis: top, sample backcard illustrations and story; centre, totals for cutie mark categories; bottom, visualisation showing environmental-themed cutie marks. Image compiled by Tanya Marriott.

3.2.5 Case study: My little pony G1 character licensed toy

Evidence suggests that character licensed designs may have peaked in the 1980s and 1990s with the influx of toys tied to children’s television. Most of these licences are staples today and continue to be mainstays for contemporary play. In 2023, the My Little Pony toy celebrated its 40th birthday, and other character licences developed in the 1980s, such as those for Masters of the Universe, Carebears, Transformers and Strawberry Shortcake, are still popular amongst their target audiences.

Each of these toy licences began with the design of the toy ecology, which then informed the worldview and narrative of the animation. As the animated series evolved, new narratives were introduced to expand on the toys’ reach as an influence on children, who use them as a starting point for play. If the toy play pattern closely aligns with the animation narrative, then this enriches the toy’s purpose and role within its world.

To better understand the link between narrative and toy play for a character licensed toy and whether the early My Little Pony range could meet the eco-fiction criteria, I conducted an in-depth analysis of the relationship between the G1 My Little Pony range (1982–1992) and the animated television series *My Little Pony ’n Friends* (1984–1986). The My Little Pony (G1) design was available in multiple play objects of different colours, shapes and groupings, and its physical robustness helped to enable its play value within the garden.

Packaging and backcard stories

According to Manel Mzoughi et al, toy design packaging serves five essential purposes. These are to:

1. Protect the product.
2. Build brand awareness.
3. Provide necessary information.
4. Create a positive emotional response.
5. Simplify the decision-making process for the buyer.

The (G1) pony packaging always included a backcard illustration and a short story of no more than 100 words. The story was specific to the toy product, and the illustration demonstrated the product in an environmental context with other ponies in their related family. The backcard narratives are predominantly environmentally themed and position the ponies in relationship to other creatures within their ecosystem—both biotic (fireflies) and abiotic (sun and clouds)—and often frame the ponies as guardians or at the least cognisant agents of the cycles of the natural world.

My little pony nature patterns

Each My Little Pony was individually named and defined by symbols on its rump, known as a cutie mark, which were as unique as their names—like a birthmark. Of the 525 My Little Pony toy cutie marks surveyed, 290 marks symbolised natural occurrences, including flora, fauna, weather and celestial indicators. Each “family grouping” included three to six characters linked by a narrative framing of their cutie marks and backcard stories. The diversity of symbols and colourway options is also relevant to the natural world, where a taxonomy of birds, spiders or fungi may show the same level of variety and consideration of relational features between species.

3.3 Demographic Analysis

3.3.1 Child demographics

The Underfoot toy series was developed for children aged five to seven as children in this age range are at their peak for imaginative play, the benefits of which were explained in section 2.1. At this age, children were developing independence from their caregivers and have developed physical, motor and cognitive skills relevant to this mode of character-toy play. By age five, children have a better grasp of emotional intelligence to act on imaginative play scenarios (Montessori Aotearoa New Zealand) and more robust physical agility, dexterity and fine motor skills to engage in outdoor play, where the natural materials they encounter have not been manipulated for human consumption.



Figure 28: An example of fine motor skills for a child aged 5 (Côté et al.). Photo by Tanya Marriott.

Toys for this age range include action figures and dolls with moving parts. Children can open and close small clasps and carry multiple objects in their hands (Fig. 28). At this age, they are attending school and will therefore be developing a more comprehensive worldview of cultures and modes of communication. Children also consume media and games in the form of animation and online or mobile device games. They can understand and construct their own narratives

within play and understand fundamental scientific principles prevalent within the natural environment (Ministry of Education 54).

The project used The Measure of Man and Woman (Tilley and Henry Dreyfuss Associates), an applied human factors publication that identifies developing physical abilities such as coordination, along with changing anthropometry of developing children to create a guide for the methods of outdoor character toy play most appropriate for this demographic, combined with an analysis of toy resource guides published by the international toy industry (Toy Association). Children aged 5 can understand “cause and effect” (Tilley and Henry Dreyfuss Associates 14) and imaginary play enables them to develop their own scenarios for play, which in turn helps them develop communication and social skills. The research checked the basic fit between child body anthropometry and the intended play test environment through a traditional activity task analysis used in industrial design. It used the methods of analysis developed through previous toy product testing combined with drawing to define a measure of the child and their fine motor skills. This indicated fit and function between end users and tasks before field trials.¹⁵

¹⁵ Prior to this research I conducted several years of playtesting activities with children in the same demographic, both through Kiwi Conservation Club and Parent Help in New Zealand. These projects also included the design of products for outdoor nature-based play. Through this prior research I have, through extensive observation analysis, developed a confident understanding of the communication, behavioural and motor skills of the user group.

3.4 The Eco-Fiction Toy Design Framework in Practice

The eco-fiction criteria (see Fig. 29) were used to develop a design framework and further criteria for designing The Underfoot characters under three categories:

1. Eco-fiction criteria.
2. As applied to character toy design.
3. Design criteria.

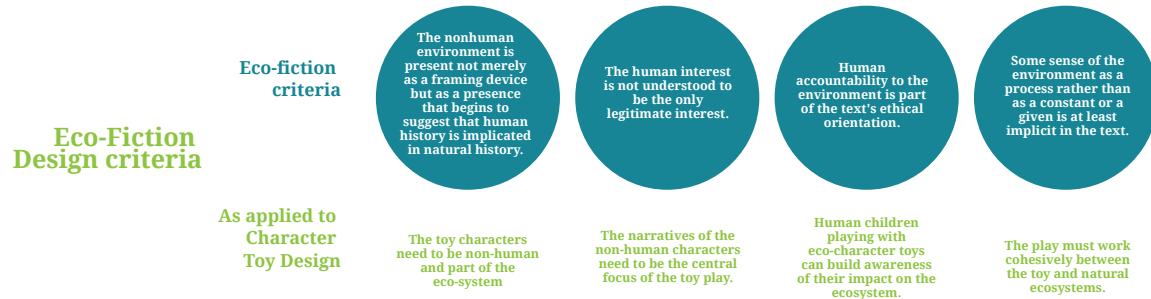


Figure 29: The eco-fiction design criteria. Diagram by Tanya Marriott.

The first category, eco-fiction criteria, define the criteria used within literature and media, as defined by Dwyer (7). The second category, as applied to character toy design, is my interpretation of the eco-fiction criteria while looking through the lens of a toy designer. The third category, design criteria, was derived from the perceived relationship between the eco-fiction criteria and the needs of character toy design. The output, the design criteria, became the framework that informed this toy design research.

While developing preliminary tests, the four-part eco-fiction criteria framework was used to test how all elements of the toys can be designed concurrently, including the ecological system, character stories and

the environment itself. All aspects of the eco-fiction criteria are non-hierarchical, so there is no order regarding how they are discussed. The list below describes the influence of the eco-fiction criteria on specific aspects of the design.

- **The toy characters:** Species living in the soil and undergrowth were analysed against the nitrogen and ecological trophic cycles. As this design specifically focused on Aotearoa New Zealand children, the project looked for unique and interesting species and a balance of rare and easily recognised creatures.
- **The backstories:** These are the methods that children use to access the overarching narrative of The Underfoot character, which is demonstrated through tangential representation within the toy design, pamphlets and backcard narratives.
- **The meta story:** The meta-narrative for the toy world needs to indicate the relationship between humans and the ecosystem, or the children as human agents and the toys themselves.
- **Natural materials:** A vital feature of this research is using natural materials within the toys during play. This combination of materials is critical to encouraging children to play outdoors.

3.4.1 Scientific authenticity

The Underfoot range of character toys has been designed to embody an ecosystem. An understanding of the dynamic systems within natural ecosystems and how they can manifest as modes of play interaction is core to The Underfoot designs. The dynamic natural systems manifest within the story of the toys, the way each toy integrates with the other toys and how children enact the natural system during play, such as mashing leaves and soil in the toys Mix and Sift, which is a form of decomposition evident in the nitrogen cycle.

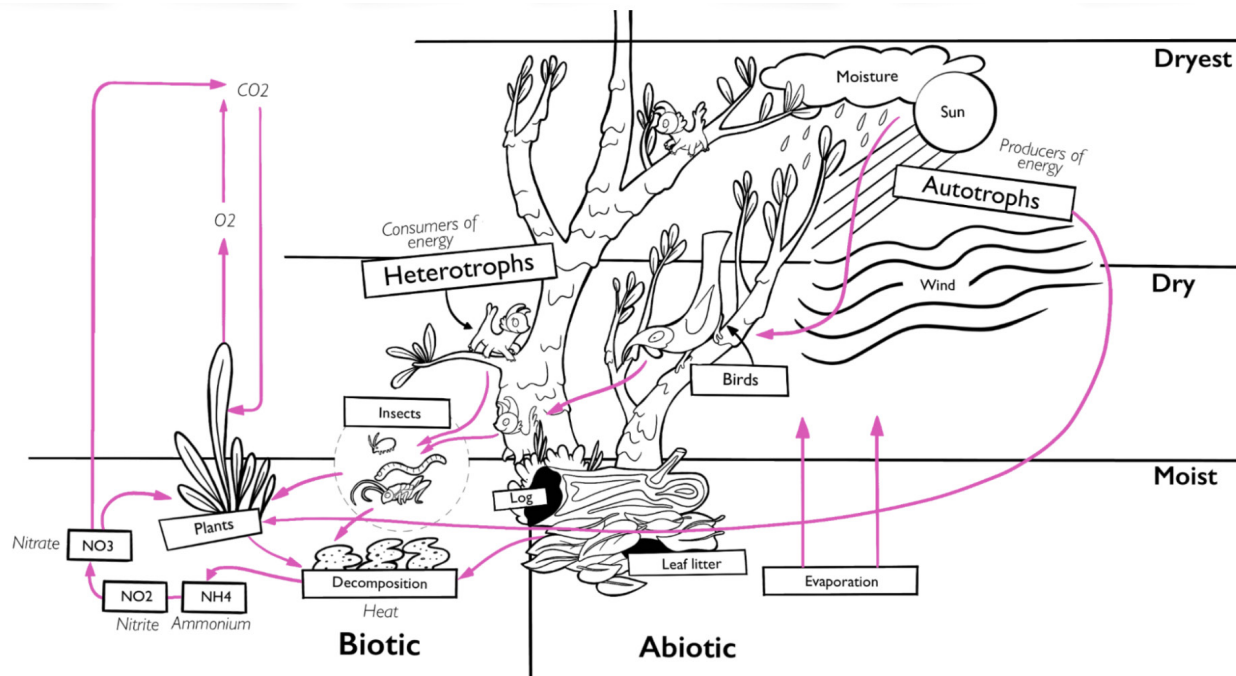


Figure 30: First ecological system drawing of the environment cycle story world. Diagram by Tanya Marriott.

Initial research into eco-fiction storytelling included informal discussions with nature educators, ecologists and contacts in Aotearoa New Zealand's Forest

and Bird and Department of Conservation. One comment made by Kiwi Conservation Club leader Sarah Satterthwaite resonated with me; she said, "What children learn about science when they are young is hard to unlearn when they are older." This statement was used as a guide when starting to develop eco-fiction narratives, and by building on research by Mabel Osgood Wright (Perez), narratives were developed that were underpinned by real science. This provided a strong framework of functioning natural systems, which demonstrated real-world tensions and challenges that helped to frame a world story for the toys.

3.4.2 Nature cycles and systems

Eco-fiction narratives speak of environmental cycles, and a key aspect of the eco-fiction criteria is that the environment is seen as a process. As part of the design ideation process, character profiles were developed, including natural relationships and story beats for each potential character to try and weave elements of story, play and ecology into the design. Extensive explorations into the four core natural cycles (nitrogen, oxygen, carbon, hydrologic) were carried out to help define systems of interaction that could inform the systemic relationship between each toy.

The generation of visual mind-maps was crucial within the design process to identify the relationships between biotic and abiotic entities so that they could be visualised as a toy system. This visual modelling of an imaginary environment provided the foundation for character development, product modelling and eventual prototyping of The Underfoot toy characters. To test the toy designs as reflective of ecology and collectively as an ecosystem, a map of occurring environmental systems was needed. It applies the ecological systems of engagement, energy and matter

mud and dirt. Figure 32 shows how natural cycle diagrams were used to examine transformation systems and understand how “objects” change and transform during play. To understand the tone and the child’s grasp of the biological systems, abstract material images were used and accompanying text descriptors, such as “animals poop me out”, were used in the textual diagram to workshop through the critical material transitions between each toy.

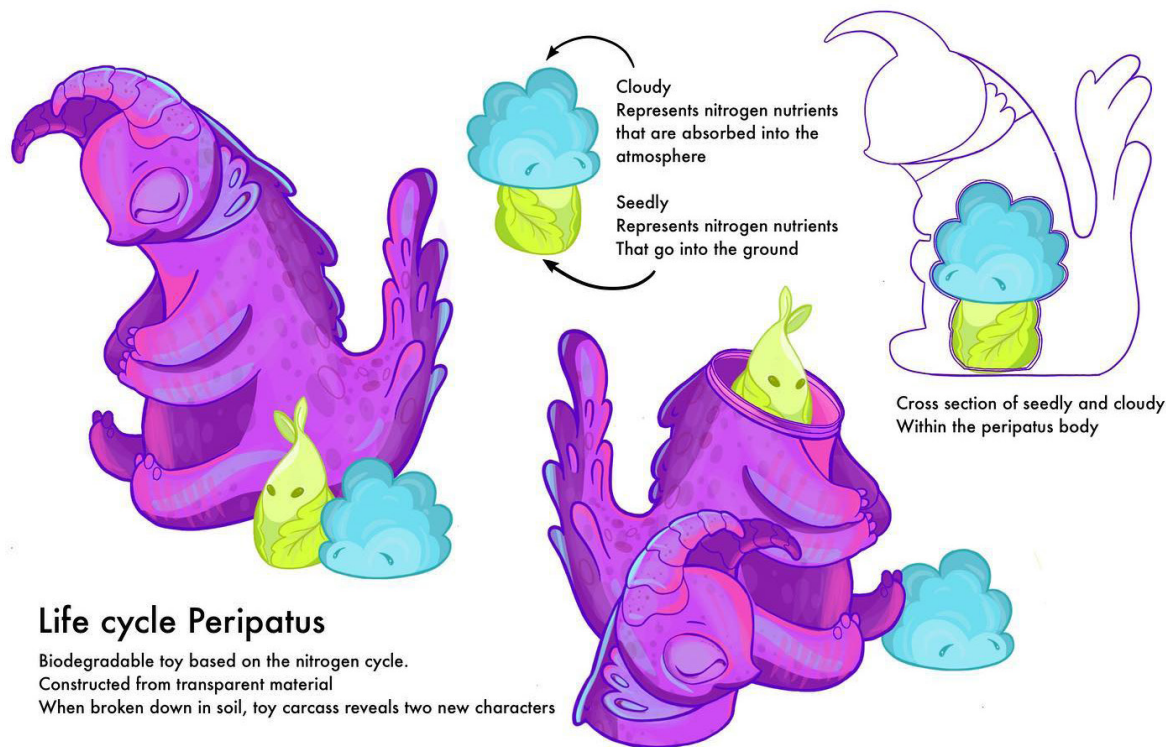


Figure 33: Sketch/Render exploring a single character embodying an ecosystem. Design by Tanya Marriott.

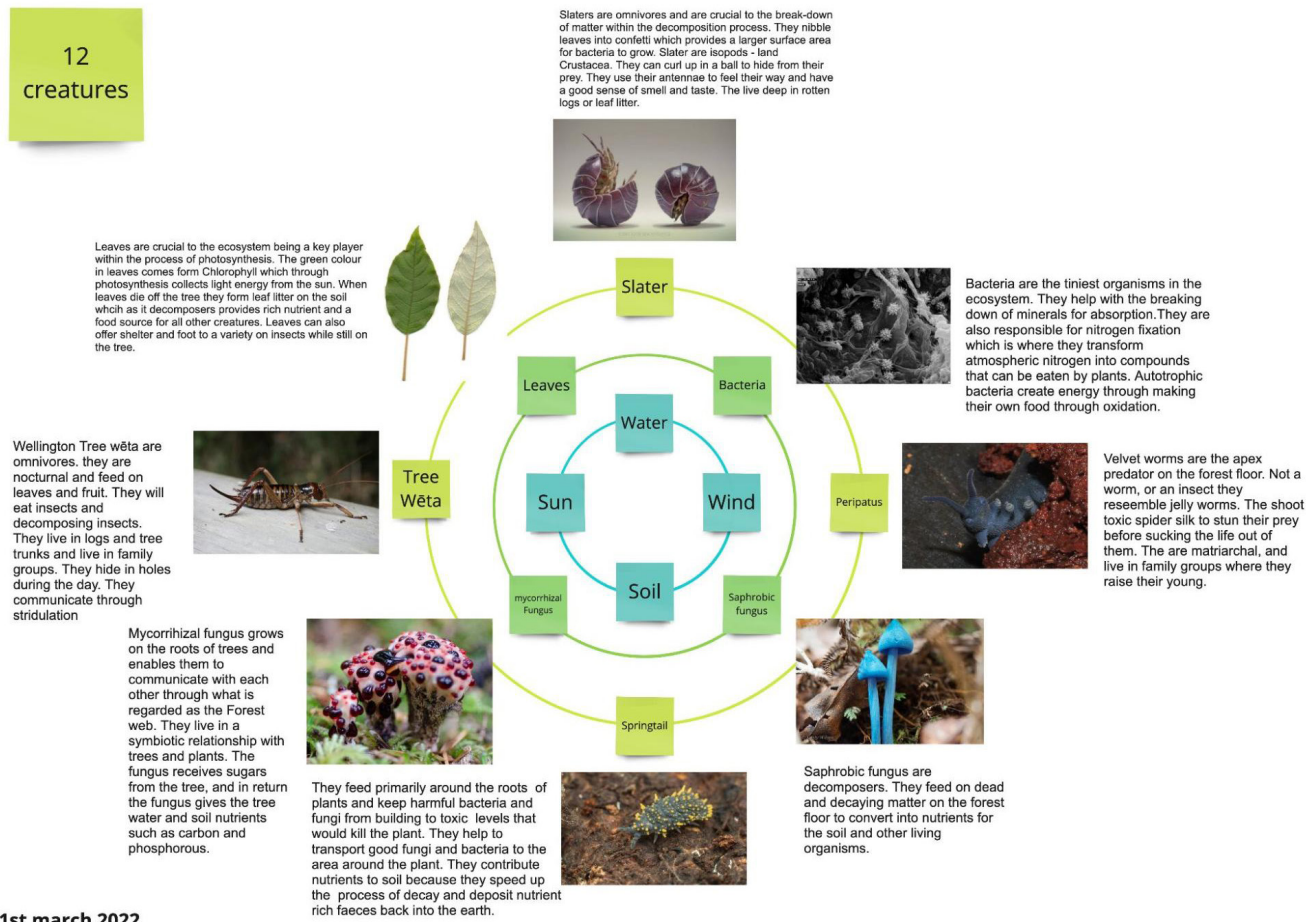
Concept mapping (Martin and Hanington 38) was used to develop visual “story worlds” of the environmental cycles, using representational images as stand-ins to explore further which characters would be most appropriate for each step within the cycle and how they might interact with each other. Text descriptions were used to introduce new concepts and connections. These drawings were used to understand how the toys would be or could be used within the natural environment during play.

Idea sketching and rendering was used to explore early iterations through to a resolved state to visualise the potential of the idea. Although the design shown in Figure 33 was not manifest in the final design, it helped to define and reflect on key attributes and to focus on and take forward those attributes within the design. The diagrammatic elements also helped define the level of interconnectedness required for the design and the potential for each toy to have multiple interlinked components representing its different stages.

3.4.3 Choice of character

A variety of analyses were conducted to define the design criteria and to focus on a key character species. Character toys are released in intervals over the span of a year and are known in the commercial toy design industry as toy quarters. These releases slowly build up the range. The first quarter is the lowest price point and is a single figure, the second quarter is usually double figures, or a figure and an accessory. The third quarter is a double figure pack, or a figure and larger accessory, and the fourth quarter is the largest product, often the playset, which coincides with the Christmas spend. Therefore, a core protagonist character was needed who could be appealing but had dimensions to their habits and could function within the ecosystem.

12 creatures



31st march 2022

Figure 34: Collation of potential insects and other abiotic entities used to aid character selection. Compiled by Tanya Marriott.

Similarly, most animated series have a key protagonist, a critical character that narrates the world and enables children to empathise. The key character needs to have a diverse relationship with other species and the ecosystem to yield opportunities for play mechanics. An ecosystem comprises a diverse array of species that enable the cyclic systems (e.g., water, carbon and nitrogen) to function. The organisms that inform

the character toy designs are representative of the ecosystem inhabitants. Additionally, they needed to have unique habits, aesthetic features or ecological functions that could help define play and make them potential toy characters.

This next section describes the process used to select the key toy character, the velvet worm.



Figure 35: A velvet worm (Peripatus/Ngāokeoke). Image by Andras Keszei, from <https://www.flickr.com/photos/nascentthought/5517509102/>, accessed 1 December 2023.

3.4.4 Defining the key character: Velvet Worm

Using the nitrogen cycle as a narrative frame, the research project looked at creatures that lived in the soil and decomposed wood to define a key character. In the 1980s, several successful licences had insects as their central characters, Glo-worms and Blinkins are two such examples. Insects fit the eco-fiction criteria

and are deeply involved in processing the natural cycles within the ecosystem. A selection of potential insects (and other abiotic entities) were collated to assess their ability to act as the key character (Fig. 34).

Peripatus/Ngāokeoke, commonly known as the velvet worm, was chosen to be the central character for the ecological world, the design of the story world and subsequent toys. Peripatus are a phylum in their own right, Onychophora (Gleeson), with their Māori name, Ngāokeoke, meaning “to crawl”. Although they are relatively unstudied, in a feature in New Zealand Geographic, Mark Bathurst suggests they “look like a subterranean soft toy, but a prowling peripatus is anything but cuddly”. Often referred to as the “missing link”, the velvet worm has the characteristics of both worms and insects.

Velvet worms are long and wormlike with multiple sets of legs and flexible bodies that enable them to rear up. They are brightly coloured and patterned, nocturnal, live in matriarchal family groups and are highly territorial and protective. They feed on unsuspecting insects by shooting sticky threads from their heads to stun and feed on their prey.

Peripatus are widely distributed throughout Aotearoa New Zealand, living in leaf litter, where they “play an important role in the overall functioning of the bush and a crucial role within both the carbon and nitrogen cycles as they need moisture to survive owing to their inability to control water loss” (Gleeson 51). They are susceptible to drowning in floods and desiccating in dry conditions, establishing the “flood narrative” foundation of the character world. Velvet worms have multiple legs, further exaggerating their alien quirkiness and making them a unique character option for The Underfoot toys.

3.4.5 Character design criteria

The eco-fiction criteria indicated that non-human elements were required to be a critical presence, so with this in mind, the project explored the defining features of existing animal toys to better understand how to design animal-centric toys. This was explored through a more comprehensive observation of existing animal toys and their playsets and an in-depth analysis

of several products from the initial toy shop review. These exercises aimed to define a character criterion set, which was used to develop design briefs for each character toy. A perceptual map analysis was conducted below of existing toys, mapping the relationship between human and animation and their respective ecosystems (Fig. 36).

The toy product colours were diverse, with bright colours favoured over a natural palette consistent with character licensed toys. Nevertheless, some interesting clusters emerged, including the prevalence of tree house toys, which placed animal characters in tree houses with human furniture and decorations. Several animal toys are defined as “pets” with the play value indicated as human collection and containment, such as FurReal (Hasbro, 2002) and Hatchimals (Spinmaster, 2016). A small subset of toys (see Fig. 36, top right) were animals in an animal world; these tended to be either horses, insects, or bears, with the My Little Pony licence still one of the only licences consistently demonstrating this. Bears, cats, dogs and rabbits are the most common animals for character licensed toys. Fantasy and wild animal characters included dinosaurs, monkeys, elephants, unicorns and dragons. Horses were one of the few characters represented standing on all four legs.

Most animal characters wore some form of clothing and hair accessories. Many animal toys are human-like, such as Peppa Pig and Sylvanian Families, in that they wear clothes and are bipedal. Bluey and the Care Bears do not wear clothes but live in toy versions of human houses. If an animal character was other than bipedal, it usually still had some form of clothing or human adornment: saddles, weapons or similar.



Figure 36: Human/animal ecosystem play perceptual map. Diagram by Tanya Marriott.

The most common environmentally focused animal toy ecosystem was a treehouse, as demonstrated in **Figure 37**, which generally had human-type furniture and accessories. These toys challenged an authentic ecological experience as their very design would actively encourage an anthropocentric narrative for play, with the human elements of furniture and decoration dominating the potential animal representation of the habitat.

Consequently, the project returned to nature cycles to help define the design criteria. One species does not make an ecosystem, just as one character does not make a toy range. The velvet worm is linked to species in the ecosystem as the apex predator within the trophic model; however, a more expansive cast of character toys was required to holistically map the play mechanics to match the systems within an ecosystem.



Figure 37: Examples of treehouses as an environmentally focused animal toy ecosystem. Image compiled by Tanya Marriott.



Figure 38: Initial trophic system diagram and the four levels of local garden creatures (both biotic and abiotic) used for the initial selection process of the final toy character designs. Diagram by Tanya Marriott.

In summary, based on this competitor product analysis, very few toys fit the eco-fiction toy criteria, with most toys demonstrating a greater influence of human-centric values than animal values.

Serendipitously, the four trophic levels also mapped out the four toy quarters that would exist within each range. Other characters were needed to be included in the world—abiotic characters, such as wind and rain,

as well as plant and fungus characters. The trophic level model was used to select characters within the velvet worm ecosystem that loosely represented the following four categories: predators, shredders, decomposers and photosynthesises.

A list of common insects found in a Wellington garden were then mapped into a trophic model. Insects, plants, fungi and abiotic systems were selected that possessed either unique attributes or shape for development (Fig. 38).



Figure 39: Mood board for character designs. Generated in Miro by Tanya Marriott.

3.5 Visual Mapping

Visual mapping is a method of design exploration used extensively within the concept design and product design of this creative practice. Visual mapping allows designers to “gather and test ideas” (Milton and Rodgers 12) through various formats, including mood boards, thematic and schematic sketching, mind maps, storyboarding and prototyping. These methods were used in the project to link the three core themes: character, story and ecology.



Figure 40: Total project planning. Generated in Miro by Tanya Marriott.

3.5.1 Mood boards

Mood boards are crucial to the design process as they provide visual cues to the diversity of references and influences for the design research. Having all visual stimuli on one canvas with relative visual hierarchies also prevented the research from privileging some influences over others, meaning the design exploration could result in unique iterations. A Miro virtual

3.5.3 Mind mapping

Mind mapping was extensively used to understand the systems at play within the design. Figure 44 shows an initial ecological system diagram that was used as a base. A variety of biotic and abiotic character options were mapped to look for potential “toy hubs”, which were organisms with multiple linkages. This is one method that was used to analyse the character options to decide which ones to develop into toys.

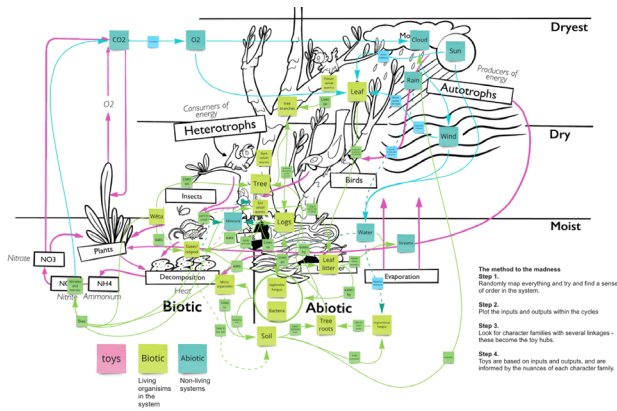


Figure 44: Diagrammatic sketch used to look for potential toy hubs. Diagram by Tanya Marriott.

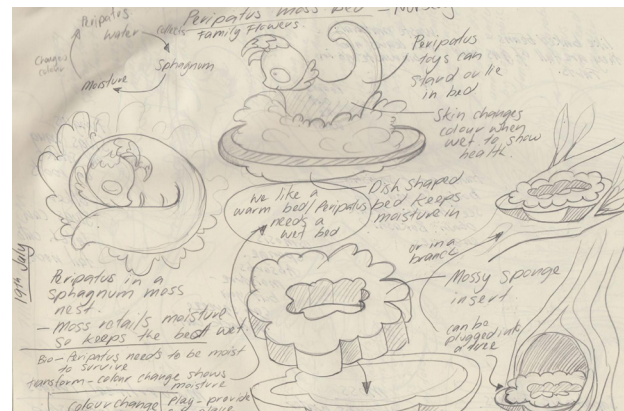


Figure 45: Drawn series of storyboard images forming a storyboard of the character and product. Drawing by Tanya Marriott.

3.5.4 Storyboarding

Storyboarding is often presented as a linear action defining a narrative evolution through sequential frames. Non-linear product development, such as location-based experience design and toy design, draws on non-linear modes of storyboarding. Sequential images or story beats were used to show the keyframes of interaction between the character and the product.

The drawings in Figure 45 display the velvet worm asleep in the bed, standing in the bed and where the bed can be placed in the environment. Rather than

show these designs as a series of products in use, the designs were sketched as the character inhabits the product, as this process helped to understand the story world of the character and the product itself. As the toy iterations were developed, character line-ups were drawn regularly to assess how the toys could work as an ecosystem and how each toy option related to the next toy within the range, as reflective practice embodied within the creative practice.

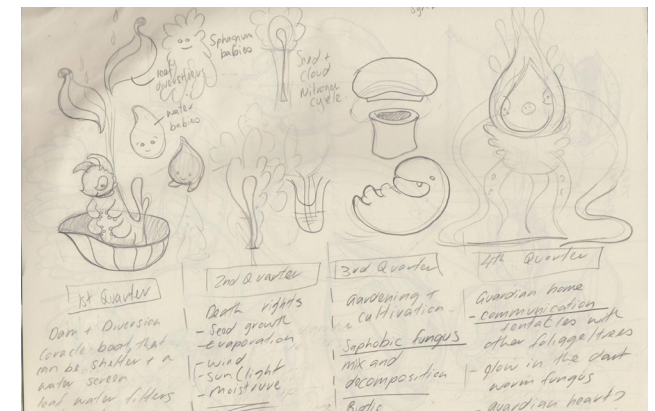


Figure 46: Drawn series of toy quarter options. Drawing by Tanya Marriott.

3.5.5 Prototyping

Physical modelling, sculpting and prototyping was used as part of the design process to work through ideas. These processes were generally used to develop an understanding of the design, to learn about interactive or functional features and as key milestones in the design process (Ulrich and Eppinger). The Underfoot toys are character licensed toys, so the design needed to be developed both as the tangible character toy and the story world that provides the character's narrative framing and emotive context. A visualisation of the world that this character may

inhabit within an animated series was required to understand how the different toy families may coexist and what tensions and challenges may exist between them and within their ecosystem.

Research began with sketches of the world, based on the ecosystem of the velvet worm (described in section 3.4.4), centering on a home tree at the bottom of the garden near a stream (Fig. 47). At this early stage



Figure 47: Initial design for the key scene of the world of The Underfoot. Drawing by Tanya Marriott.



Figure 48: Sketchbook with drawings of real-world plants found in my local neighbourhood that would exist in the physical playspace and be visualised in the digital version of the ecosystem. Drawings and photograph by Tanya Marriott.



Figure 49: Early example of the digital ecosystem diorama used as a narrative backdrop for toy design development. Modelled in Autodesk Maya, assets painted in Maxon Zbrush then rendered in Keyshot. Model and Render by Tanya Marriott.

of the project, the magical colours and shapes of the characters' environment could not be visualised, so a 3D diorama was developed to test these ideas. Using plants and trees drawn from real-world ecosystems (Fig. 48), a kit of digital assets in 3D software Autodesk Maya was developed to dress the diorama, much like a dolls house or a physical sketch model.

As the design research process progressed from “through design” to “as design”, the toy iterations of the model were tested for the appropriateness of the animated version of the world that was developed. The diorama evolved and was iterated numerous times throughout the project as a virtual environment was used as a framing tool for the designs. The digital 3D nature of the model meant the scale and composition could be adjusted with the digital camera to suit the view that was needed of the model (Fig. 49).

This method of design exploration proved invaluable for the project as it allowed continuous appraisal of the product through active modelling. As the research progressed, this diorama was used as the backdrop for the character renders within the pitch bible's world bible, and for all digital visualisations of the toy characters that were used to explain their story world to user groups and stakeholder communities (described in section 5.1).

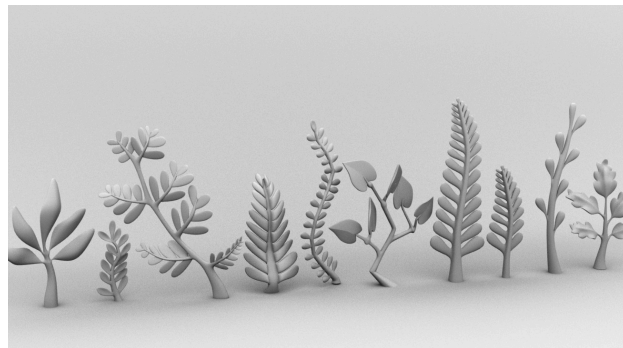


Figure 50: Examples of plants modelled in digital 3D for the diorama. Model by Tanya Marriott.

3.6 Story Development

3.6.1 Analysis of species habitats and relationships

Choosing species for characters was a continuously informed process due to the range of modelling, information and creative activity concurrent within the project. At the initial stages of the project, species were selected based on how they fit into the ecosystem trophic levels and a map of resources concerning their behaviours and unique traits was collected (Fig. 51).

The play and ecological cycle was then mapped to a character. Sometimes several characters had similar play mechanics, so it was a case of finding one that was nuanced to its role within the ecosystem. This was not a linear process, and many iterations were conducted to define the most appropriate characters (3.4.4 and 3.4.5).



Figure 51: Model for character toy design development and ideation. Diagram by Tanya Marriott.

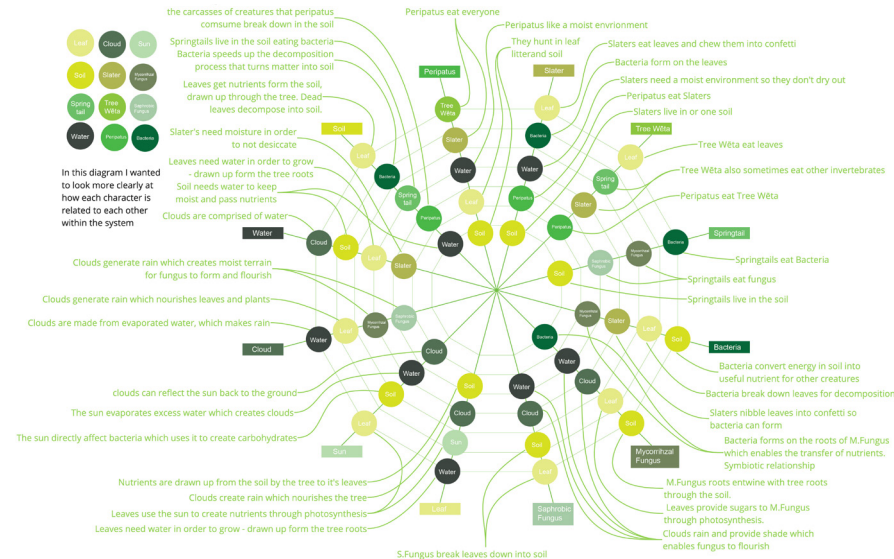


Figure 52: Visualisation showing initial analysis of twelve (12) organisms aligned by trophic systems that could be used as characters for toy design. Diagram by Tanya Marriott.

The next phase of the project was to look for an ecological phenomenon or process that was crucial to the ecological cycle. This was explored through the lens of play and the inputs and outputs of the ecological cycle were considered as they were adapted as play mechanics. For example, decomposition requires matter to be contained for the process to occur, so a play mechanic could be collecting and containing.

The last step was to use the ecological cycle, play mechanics and characters to define the story. These criteria then needed to be measured against each other for any design development. Figure 52 demonstrates how each criterion informed the next. The development of the story world also follows the process in Figure 52. This cyclic system ensures all design influences are equally weighted and developed to work together.

3.6.2 Developing the story world

Site studies of an ecosystem were collected to attune the project to the details of the space.¹⁷ Field studies were conducted to build an understanding of the natural ecosystem of play.

In February 2020, a field trip was conducted to Piano Flat in the Waikaia Forest in Southland, Aotearoa New Zealand. Clusters of velvet worms had been



Figure 53: Example of a character grey model photographed outdoors. Photo by Tanya Marriott.



Figure 54: Tanya looking for velvet worms in Piano Flat, Southland, just before the flood. Photo by Garry Buckley.

As noted in [Section 2.2.1](#), when playing outdoors, children need exposure to an environmental narrative so they can be empowered to make change as they struggle to comprehend the effects of climate change. Several toy designs were explored at this early stage, including play within forest streams. For this reason, a flooding and soil erosion narrative for The Underfoot characters felt appropriate for our current



Figure 55: Day three of the flood, waiting for the flood water on the main highway to recede. Photo by Tanya Marriott.

¹⁷ During my previous research work I have participated in various residencies on off-shore islands and wildlife reserves in New Zealand. This immersion method opens up opportunities to observe nuances in the ecosystem that are only evident through being present in the space.

¹⁸ The website (iNaturalist) allows scientists, citizens and interested parties to geotag photos of species into a worldwide mapped collection of flora and fauna. It allows users to discover what organisms are prevalent in their local community.

¹⁹ Game pillars are the core values within a game (or any media such as film or animation) that embody the core values and concepts of the product. They form the foundation principles of the entire game.

photographed and uploaded to iNaturalist in this location,¹⁸ so it was selected as an appealing site to observe velvet worms in the wild. In-the-field observation techniques were used to gather further understanding of the diversity of foliage and other organisms within the location (Fig. 53). The river rose several metres overnight, and a State of Emergency was declared for the entire Southland region (Yong and Armstrong; Todd). The extensive flooding which followed had a profound impact on the avenues for the toy designs (Fig. 54).

environmental challenges.

Game and animation design principles of world-building were applied to develop a cohesive world for the characters to inhabit. Three core pillars¹⁹ were established for the world:

- The characters live in a tree home.
- The character relationships between species can have tensions and challenges.
- The ecosystem is affected by flooding.

The world story evolved from here, but these three principles guided the iterative development of the

project. These three criteria are based on a need to ground the world in a believable reality. The creatures in this ecosystem are tiny, so they are all likely to live in a similar location. Having a tree home builds on the notion of the tree house but frames the narrative with ecological principles in mind. It makes it easier for children to engage in small world play as they can centre their play around the roots of a tree or a shrub. The notion of tension between character and species family groups living in proximity also reflects the need for ecological authenticity, but this also makes for interesting storytelling as different species work out how to coexist with each other, paralleling similar challenges in the human world.

3.7 Key Observations and Reflections from Sections 3.4 to 3.6

For the toy characters to best fit the eco-fiction criteria and demonstrate an animal worldview rather than an anthropogenic view, critical findings from this character exploration indicated the following.

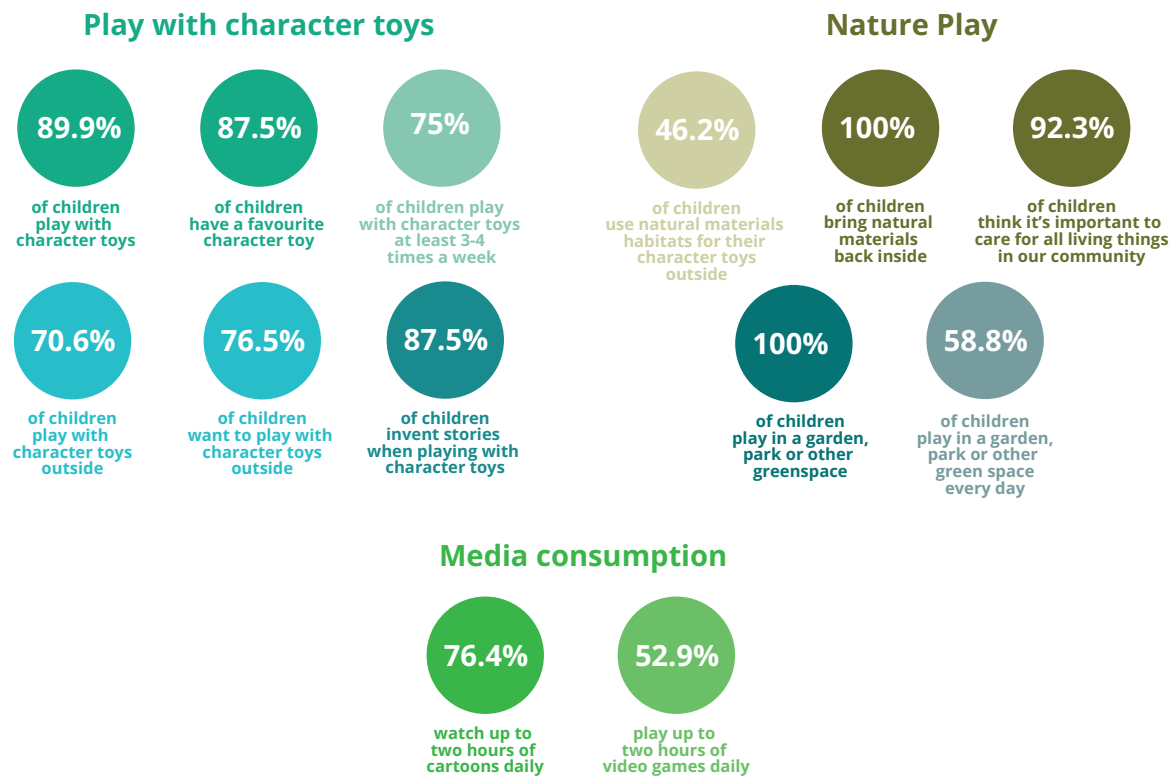
- The toy designs need to represent the diversity of the ecosystem, including biotic and abiotic characters. Hence, the toy set has representation beyond animals. Using more diverse characters will also encourage children to relate and play with ecosystem elements as a “whole” and not just popular species.
- As the toys are designed for play in the soil, the nitrogen decomposition cycle and transformation into nutrients provide a diverse engagement system for the toy range.
- Consideration must be given to including a diverse set of characters within the range, as discussed in section 3.4.5 on character design criteria.
- The velvet worm should be used as the key character, partly due to its role as an apex predator within the trophic level and partly for its uniqueness as a potential character.
- The toys should not be bipedal and wear clothing as this mimics human embodiment and instead is a missed opportunity to engage children in animal attributes.
- The toys cannot be pets or encourage humans to contain them within the play.
- If the character playset is a “treehouse”, it needs to mimic animal world conditions rather than place the animal doll in a human world scenario.
- The meta-story for the character world is a flood narrative that parallels real-world scenarios that children currently witness, enabling them to potentially use the toys to form resilience around these climate-related themes.
- The characters chosen for the toys will be different species that may not cohabitate harmoniously; this also mirrors the ecological world where species compete for resources and all face similar environmental meta challenges.

3.8 Ethics, Questionnaire and Interview Results

3.8.1 Ethics

Three ethics applications were lodged and approved for different aspects of the project.

1. Full ethics application: Playtesting and focus-group work with children.
2. Low-risk ethics application: Parent feedback interview.
3. Low-risk ethics application: Industry toy designer interview.



Full details of the ethics applications are in [Appendix 1](#). The toy design questionnaire is in [Appendix 2](#), and the playtesting transcripts are in [Appendix 4](#).

3.8.2 Questionnaire and Interviews

Results from the toy design questionnaire

An online survey was conducted with children aged five to seven and their guardians to gather Aotearoa New Zealand-specific data about character licensed toy play outdoors. The results are summarised in [Figure 56](#). The children surveyed used stories embodied within their character toys as a starting point and then diversified the narrative form based on their personal experiences and interests.

Some of the stories were interesting, creative and engaging. These were some of their comments:

“When Pinky Pie was drinking her milk from her bottle, she found something hard. She opened up the bottle and found a diamond. She took the diamond out and put it on her lab table.”

“I have three stormtroopers, and I like to pretend they are a family doing fun things together.”

“I made up a game called Cars, and Elsa was riding the cars, and she was fixing the cars.” (Appendix 2)

Results from the screening questionnaire indicate 89.9% of children surveyed played with character toys. All (100%) of the surveyed children played outside, but only 70.6% played with their character toys outside. This means almost 20% of surveyed children don't play with their character toys outside when they could. Children take their character toys outside to

Figure 56: Results from the Wildplay questionnaire conducted by Tanya Marriott. Visualisation by Tanya Marriott.

play, demonstrating the potential for more purpose-designed character toys designed for outdoor play to enhance this play mode. The surveyed children were asked where their play ideas came from. The responses included from

“the toys themselves”, “the TV shows”, “watching them on TV”, “the movies and episodes” and “I make it up in my head”.

Of the children surveyed, 76.4% watch at least two hours of cartoons a day, 52% play two hours of games daily and their media consumption appears to influence the narratives they play with their toys. Of the surveyed children, 46% made homes outside for their toys and used items such as “twigs, bamboo sticks, leaves, grass, flowers, moss” and 92.3% of children think caring for all living things in the community is important.

The questionnaire respondent group was small but provided rich qualitative data on Aotearoa New Zealand children’s character toy play patterns and their desire for more engagement in natural spaces (Appendix 2). Children want to play outside, and many participants played outside in structured and unstructured activities. Changing character toys to make them more outdoor-focused could increase opportunities for further and sustained outdoor play, especially when toy play is combined intrinsically with playing with natural materials.

Results from the toy industry interviews

Toy industry interviews were conducted with three freelance toy designers, all currently working freelance with experience in designing character licensed toys ranging from twenty to thirty-plus years.

This experience came from work at various companies, including Hasbro, Mattel, Spinmaster and others, both in the UK and USA. The experts were as follows:

- Expert 1 (Matthew*): Toy designer and inventor UK (30+ years)
- Expert 2 (Michael*): Toy designer and mechanistic and inventor UK (20–25 years)
- Expert 3 (Sue*): Toy designer USA (20+ years)

The industry experts all agreed there was a clear need for environmentally focused toys and felt that this was an excellent way to teach children about how nature works. They all described positive memories of childhood playing with their character toys outside. What made a toy ecological was a system of toys using biomaterials and natural materials and a nature-focused narrative to teach children how to do things differently. They felt an eco-fiction toy needed to be an animal or creature-based toy that was ecologically driven throughout the story. They all agreed that dolls and action figures are not currently designed for outdoor play. Although the industry has explored this option, it has yet to do so through dolls and action figures, with the key challenge being an inconsistency in natural play spaces for children.

Only one industry expert had worked on designs for outdoor play with dolls and action figures, but this was a very recent project and a very new experience, and they felt that the designer needed to design appropriately for the context of play.

²⁰ Respondents’ names have been changed to retain anonymity and to protect the respondents’ privacy.

They all felt the challenges toy designers face in designing environmentally focused doll and action figure toys were about cost, especially with eco-friendly materials, but also risk, as this type of toy would not fit the known models for doll and action figure design. They felt innovation in these areas would come from smaller innovators rather than the large toy companies as they may be more open to risk. When asked what features they would prioritise if designing a new doll or action figure for outdoor environmental play, they referenced play mechanics, such as secret hiding places, as well as animal behaviours, scale and story.

The ability to narrate the product would be key to how they could build excitement and interest around it.

3.9 Suggested Design Criteria

As a result of the initial exploration into the design of eco-fiction toys, the following criteria was considered in phase two of the project.

- The toy range needs to be an ecosystem.
- The toys need to be designed as a 4-quarter toy range to demonstrate multiple price points and levels of complexity.
- The toys need to function best when played with outdoors.
- Natural materials need to be incorporated into the toy play.
- The toys should have appealing and empathetic character shapes.
- Each toy needs to contribute to and further the natural cycle.
- Toys should be easily carried to and from the play space.
- The toy world stories should be believable and relatable.
- Toys should be made from renewable or eco-materials.
- Toy aesthetics could be influenced by designer toys, as they have a higher perception of value and already use shapes and character inspiration that works well in nature.
- The toys need to encourage environment play.
- The toys need to encourage a basic understanding of ecosystem/ecology or natural cycles.
- The toys are responsive to the eco-fiction toy framework.
- The velvet worm is the key character, but other characters are needed to create an ecosystem of play.
- The meta-narrative for the story world of the toys is a flood narrative. Characters live in a home tree, and the stories focus on how the creatures co-exist.

4. Design: Research as Design

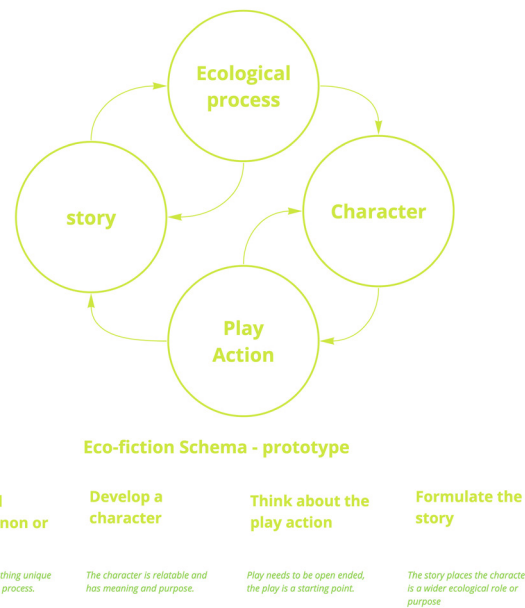


Figure 57: Prototype for the eco-fiction schema for the interrelationship of relevant first principles. Diagram by Tanya Marriott.

This section documents the creative practice activities used to develop The Underfoot range of character toys. A broad range of processes, techniques and tools were used to provide the foundation for research as design. Each process has a particular purpose or objective to build the design coherence and understanding of the design. The design methodology used in this research is a hybrid between the methodological models offered by Cross and Frayling, as described in Section 3.0, to develop the design from relevant first principles to a solution concept. This research produced a speculative design concept to discuss eco-fiction toy design as a new genre within the context of the commercial toy industry. As this research project focused on character licence toys, the research also explores story and world development for an animated children's television series through a pitch bible.

Toy design is interdisciplinary and crosses boundaries between product design, concept and entertainment design, storytelling and play. The above hybrid methodology was used to maintain agility across and between these design disciplines. It enabled the design process to move circularly with strategic points for critical reflection and adaptation. As the five (5) toy products for The Underfoot toy range were designed concurrently with the development of the story world, this model enabled the design to embody the eco-fiction criteria across all aspects, including product, environment, narrative, play and character development required for authentic engagement with the toy.

4.1 Concept Framework

In this section, the relevant first principles within the toy design are defined and measured against the concept framework with the eco-fiction criteria.

4.1.1 Relevant first principles:

Defining the character toy design criteria

This phase is about establishing the design challenge with clarity and simplicity and defining the toy product design criteria. The problem frame defines the need to explore character toy play in nature. From this, relevant first principles were defined as a system intersection between ecology, story and play, as this is where the toy innovation lies and what this research defines as the identifying factor for an eco-fiction toy design. Character is the modality with which the product is defined. Figure 57 shows the system relationship between the design elements that define the first principles.

When designing each toy in the range, the ecological process (**nitrogen cycle**) was examined, and an organism from that system (**biotic or abiotic**) was chosen. This organism was then developed into a character, interpreting elements from the ecological system as character characteristics. Once the character is fleshed out more, attributes are explored as play actions; thus, there is a direct link between the ecological system and play action. The last step is to narrativise the character, play action and ecological process to develop the story for the character and how they fit in the toy world.

There is a point in the process where a value judgement was made: the product met the criteria. As the toys were developed concurrently, some toys were keystones for the other toys to be measured against.

During this part of the design process, an environment was generated where emerging patterns and a sense of structure and interrelationship between each toy design were seen in the designs. Working on multiple products and measuring them against each other helps to see and resolve any irregularities or anomalies that do not work within the system.

At this stage of the design process, all ideas are good ideas. A toy company would define this as a “new ideas” development, where any idea is tested for viability. The brainstorming process included “wild ideas and visual iteration”, documented in sketchbooks for later consideration and structuring while remaining in the framework and staying on topic. These activities of structured ideation were balanced with ideas generated in isolation when the “brain is problem-solving in the background”. During this stage, the character toys to be designed were chosen. Initially, three toy ranges with twelve characters were planned, but this was scaled back to one toy range as a proof of concept with an extra character from range two.

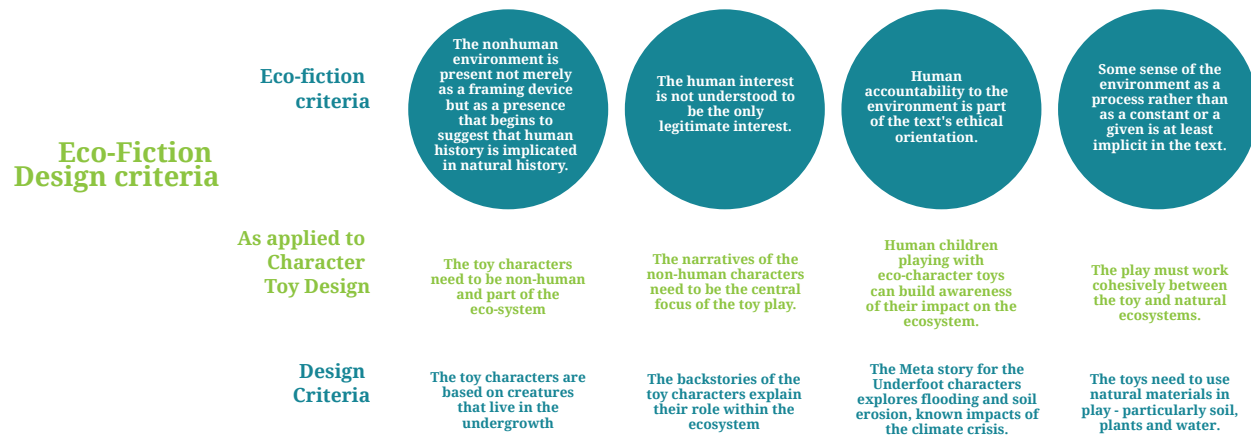


Figure 58: Eco-fiction design criteria for character toy design. Diagram by Tanya Marriott.

4.1.2 Eco-fiction character toy schema

The eco-fiction schema was used concurrently to work through the first principles (Fig. 58), as this guides the pillars of fundamental design criteria of The Underfoot toy range. This is related to the broader aspects that interrelate each of the five toys in the range, and how the parts of the toy products' story, toy, packaging and informational pamphlets fit together. The eco-fiction criteria also measured the design's animalness and a holistic integration between toy and natural materials during play outdoors.

Figure 59 demonstrates a sample of each character's mini-brief / story moments. These mini briefs were used as a shorthand to map character interrelationships and expanded to include play and toy characteristics criteria. Once the framework for each toy design brief was formed, Trello's (Atlassian) Kanban system (on which see Hoogerwerf) was used to document the design development process, (see Fig. 60). This offered the ability to visually measure and compare aspects of each toy brief in discrete chunks as they developed to ensure that the ecological system remained consistent across the range.

4.1.3 Eco-fiction toy pitch bible

The story world was developed alongside the toy range. The story world defines the identity of the character range and is part of the character licence. The characters' story world can be adapted to fit different media, including toys. The story world was developed as an animated TV series in the form of a pitch bible. In the framework of elements needed to design for any character licence, the pitch bible is a predominantly visual document summarising the story's core agenda, key characters, environments, antagonists and some

episode treatments. It is a tool commonly used by concept designers when they are seeking funding for a media licence they have developed and it serves as a talking point, guide of reference and marketing tool for the world ([Sprinkles on Top](#)). Short story treatments were written, and the characters were illustrated to define them more deeply. All of this content was then packaged in the pitch bible. As the final toy characters were digitally designed, the 3D assets were also used in the digital 3D terrarium, which was used to create each scene for the pitch bible.

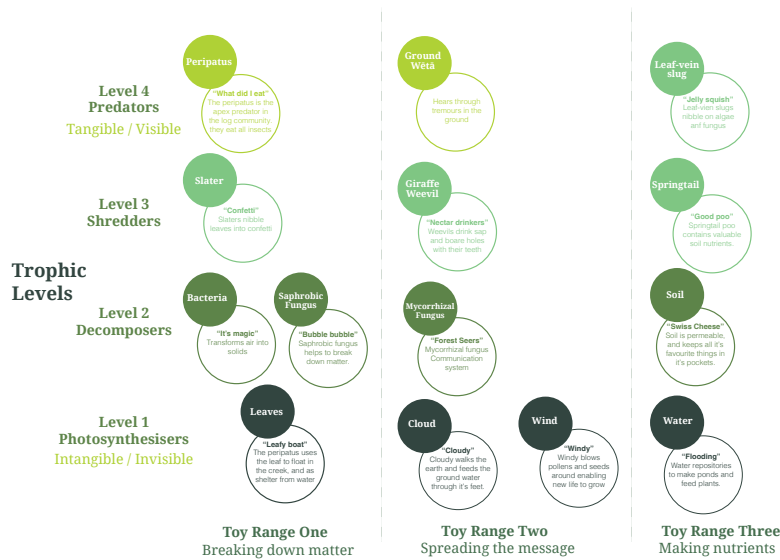


Figure 59: Trophic system diagram with potential toy characters, both biotic and abiotic. Diagram by Tanya Marriott.

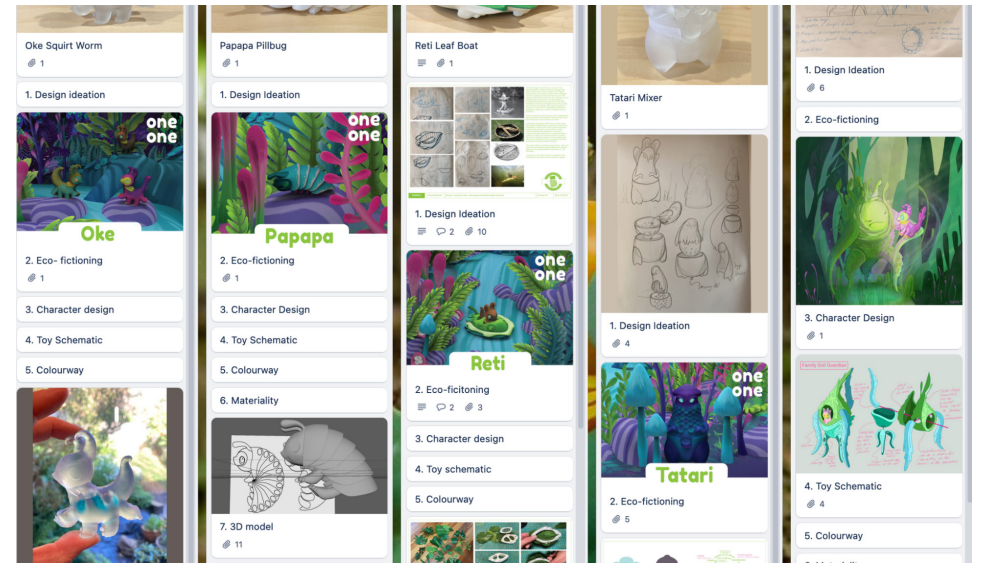


Figure 60: Screenshot showing the Trello Kanban system used to keep track of the toy briefs and ensure consistency across the design. Image by Tanya Marriott.

4.2 Design Development

4.2.1 Developing toy briefs: The industry requirement

The toy design process begins with defining a design brief. This is a working guide that evolves as needed across the project. As a range of toys was developed, each brief was lined up so the other briefs could be

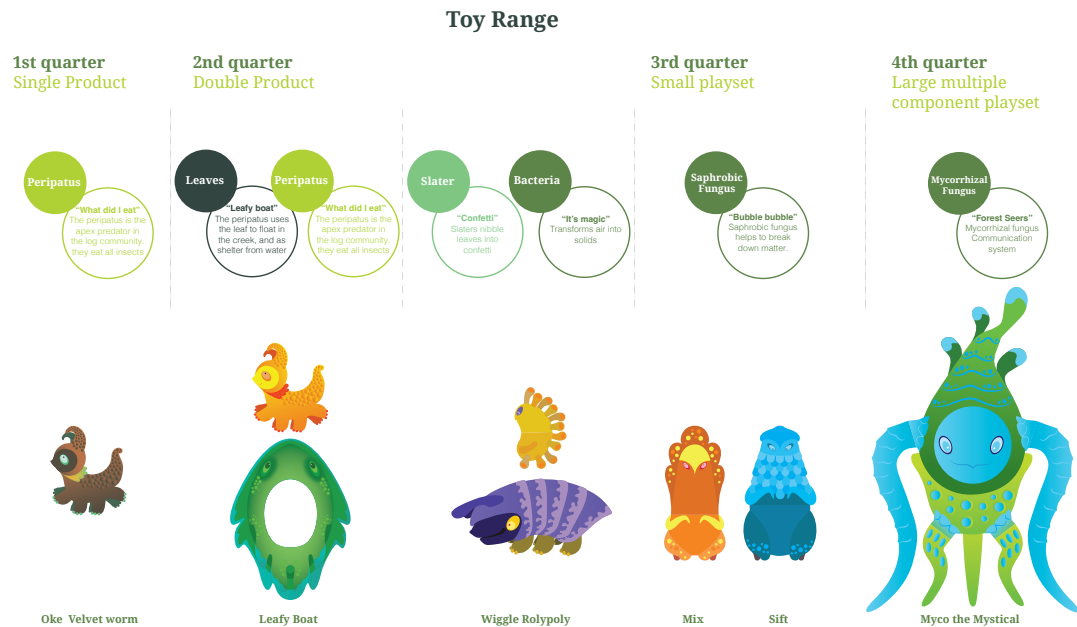


Figure 61: Lineup of the toy range quarters. Diagram by Tanya Marriott.

²¹ A toy skew is a toy variation. Often using the same sculpted mould, multiple character options are created through different spray-ops.

²² A spray-op is a term for the individual layers of paint that make up the details on the toy. Now, they are often produced as stickers, but traditionally colour was applied layer by layer, using a mask and spraying each colour individually.

²³ A key character is the lead character, or hero character in the range. Often this is not apparent in the toy range, but in the supporting media licences where this would be the main protagonist in an animation, or main playable character in a game.

tweaked to match if any other brief needed changing. A toy range must include at least four (4) products to make up the four toy quarters from the lowest to the highest price point. The price points are reasonably standard across the industry and internationally, with the lowest price point at about twelve to fifteen New Zealand dollars and the highest for the most significant product (usually the Christmas playset) at about one hundred New Zealand dollars. From personal industry

experience, designers develop products from the dimensions of the final packaging, toy quarter and a point of sale price point. It also helped to draw out the toy concepts as quarters to see whether the designs worked in the range, as shown in Figure 61. The colour code in each circle is as follows: green is for predator, teal is for shredder, dark green is for decomposer, and black is for photosynthesiser. The designs below correspond to the five final character designs.

Five (5) products were developed as the project progressed, with two options for the second quarter. Starting with the trophic range, some tweaks were made to the level of complexity of each toy to ensure that they fit into the Toy Quarter product model within the toy industry, as some designs would end up more significant in size or more complicated than others. Many design variations were developed, especially in the second quarter space, most of which did not make the final cut.

The velvet worm character is the first quarter toy. First-quarter toys are produced in different variations called skews.²¹ These use the same sculpt but with varied spray-ops²² to manage production costs. An excellent example of this is Moose Toys' the *Magic Mixies Mixlings* (2022–), which enable the option of collectability and allow children to understand the key characters through either multiple versions or multiple related character species.²³

The second quarter toy is usually a double product. For The Underfoot range, there are two designs in this category, the slater and bacteria, which looks to break down matter, and the Velvet Worm and Leafy Boat, which explores the need for leaves to fall from trees. The third quarter is a small playset, or a more expansive double figure with more play actions.

For The Underfoot toy range, this is a saprobic fungus-inspired duo Mix and Sift that acts as a set of characters that mix and mulch matter. The fourth quarter toy is a sizeable multiple-component playset. For this quarter, a mycorrhizal fungus character was chosen, Myco, a complex organism that communicates nutrients between trees. The mycorrhizal fungus character was a late addition to the line-up and was added as it was felt the saprobic fungus duo were not

to weave a narrative that connects the characters as believable entities and tangentially explores the nitrogen cycle. Much of the character development at this stage was through writing story beats for each character and drawing character visuals from written cues. Naming characters made it easier to embody them with personality during design. The final characters are as follows.

Peripatus: Oke
 Slater and bacteria: Rolypoly and Tily
 The leaf boat: Leafy Boat
 Saprobic fungus: Mix and Sift
 Mycorrhizal fungus: Myco the Mystical

The text below is an example of the narrative of the world with one of the finished images of the characters from the pitch bible. This process complemented drawing and writing to resolve the story world. Defined by world pillars, which form the core values within the product, short narratives for each character were developed; these link the characters to each other and the ecosystem. Here is an early treatment of the Meta-narrative for the world of The Underfoot.

“At the bottom of the garden, the home tree stands on the stream’s banks. This is the magical home of the Underfoot, guardians of the forest floor, they help to keep everything in balance. Mix and Sift sing stories to the tree roots to help them find water, Oke is always on the hunt for a tasty meal when they are not riding the stream waves with their mate leafy. Rolypoly lives with their extended family at the bottom of an old log alongside Tily and their family. But the stream water has been rising and flooding the garden. The trees are starting to worry, something is coming that could change their way of life forever unless Oke and their friends can save their home and everything in it.”

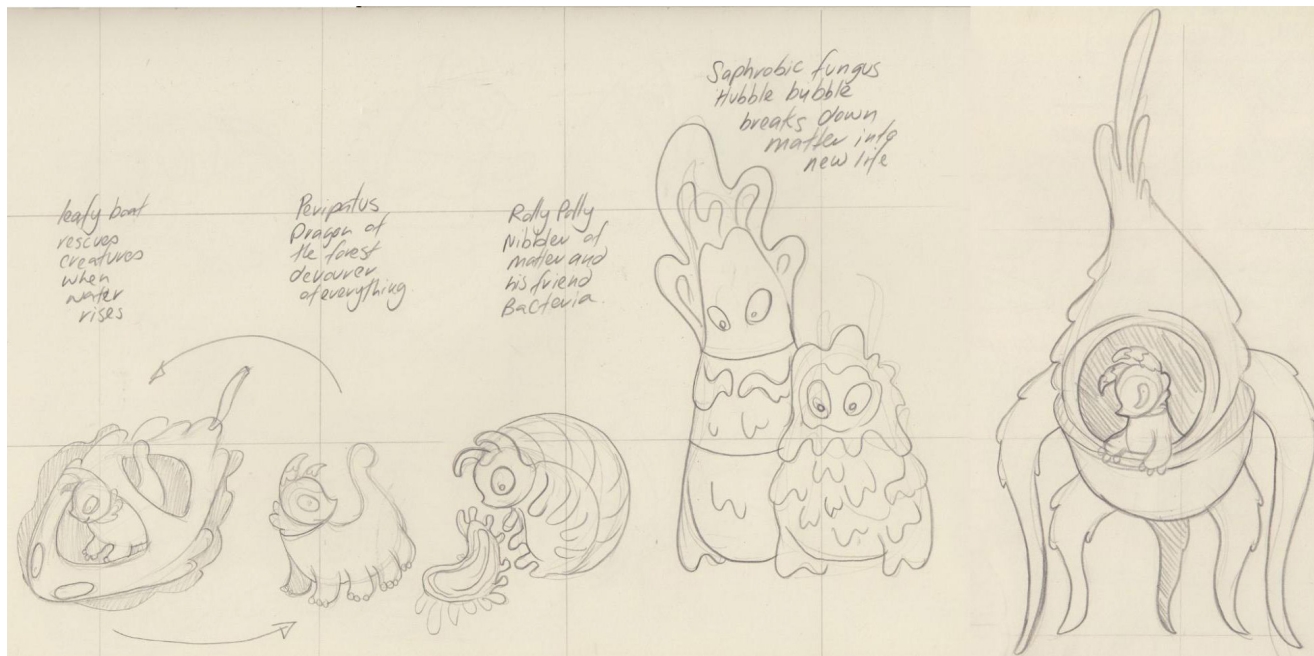


Figure 62: Compilation drawing of the final lineup of the toy range quarters. Drawing by Tanya Marriott.

extensive enough to be considered a fourth-quarter toy. The toy line-up was re-aligned with the new fourth-quarter toy (Fig. 62), and two second-quarter toys were retained to give the range enough design scope and as an appropriate reflection of an ecosystem of products.

4.2.2 Story and worldbuilding

The story world is embodied in the toy, packaging, story snippet and character artwork. Care was taken

²⁴ Tily is named after *Bacillus subtilis*, a common bacteria found in soil.

The short story snippets for each character defined their personality and characteristics and matched their interactions within the ecosystem with potential play mechanics for the toys. Figure 63 contains the earliest story for Leafy Boat.

Illustrations and 3D renders helped to visualise the world of The Underfoot toys. As each character and subsequent toy design was finished, the digital 3D model of the toy was used within the digital 3D terrarium to stage the key scenes for the pitch bible.

In the final text in the pitch bible and back cards, the narrative for Oke was simplified as follows:

“Oke is a risktaker! He’s a nutrient courier and zips

Some characters were developed far quicker than others and needed less iterative development of the narrative to get them to work within the ecological theme. One

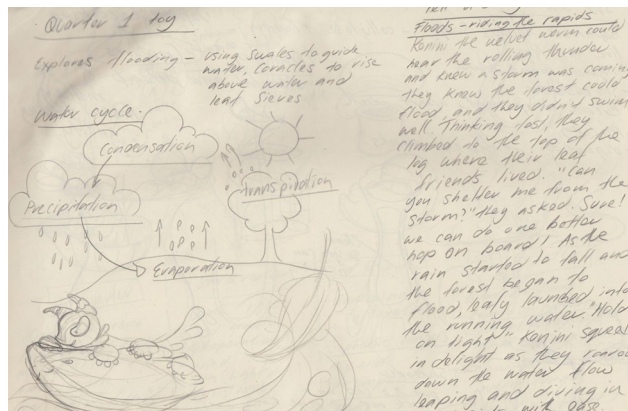


Figure 63: First story for Oke Velvet Worm and Leafy Boat. Drawing by Tanya Marriott.

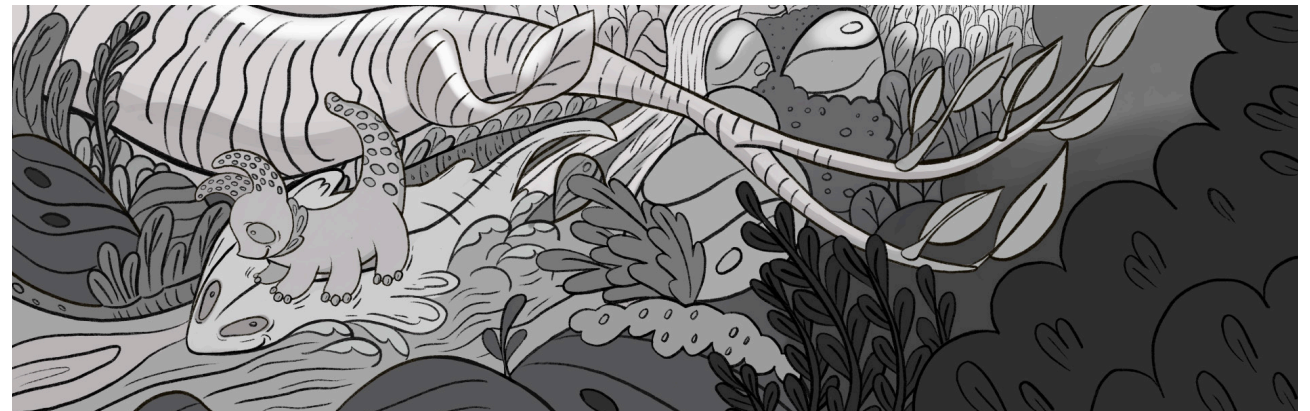


Figure 64: Iterative development of story world narratives and development of individual character stories and bios. Drawing by Tanya Marriott.

around the valley floor with their friend Leafy, delivering everything the ecosystem needs. Oke is curious about what lies beyond the Underfoot. Oke is brave and risky, which can get them into trouble”.

And for Leafy Boat

“Leafy is one of the leafy creatures that live in the sister trees, Leafys seek adventure, and when the Sister trees are napping, they jump from the home tree to ride the waves within the stream. It was on one of these trips that Leafy met Oke. They both share the same excitement for adventure and exploring their homes’ outer limits”.

specific challenge was with Oke Velvet Worm. As an apex predator, Oke hunts all other species within the ecosystem. Rather than gloss over this characteristic, it was turned into a feature that they were a brave risk taker, and the other characters had to work out how to distract them when Oke was hungry. To further explain a character relationship, in the story world, Oke had a nibble of Rolypoly and decided they were not so tasty to eat, so they became friends instead.

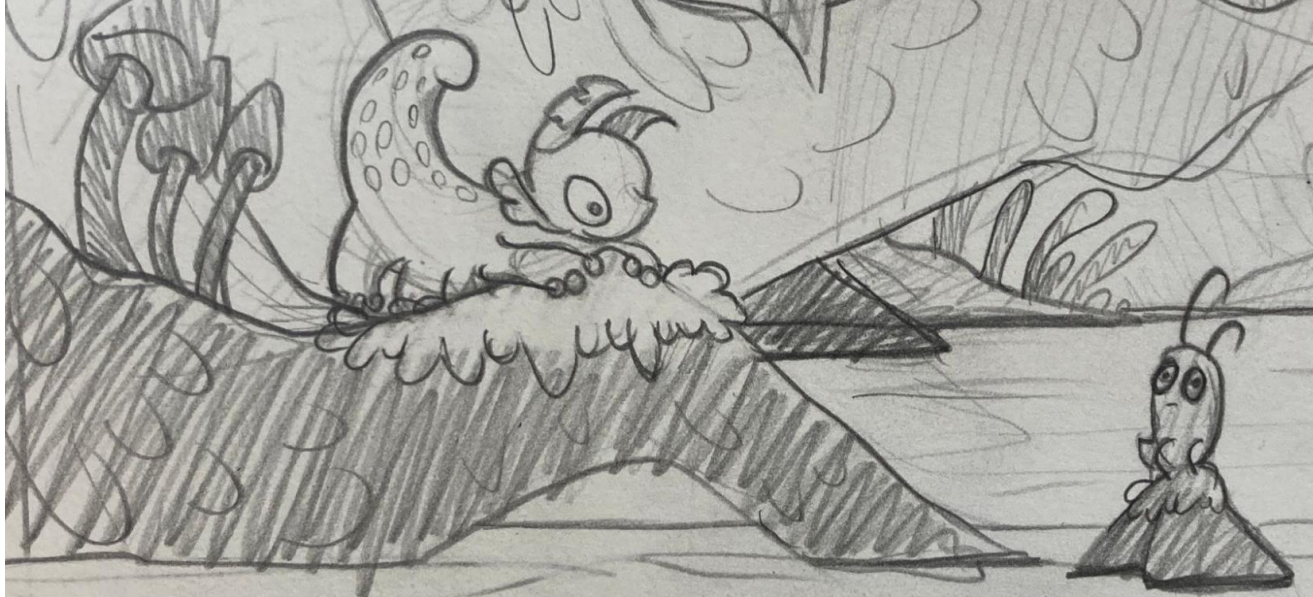


Figure 65: Drawing showing character persona development for Velvet Worm. Drawing by Tanya Marriott.



Figure 66: Final key scene in the pitch bible of Oke Velvet Worm. Render by Tanya Marriott.

4.2.3 Toy scale

The overall size of the toy was another area explored at length. Character dolls and action figures come in various scales, and although there were standard sizes for action figures and fashion dolls, this has evolved over the years to be a scale-by-product model (Fig. 67), rather than a universal scale for playthings. In the toy industry, toy sizes are indicated in all marketing in inches, even in countries using the metric

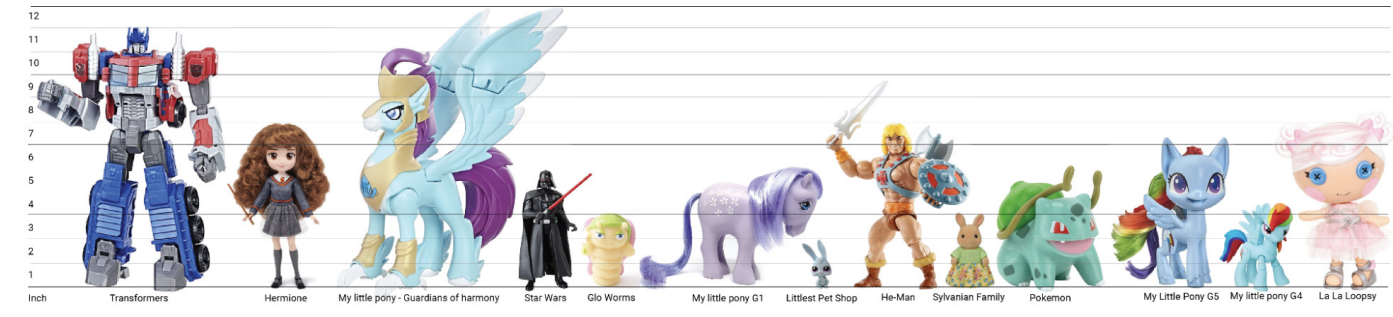


Figure 67: Standard character licensed toy scales. Diagram by Tanya Marriott.



Figure 68: Velvet Worm scale line-up. Photo by Tanya Marriott.

system, like Aotearoa New Zealand. An appropriate size for Velvet Worm was established first, as the size of all other toys scaled from this key character. Velvet Worm needed to fit comfortably in a child's hand but also be of the correct scale for play with leaves and other natural materials where size might be a factor.



Figure 69: A Rangiora (*Brachyglottis repanda*) leaf with hand for scale. The leaf is approximately 140 mm long. Photo by Tanya Marriott.



Figure 70: Scale experiments with the Mycorrhizal Fungus models; shown with the final Velvet Worm scale. Photo by Tanya Marriott.

The first velvet worm was much larger, at 4.2 inches (106 mm). Experiments were conducted with a miniature size (70), similar to Polly Pocket, when working on the Mycorrhizal Fungus toy. The Rangiora leaf (Fig. 69) used in the leafy boat was the final decider for the scale of the entire Underfoot product range. The final Velvet Worm is 3 inches (76.2 mm), and all other characters are scaled to relative sizes. This size range made the toys small enough to be portable and large enough not to go missing outdoors.

4.2.4 Recommendations for design criteria

- There needed to be at least four to five toy characters to ensure The Underfoot toy range would demonstrate an ecosystem, and to provide a standard number of toys for a range. The trophic levels provided a useful guide to help define a spread of characters to take into development.
- The toys needed to be linked through a cyclic ecological narrative; writing short narratives about the designs as they were designed helped to develop the character and play mechanics.
- The characters needed to have a unique and appealing shape that is reflective of the natural occurrences within the ecological cycle they represent.
- The characters needed to represent the diversity of the ecosystem from apex predator to nurturing guardian to enable a wide opportunity for modes of imaginative play to occur.

4.3 Prototyping

Through ideation and prototyping, the design criteria was refined and measured against the eco-fiction criteria and relevant first principles. Through this phase, the story for the pitch bible and the five (5) toy designs were prototyped concurrently to ensure all products are cohesive.



Figure 71: Gestural narrative-focused sketch of the characters Mix and Sift for the pitch bible. Drawing by Tanya Marriott.



Figure 72: Digital schematic and breakdown of the Mix and Sift toys. Generated in Adobe Illustrator by Tanya Marriott.

4.3.1 Prototyping through sketching and digital schematic drawing

The character designs for the Underfoot toys were iterated through physical sketching and digital schematic drawing (Fig. 71 and 72). The initial physical sketches are rough and gestural. A pencil was used to generate the designs as it gives reasonable control and gestural motion over the linework before refining and shape iteration drawings were undertaken in Adobe Illustrator. Because the designs are based on a character licence, they have an additional translation mode. The pencil drawings are often very characterised and narrative-focused. In this drawing phase, the design is considered from an animation or game perspective to synthesise the story behind the characters and the things they interact with.

The next set of drawings were more toy-like, with elements sectioned off, such as arms or legs that would be made from a different material or tool. At this stage, part lines for components that clip together are considered. Sketching on location or using natural materials like leaves, sticks and moss back in the studio for reference and inspiration aided in maintaining an authentic eco-fiction-focused design process. All designs were worked on simultaneously so they would evolve together and remain consistent aesthetically in their ecological story and play mechanics.

²⁵ I think this is why many designers use “pencil” brushes when roughing up designs digitally, as they still need a fast ideation tool to get the idea down first, regardless of whether it is physical or digital.

²⁶ I work this way probably due to my foundational design strengths in sculpture. I always design with the view that the final object will be three-dimensional. However, this additional employment of narrative drawing at the beginning helps me achieve more movement and dynamism within the character and think about how it would move if it were a real animated creature.

4.3.2 Prototype modelling

Cardboard models are used extensively in the early design prototyping process to test for play, as the models can easily be adjusted as the design is iterated. At this stage, neither the drawing nor the cardboard model was the defined design; both evolved in a symbiotic design process. The cardboard prototypes needed to house and break down leaves, sort soil and

toys would integrate natural materials to “activate” the toy. Photographs of the cardboard models were taken, which were then drawn over to continue evolving the design. The cardboard prototype explores play-ability, the overall shape and object composition. This was not necessarily an aesthetic model, although some defining shapes were established at this stage.



Figure 73: Cycle of prototypes for the Leafy Boat character, showing design development and integration through iterative design testing/trialling cycles. Rangiora leaves at centre, then clockwise from top left: cardboard model, quick 3D print, cardboard models with Rangiora leaves, resolved 3D print models with Rangiora leaves. Prototypes and photo by Tanya Marriott.



Figure 74: Testing the prototypes outdoors in natural spaces (left, leaf litter; right, trees). Photos by Tanya Marriott.

grow matter, so they needed to be robust enough to test outside. **Figure 73** shows an early prototype development for Leafy Boat. Leaves were incorporated into the prototype process to link the design directly with using natural materials in play. The leafy boat toy is representative of photosynthesis within the nitrogen cycle. It uses an actual leaf to transform the shape into a boat, making the natural material a core component of this design. This toy design defined how the other

During the prototyping stage, there is an element of play where the products are taken outside to stage them in play and explore how the designs would be used in a natural environment (**Fig. 74**). Prototyping both indoors and outdoors enabled the final context of outdoor play to stay at the forefront of the design process. When the cardboard prototype functioned as a toy and met the brief, the design process moved into digital 3D modelling.

4.3.3 Cyclic design

As The Underfoot toy range was developed, the toy design system was reflected on to consider how they work cohesively at every step. The Underfoot toys are based on the systems in the nitrogen cycle, so the toys are all linked through a breakdown and transformation play narrative. When placed in a moist environment, the Velvet Worm changes colour, Leafy Boat becomes a boat when a Rangiora (or similar-sized) leaf is used. The Rolypoly character nibbles the leaf into confetti when it becomes too damaged to float. The leaf is the transformational element within the toy range, enabling each toy to follow the nitrogen cycle.

The leaf is also a metaphor within the story world narrative for natural disaster and transformation. One of the core story themes for the characters is flooding. Centennial Park was visited numerous times as part of the research to observe the ecosystem change through the seasons. One of the fundamental changes was due to leaves falling and blocking the creek, causing it to flood or change course. Nearly all of Aotearoa New Zealand's native trees are evergreen, so they do not drop their leaves in a regular cycle, but leaves are shed when the tree is under strain due to storms and turbulent weather patterns. The creek was consistently blocked with leaves, making the water's flow difficult (Fig. 75).



Figure 75: Test of Leafy Boat in the creek in Centennial Park, Maupuia, Wellington. Photo by Tanya Marriott.

4.3.4 Digital drafting

When the prototype model achieved functional play mechanics, a digital drafting process within Adobe Illustrator was used to detail the toys' overall aesthetic shape and colour. The toys were developed in a line-up to compare shapes and components and ensure the scale and shape language work across designs. Adobe Illustrator was used to iterate the toy aesthetics and quickly set up components as separate parts to

by the toy mechanism. Illustrator was then used to conduct colour studies and refine the shape language again, ensuring that each toy stayed on brand with the colour design.

There was a specific challenge with the Mix and Sift characters, which entails how all the separate components would fit together (Fig. 76). The earlier design had more complexity in the sieves, enabling

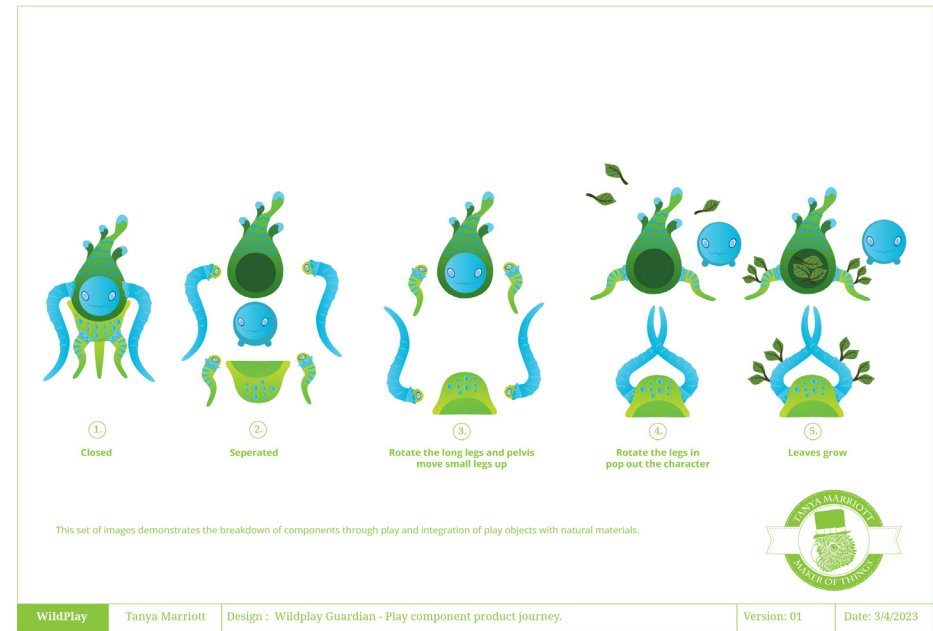


Figure 76: Left, Version 01 Mix and Sift digital schematic design, and right, Version 01 Myco design demonstrating how components fit together. Generated in Adobe Illustrator by Tanya Marriott.

²⁷ One of my roles in the toy industry was to make physical tooling models for manufacturing. This involved making detailed physical functional models that when sent to manufacture in China would serve as the master model from which the metal moulds were made. When making The Underfoot toys, I developed both the digital model files and the physical prototypes to the same level of detail as a tooling model.

swap them out as fit options were further explored. Extensive explorations were conducted in Illustrator to ensure the shape language would retain core values when the design moved to 3D and that the character was always present in the toy, and not dominated

them to be flipped upside down. It required much digital tooling to make something so small work. It would have made the design more complicated and did not add anything further to the play for the narrative that the design still needed to deliver, so the design

was simplified. Working in this form of diagrammatic 2D is quicker to see shapes and components and translates well to working in the orthographic view in 3D software.

4.3.5 Digital 3D modelling

3D modelling was used extensively within The Underfoot toy design process to resolve the design in various ways, including:

within the 3D printing and toy design pipeline and the 3D animation and game pipeline. Maya was used to develop the overall shape and form of the design based on reference drawings, while I remained mindful to keep the polycount low, so the shape and form could still be iterated as needed.

Illustrator reference drawings were used to ensure the dynamic lines and fluidity of the design through the

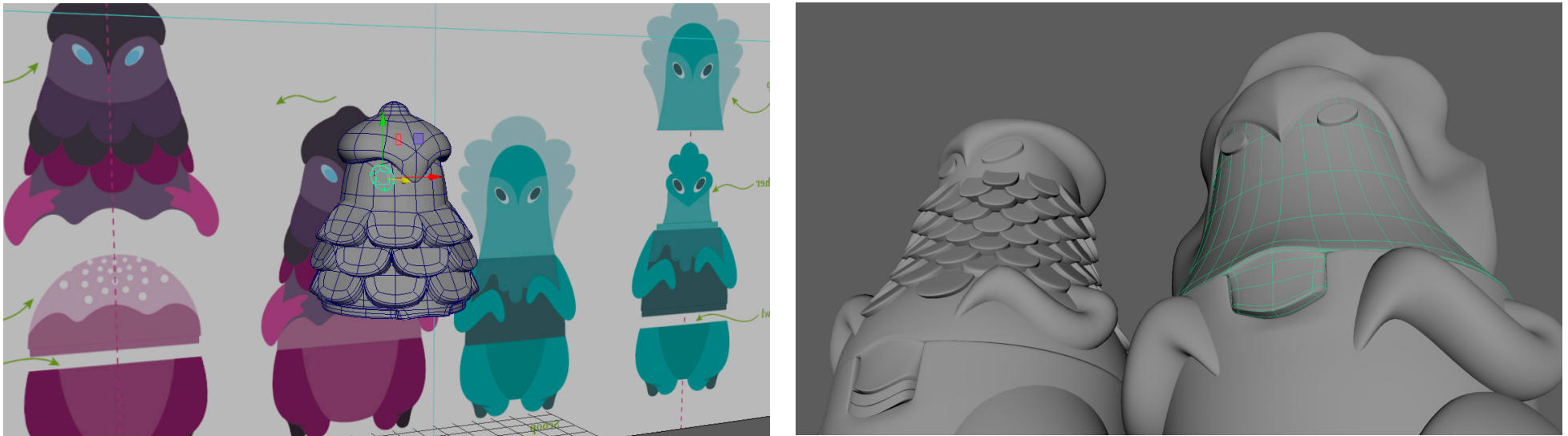


Figure 77: Left, design drafts using Adobe Illustrator drawings as reference for 3D modelling in Maya, and right, 3D modelling in Maya. Generated in Adobe Illustrator and Maya and compiled by Tanya Marriott.

- To resolve the shape language.
- To test and resolve the toy mechanisms and fixing systems.
- To use within the worldbuilding and story-telling images.
- To develop tooling models.

Autodesk Maya was used as the primary modelling tool as it is suitable for organic modelling and 3D printing. However, these 3D models can also be used seamlessly

modelling process (Fig. 77). A movement is captured in a drawn line that is easier to emulate digitally with the reference material on hand as a guide. All components are modelled as separate parts to be duplicated and iterated further in 3D.

Rhinoceros (Rhino) was used to draft up, tolerance-fit joints and parts of the toy mechanism with a defined scale, import the .obj files back into Maya and then scale the Maya model around them (Fig. 78). Maya

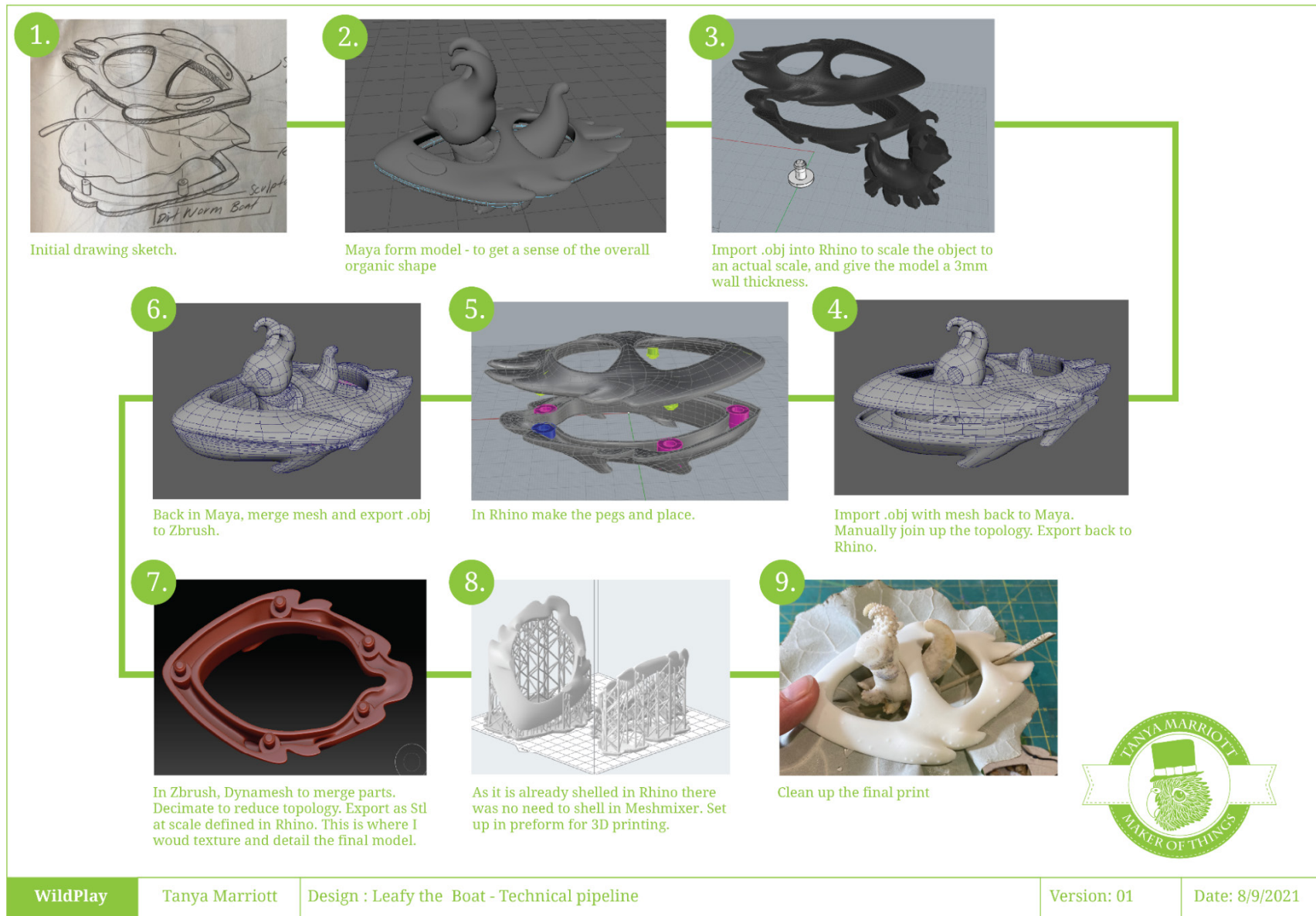


Figure 78: 3D modelling process for developing prototypes into tooling and grey models, using Autodesk Maya, Rhino and Maxxon Zbrush. Diagram generated in Adobe Illustrator by Tanya Marriott.

was also used to develop simple press joints for the models and was used much the same as in a CAD package. Although Maya has no real-world tolerancing and dimensioning, a method was developed to “fudge” this through arbitrary scaling, which is suitable for initial prototyping. A scaled component from Rhino was then used to guide the Maya model to fit the press joint component (Fig. 79).

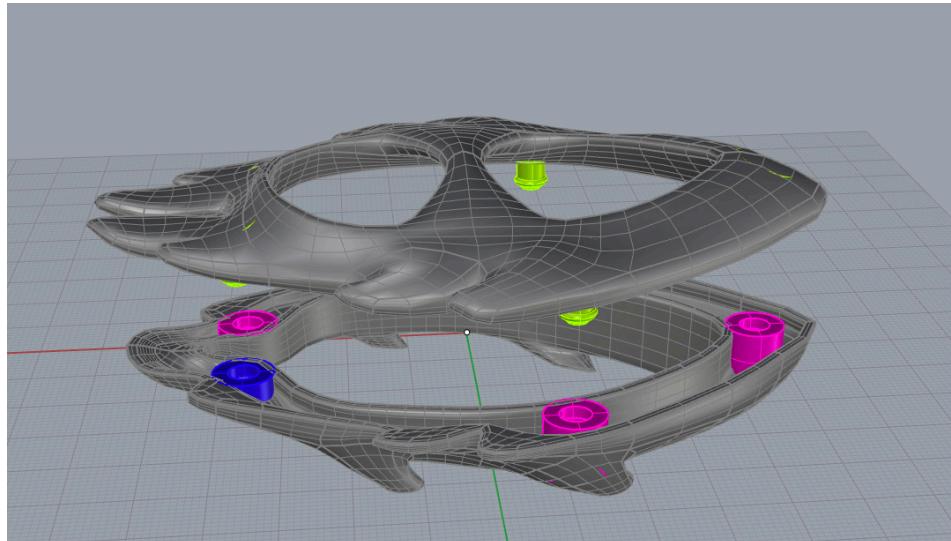


Figure 79: Original press fixing design in Rhino, located in the scaled Maya model. Generated in Maya by Tanya Marriott.

Figure 79 shows the first mockup of the leaf boat design. It initially had press-fit fixings that held the sandwiched leaf contained. In playtesting, children found it too hard to line up the locators, so the design switched to magnets but still used the original pegs for the magnet placement. The original boat design also had a modelled strap to hold the character in place. This was removed to enable various characters other than the velvet worm to ride the boat. Children can

²⁸ Spray operations are the number of colour paint layers on the toy that are needed to build up detail. A metal mask is made for each spray operation which acts as a stencil for each paint layer. The more spray operations a toy has, the more expensive each unit is to manufacture.

use moss, dirt or leaves to “pack” around the character in the leaf for support.

Once the designs were resolved, the model was imported into Zbrush for surface texturing and patina. Custom and standard brushes in Zbrush detail the model surface and give it texture (Fig. 80). The toys have been developed to have more textural detail in the

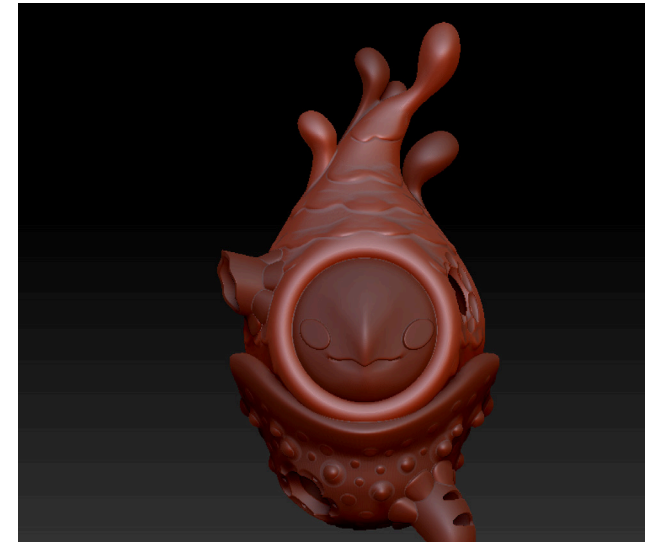


Figure 80: Myco model subtools showing separate tool parts, with magnet holes on cradle. Image generated in Zbrush by Tanya

model surface rather than the paintwork. This partially keeps costs down as more spray operations drive the price up. However, this is another material homage to the natural world. After years of play with My Little Pony toys, the vinyl surface was notably marked by ingrained dirt from outdoor play. The intention is for The Underfoot toys’ surfaces to “wear in” and weather through play in the environment. In Zbrush, each design has some form of raised surface, feathering or

texture that will change and patina with extensive outdoor play (Fig. 81 and 82).

The 3D models were printed regularly to test function and fit. There is only so much that can be observed from a 3D model, and as part of the creative practice, tangible models were used throughout the iterative process to test whether they work for outdoor play. The models were printed using an SLA printer, which

subsequent test prints, the scales and number of parts were adjusted to ensure the mechanism fit and the toy was at scale to the other toys in the range. Digitally painted versions of the 3D models were used to test the physical toys' colour options and mock-up visuals for the narrative world. Moving the 3D models back and forth between digital and tangible processes provided an effective means to advance the design resolution and integrate a range of physical and digital eco-fiction

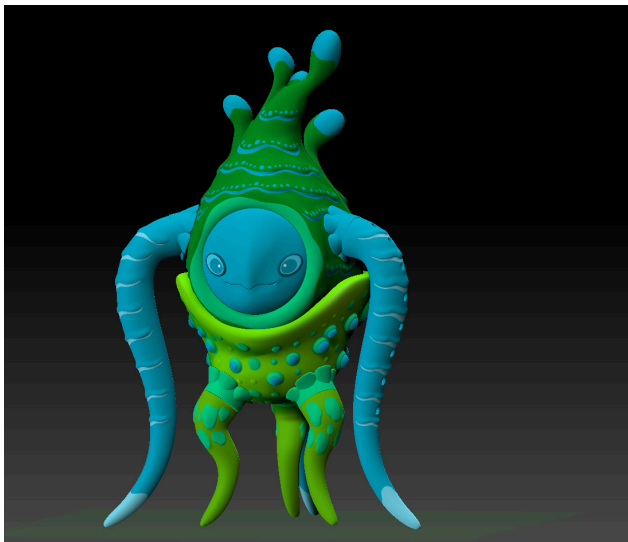


Figure 81: Textured and painted Myco model. Generated in Zbrush by Tanya Marriott.



Figure 82: Grey models for the Mix and Sift characters after playtesting. Photo by Tanya Marriott.



Figure 83: The first functioning Rolypoly prototype at left, with the Velvet Worm prototype at right. Photo by Tanya Marriott.

enables a higher level of fidelity than is usually needed for prototype trials; however, this level of model surface texture detail is required for fitment with smaller-scale prototypes. The prints require minimal clean-up before they can be tested. In Figure 61, the scale of the Rolypoly character worked relative to the Velvet Worm character, but it had too many parts, and the mouth mech was too big to fit in the face. The design first needed to function as a tangible 3D print, and then in

content within the same design. The 3D models were UV mapped in Maya and textured in Zbrush before rendering in Keyshot. This digital pipeline enabled the same 3D toy models to be used as 3D printed toys and rendered characters in the pitch bible (Fig. 84 and 85). The digital models are animation-ready; this means they can also be used in any subsequent animated media, which extends their use as an asset.

²⁹ UV mapping "pelts" a 3D polygon-based model to make a 2D flattened version of it. This forms a skin around the model that can be digitally painted and will remain true to the 3D form without distortion. It is a required process when moving a model between 3D software programs if the model is to be painted, rendered or animated.



Figure 84: Storyworld renders of Rolypoly and Leafy Boat for the pitch bible. Rendered in Keyshot by Tanya Marriott.



Figure 85: Final 3D-printed toy design for Rolypoly and Leafy Boat (using the 3D model in Fig. 84). Photo by Tanya Marriott.

4.3.6 Toy mechanisms

Each of the five toys has a mechanism activated through play in the natural world, supporting active, engaged play with cause-and-effect features. A toy mechanism can be an active transition, such as a button or projectile, or more passive, such as using magnets. When designing the toy mechanisms, how the toy mechanism functioned with natural materials needed to be considered, as elements in the natural world activated the mechanism.

The story defined the development of the mechanism design. For example, for the character Wiggle, who eats leaves, the leaf punch mechanism was encapsulated in the head of the toy, so the bite mechanism lined up with the toy's mouth. The mechanism needed a button located at the top of the head. The button profile was made flush with the toy head, so the button was subtle and did not disrupt the aesthetic "feel" of the character (Fig. 86).

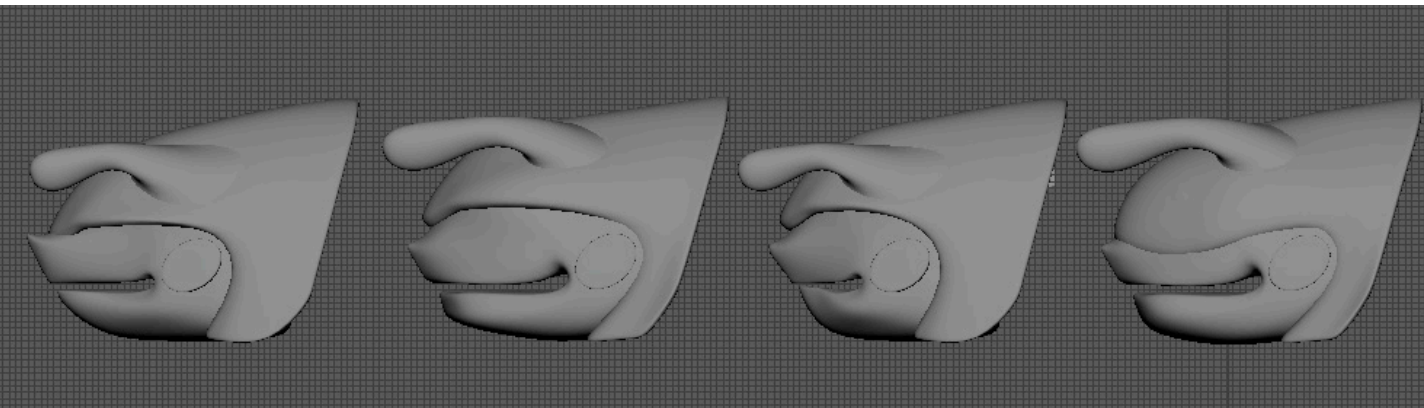


Figure 86: Side profile variations of the mouth cite mechanism for Wiggle Rolypoly. The final design (far right) was not as “cute” as the initial proposal (far left), but assessment during playtesting indicated the mouth needed to be longer to ensure children could fit the leaf. Image rendered in Maya by Tanya Marriott.

4.3.7 Colour and material

Material specifications are not addressed in depth within this study due to the work already conducted by the toy industry. There has been much development in bio-polymers and eco-friendly plastics. The toy industry is already moving towards replacing oil-based plastic—as noted, by 2030, LEGO intends to replace all ABS bricks with sustainable materials—but it will need the big players to make the move first. However, material characteristics were considered within the

The materials The Underfoot product will be manufactured from, and that were used (where possible) in the prototypes, are as follows.

- Bio-polymers.
- Renewable timber (a pressed composite timber).
- Wool felt.

Some excellent examples of innovation in bioplastics were showcased at Spielwarenmesse 2023, reaffirming



Figure 87: Examples of left, bio-plastics, and right, composite timber from Spielwarenmesse 2023 (the Nuremberg Toy Fair). Photos by Tanya Marriott.

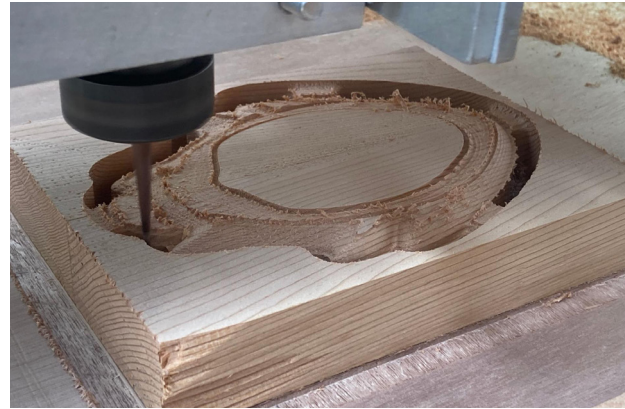


Figure 88: CNC milling a Leafy Boat in Cedar. Photo by Garry Buckley.

product range, and it is intended for The Underfoot toys to be manufactured from materials that will break down in the ecosystem if left outside for an extended period. This consideration is in keeping with the whole ethos of natural cycles: once the toys have served their purpose, they will return to the earth. This approach encourages children to be more respectful and conscious of the life cycle of their toys, and to realise that if they do not take care of them, they will disappear.



Figure 89: Final Leafy Boat in cedar. Photo by Tanya Marriott.

the ability to achieve bright colours with sustainable materials (Fig. 87).

Leafy Boat prototypes were also CNC milled from walnut and cedar timber as examples for the wood texture finish (Fig. 88 and 89). Although this was a time-consuming manufacturing process, many promising composite timbers on the market have a wood texture that is moulded rather than milled, which could be used to simulate this aesthetic. The Wiggle Rolypoly character and Myco guardian both feature wool-felt components.

Colour is an area this research explored in depth. Nature is a brightly coloured space, yet we greenwash toy products with a neutral palette of muted greens and browns. These colours make us feel the brand is clean and environmentally conscious, but it is an inaccurate representation of the varied colours of the natural world. In keeping with the authenticity of eco-fiction narratives and presenting the natural world

bright harlequin variation (Fig. 91). The Mix and Sift characters' colour palette is based on saprobic fungus indigenous to Aotearoa New Zealand, which is all very brightly coloured. Sift (Fig. 92) references the fungus colour palette of the sky-blue mushroom *Entoloma hochstetteri* (see Fig. 93), which appears on the New Zealand \$50 note.



Figure 90: A tricolour *Merulanella slater* from Vietnam. Photo by The Isopod Barracks, from 2022, <https://www.instagram.com/p/CkeJf-1Byj4b/>, accessed 1 December 2023.



Figure 91: Colour variations for Wiggly Rolypoly. Generated in Adobe Illustrator by Tanya Marriott.



Figure 92: Model of Sift; the colour palette references the Aotearoa New Zealand mushroom *Entoloma hochstetteri* / *werewere-kōkako*. Photo by Tanya Marriott.



Figure 93: A mood board of collected images of saprobic fungi found in Aotearoa New Zealand. Image compiled by Tanya Marriott.

as it is, the colour of The Underfoot toys is based on colours found in the natural world (Fig. 90). Velvet worms are bright reds, violets and blues; fungi are rainbow shades; and even bacteria, when stained, glow with luminous colours. Even the humble slater has a

The Underfoot toys are also brightly coloured to be easily found when playing outside. While photographing the product, one of the Velvet Worms was momentarily lost after it was left hanging in a tree. The toy's bright colour made it easy to locate against the tree foliage.

Reactionary materials are popular in the toy industry as they give the product a low-cost surprise. Colour change paints are standard in toy products and were implemented within The Underfoot toys. Colour change pigments also have resonance as environmental indicators. This research explored colour change paint for all characters in the following forms.

- Glow in the Dark (for Rolypolys who live in the dark)
- Hydrochromic (for all toys squirted by Velvet Worm)
- Photochromic (for Velvet Worm, who lives in the shade)
- Thermochromic (for Mix and Sift when



Figure 94: Pigment test using red cabbage dye, with lemon juice (acidic) and baking soda (alkaline) to activate the pigment change. Photos by Tanya Marriott.

decomposition generates heat)
 Tests were conducted with natural pigments and acidic and alkaline reactions, similar to how a hydrangea flower alters colour with soil changes. The pigment is a red cabbage extract (Fig. 94 and 95); although it worked well in the studio, the dyes are not permanent. The Underfoot toys change colour when playing within certain soil conditions. Hydrochromic paints were used to simulate this effect, which moisture

4.3.8 Recommendations for design criteria

- Cardboard prototyping was successful as a process of iteration alongside drawing, but the designs must also be tested outdoors during this development phase.
- In the design and fabrication process of the prototypes, digital drafting was used to refine shape components, whereas 3D modelling was used to refine mechanisms and textures.
- The toy designs featured simple paint spray-ops and textural sculpted forms so that they would form patinas with environmental play and wear.
- The toy scale of the standard Velvet Worm figure is 3". All other characters were scaled to suit.
- The Underfoot toy range referenced the nitrogen cycle through five character designs. The leaf was used as a transformational organic material as it can interact with all toys.
- 3D modelling assets were used to visualise the story world in the pitch bible, so the exact shape language for the toys is used in the proposed animation licence.
- Toy Mechanisms are related directly to the ecological cycle, and each toy is related to each other. The toys used environmentally reactive paints and pigments to build on more subtle forms of environmental transformation.
- The toy product represents the story world, packaging and story snippet as a united system. A cohesive storyworld defined the character's purpose and nature play motivations to the child and parents.
- The toys are brightly coloured to authentically represent the natural world and avoid green-washing the product so that it can compete in the market with other character licensed products.
- Although eco-plastics were not the focus of this research, the toys would use bio-polymers, wood and felt in manufacturing. These materials will naturally break down in the ecosystem if children leave their toys outside for long periods.

5 Final Design Package

The final Underfoot toy design package consists of the following design components:

1. Pitch bible: 12-page pitch bible for a children's animated series
2. Range of five (5) character toys:
 - Oke Velvet Worm
 - Leafy Boat
 - Wiggle Rolypoly and Tily
 - Mix and Sift
 - Myco the Mystical

5.1 The Underfoot Pitch Bible

The Underfoot pitch bible (Appendix 6) frames the media narrative in an animation format for the toy range. The 12-page bible outlines the core themes of the story world, key characters, environments and key episode story beats (Fig. 95). A pitch bible is a standard format used to demonstrate a character licence, and once optioned to be produced, this is translated into a show guide.

The underlying flood narrative was reaffirmed by the choice of characters who would be affected in a flood and the textual explanation of the character's attributes and motivations. The world environment of the Underfoot characters is prone to flooding due to the actions of the humans living in the garden above. The humans are never seen, but their influence is implied. The Underfoot characters are based on real creatures living in Aotearoa New Zealand gardens, specifically in Wellington, where this project was developed. The story world explores the interrelationships that mimic those of real-world creatures, who live in a mutualistic relationship but exhibit natural behaviours towards creatures from other species. This realism is tempered

by the eco-fiction narrative and made appropriate for a child audience. However, the core environmental messaging is as authentic as possible within the believability of the narrative.

There is a direct link between the character story moments in the pitch bible and how the characters manifest in the toy mechanics. Hero character Oke Velvet Worm is adventurous and likes to explore the outer edges of the ecosystem with their friend Leafy, so the second quarter toy is a Velvet Worm and Leafy Boat. Children must use an actual leaf to make the toy into a boat. Wiggle Rolypoly is portrayed as a quiet character with a voracious appetite, which ecologically reflects the role of a slater. In the toy, this character has a mechanism in its jaw to make confetti from leaf litter. This consistent design between narrative and toy reaffirms the eco-fiction narrative and demonstrates a cohesive design strategy between the story world and the product.



Logline
The Underfoot is a sci-fi comedy about a team of alien explorers who discover a planet teeming with life. The team must work together to survive in a hostile environment while uncovering the secrets of the planet's advanced technology.

Summary
The Underfoot is a sci-fi comedy about a team of alien explorers who discover a planet teeming with life. The team must work together to survive in a hostile environment while uncovering the secrets of the planet's advanced technology.

Characters

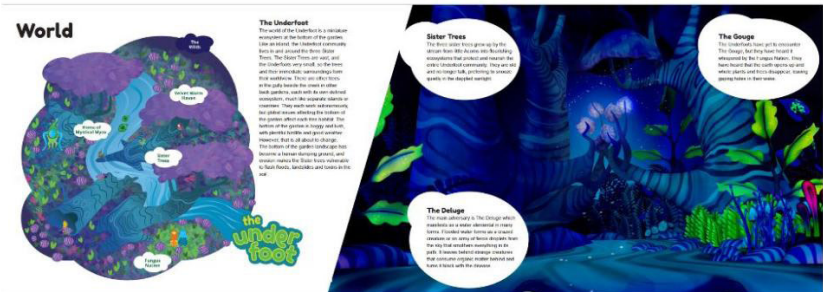


Figure 95: The Underfoot pitch bible spreads. Generated in Adobe Indesign by Tanya Marriott.

5.2 The Underfoot Toy Product System

The diagram in [Figure 96](#) introduces the five Underfoot toys, ranging from the first quarter low-price-point product, the Oke Velvet Worm on the left, through to the fourth quarter large-scale playset Myco the Mystical. Using the eco-fiction criteria as a guideline for The Underfoot designs, each toy quarter represents a process within the nitrogen cycle, with the toy mechanics embodying the ecological decomposition processes. All play mechanics are positive transformation actions, so even though a leaf may be plucked from a tree and worn down through play, the act of the leaf wearing down is a natural aspect of decomposition.

The nitrogen cycle is not manifest literally but is a tangential system that enables children to experience the ecological cycles' raw transformative aspects in exciting and playful ways. Each toy shown is a design iconic for its character line, with between three and six variations available in different skews for each toy. The variations within each toy character enable children to collect families of characters, each with their own story, culture and purpose within the ecosystem. For example, there are six Velvet Worm characters: Oke is the main character, and Fuchsia and Terra ([shown in Figure 95](#)) are other characters in the pitch bible. Three other characters are also available as toys to round out the set.

Each toy has a particular natural material that activates play. Leaves are a core natural material that links all character toys together, and as the leaf degrades through play, it can be transformed into soil and nutrients through each consecutive toy. Children do not need to have all toys to develop an understanding

of an ecosystem, and it is enough that they understand that toys affect and transform the natural world. All five characters are biotic, but they all engage with abiotic aspects of the natural world within play.

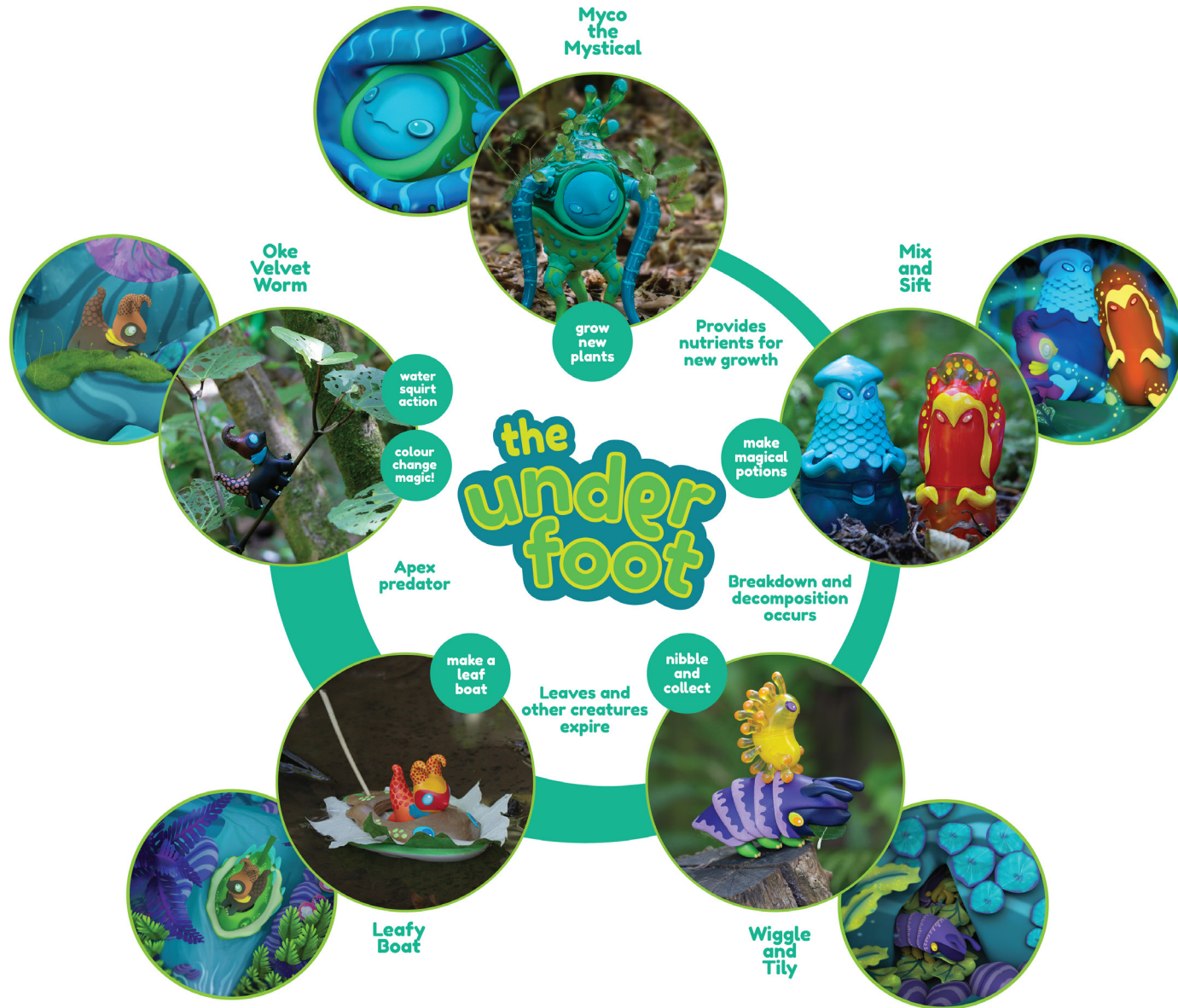


Figure 96: The Underfoot toy range, showing toy designs and corresponding narrative moments. Visualisation by Tanya Marriott.



Figure 97: Daytime Velvet Worm toy attached to a branch. Photo by Tanya Marriott.

5.2.1 Oke Velvet Worm

The Velvet Worms are the first (1st) quarter toy designed in various colourway skews and personalities. Oke is the hero character in the pitch bible narrative. The Velvet Worms come in two varieties, each actively exploring their apex predator role within the ecosystem. These are the nighttime version, with a squirt mechanism, and the daytime version, with a colour change action.

Velvet worms shoot slime, which it uses to stun its prey (Fig. 98); this is mimicked by the toy, where squeezing the belly activates the squirt mechanism (Fig. 99). The Wiggle Rolypoly characters have hydrochromic paint, so the toy body changes colour when a Velvet Worm has squirted them.

The second range of Velvet worms, the daytime version (Fig. 101), has photochromic colour change bodies, so



Figure 98: The velvet worm squirting slime. Image by Alexander Bär / Nature Communications (2017), from <https://www.instagram.com/biomimicryinstitute/p/CiVRtpKrsI4/A>, accessed 1 December 2024.



Figure 99: The Velvet Worm toy squirting liquid. Photo by Tanya Marriott.

Both ranges have three variations of tail, which references a real-world phenomenon whereby different velvet worm species have been found living in the same tree habitat. The velvet worm characters have eight legs, which enables them to be pressed to fit into branches (Fig. 97). Their antennae can also suspend them. The toys can be rocked across the eight legs.

when the Velvet Worms are in the sun it reveals they are hungry and what insects they like to eat. To “feed” them, children need to put them back into the shade to find food for them. The nighttime worm is made from soft vinyl and is hollow with a removable tail (Fig. 102). Children remove the tail and fill the cavity.

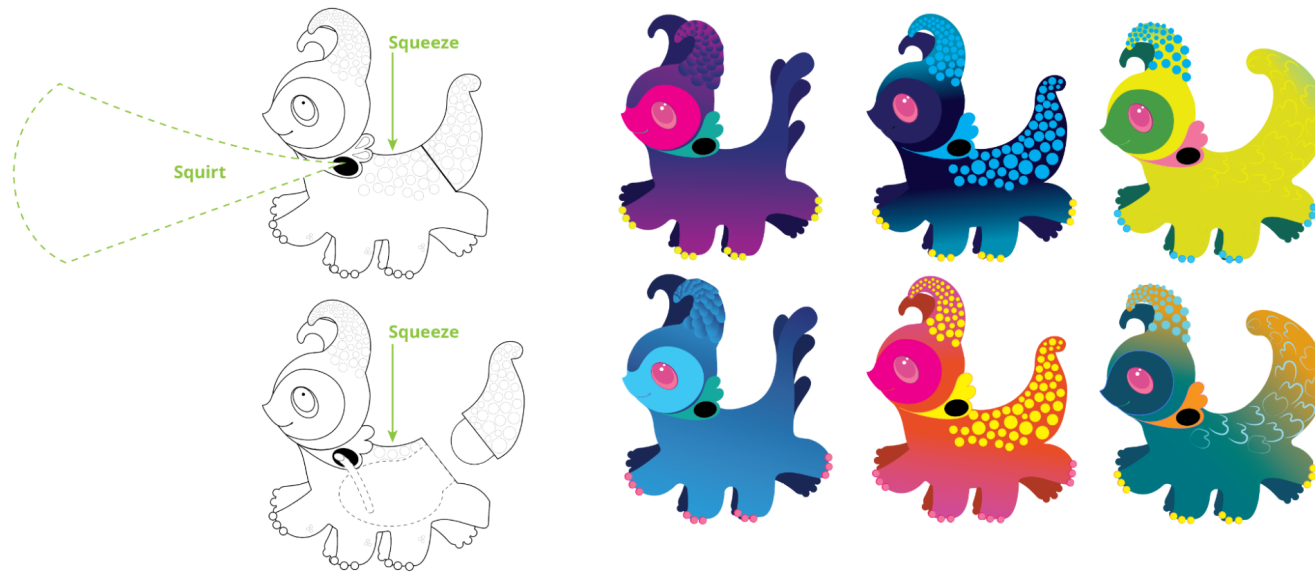


Figure 100: Nighttime Velvet Worm, hunting version, with a bright, translucent gum-drop colour palette, to show the water inside. Diagram by Tanya Marriott.



Figure 101: Daytime Velvet Worm; when warm and “hungry” their favourite meal is revealed as a colour-change action. Diagram by Tanya Marriott.

*Oke is a velvet worm
—an apex predator that
is oh so cute!*

*Velvet Worms come in a
variety of shapes and
colours. All characters
have temperature
change pigment to indi-
cate when the toys need
to find shelter.*



*The “Nighttime” Velvet
Worm is made from
flexible material and can
squirt water. This
simulates the feeding
patterns of velvet worms.*

*They have removable
tails so children can fill the
bladder, then squeeze the
sides to squirt.*

Oke Velvet Worm

**under
foot**



Figure 103: Leafy Boat carrying Velvet Worm in a stream. Photo by Tanya Marriott.

5.2.2 Leafy Boat

The Leafy Boat is a second-quarter toy with a Velvet Worm character and the character components to make a boat using a natural leaf (Fig. 103). There are a variety of leafy boat sizes in the range that enable children to use different leaves to make up the boat.

Encapsulated magnets hold together the two halves of Leafy Boat, which sandwiches the leaf, making a

watertight seal (Fig. 104). Children use moss or other natural materials to pack around the Velvet Worm to hold them steady. There is a hole in the back of the boat to poke the leaf stem through; this helps locate the leaf and gives children something to hold when they carry the boat or lower it into the stream (Fig. 105). The largest leafy boat is big enough to carry Wiggle and Mix.



Figure 104: The setup of Leafy Boat, showing leaf insertion. Photos by Tanya Marriott.

Leafy is a wooden boat that can float in the stream.

Velvet Worm, Tily, Mix and Rolypoly can all ride with Leafy Boat. Children can use moss and leaf litter to pack these characters in the boat to make them stable.



Children can sandwich a leaf between the top and bottom layers to make it into a boat. Pulling the leaf's stem through Leafy Boat's tail will align the leaf.

The two halves are held together by encapsulated magnets. Leafy Boat is made from eco-plastics and/or sustainably sourced timber.

Leafy Boat

**under
foot**

Figure 105: Design sheet outlining Leafy Boat's components. Diagram by Tanya Marriott.



Figure 106: Wiggle Rolypoly and Tily. Photo by Tanya Marriott.

5.2.3 Wiggle Rolypoly and Tily

Rolypolys are slaters and are crucial to breaking down matter in the ecosystem. The Wiggle Rolypoly toy is also a second-quarter toy with Tily, a bacteria-inspired character (Fig. 106), who rides on Wiggle's back (Fig. 107). Wiggle has an articulated body, movable legs and a soft felt belly. The combination of textures and movement was appealing to children during playtesting. Wiggle has a punch mechanism in its mouth that turns fed leaves into confetti (Fig. 108).

The confetti shapes can be stored inside Tily (Fig. 109),

These two characters work in a symbiotic relationship where the bacteria that forms on the edges of nibbled leaves helps them to decompose faster. Tily would be manufactured in soft vinyl, so the nodules on the back can help affix it to branches. Wiggle is painted in hydrochromic paint that reacts to water, with the edges painted with glow-in-the-dark paint so Wiggle can glow when placed in tree hollows.



Figure 107: Tily riding on Wiggle Rolypoly. Photo by Tanya Marriott.



Figure 108: The bite mechanism for Wiggle; a press button enables it to "eat" leaves into shapes. Photo by Tanya Marriott.



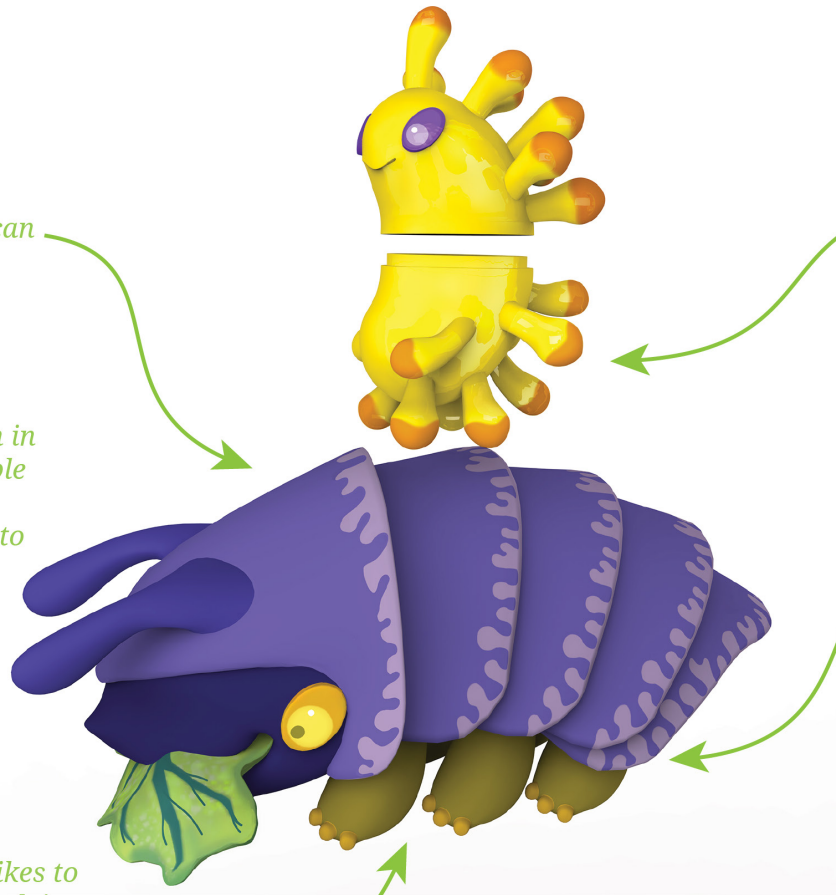
Figure 109: Tily opens to store found natural materials. Photo by Tanya Marriott.

Wiggle Rolypoly is a slater and Tily is a bacteria character. Together they break down and store leaf matter as confetti.

Wiggle Rolypoly's articulated body can curl in a half-ball. Their 6 legs are articulated.

Wiggle has a leaf punch mechanism in their head to enable children to break leaf litter down into confetti shapes.

Wiggle Rolypoly likes to hang out in the dark in old rotten logs. Rolypoly's scales and eyes glow in the dark.



Tily can ride Wiggle. Tily's middle opens so children can store their leaf confetti.

Tily is semi-translucent in colour so children can watch the decomposition process.

Wiggle Rolypoly has a soft felt belly.

**Wiggle Rolypoly
and Tily**

**under
foot**

Figure 110: Design sheet outlining components and features of Wiggle Rolypoly and Tily. Diagram by Tanya Marriott.



Figure 111: Third quarter toys Mix and Sift. Photo by Tanya Marriott.

5.2.4 Mix and Sift

Mix and Sift are based on saprobic fungus characters that pop up after the rain (Fig. 111). They are brightly coloured to reference the fungi that inspired the design. Together, they comprise the third quarter toy. Mix and Sift's play focuses on transforming matter into soil or nutrients and mimics potion-making play. Both toys have a variety of actions within the toy,

including sifting, a mortar and pestle, liquid straining, scooping and scraping (Fig. 112). Mix and Sift are made from translucent material so children can watch the composting process in their bellies (Fig. 113). There are six variations of the characters available in the range, and all have similar functions. The fungus characters are considered mystical or guardians in the pitch bible narrative.



Figure 112: Sift in play. Photo by Tanya Marriott.



Figure 113: Sift in play: left, three different levels of soil sifting; centre, scooping soil; right, shaking soil for sifting. Photos by Tanya Marriott.

Mix and Sift are saprobic fungus characters. They transform matter into soil or nutrients through potion-making play.

The head and base of Sift is a mortar and pestle. This enables children to grind up matter and break it down.

Turning Sift's head upside down makes it into a cup.

Sift has two grades of sieve in its belly so children can sift different-sized matter. The base catches the largest pieces.



Mix is semi-translucent in colour so children can watch the transformation in process. The top of Mix's head is a trowel to enable children to turn over and move the soil. The head interior is a scoop.

Mix has a small Flower character in its belly which can strain liquid like a tea strainer.

Mix and Sift

underfoot

Figure 114: Design sheet outlining components and features of Mix and Sift. Diagram by Tanya Marriott.



Figure 115: Fourth quarter toy Myco (complete); shown with Velvet Worm. Photo by Tanya Marriott.

5.2.5 Myco the Mystical

Myco is the fourth quarter toy and represents the large playset design based on mycorrhizal fungi, which form on tree roots and enable trees to communicate with each other and transfer nutrients to support new growth (Fig. 115). Myco can be broken down into various play parts that can store water, grow seeds and provide shelter to other toys in the ecosystem (Fig. 116). This toy can be broken down into ten

interchangeably, while the long limbs come in two forms, which could be purchased separately: either rigid vinyl that can grow elements within or soft poseable felt (Fig. 117 and 118). The core face of Myco is a removable plush character that represents the heart of the character (Fig. 119).

The body itself can provide storage (Fig. 120) and shelter for other characters. The most abstract of



Figure 116: Fourth quarter toy Myco: left, full body; centre, cradle and leg components, shown with Velvet Worm; right, cradle and plush character. Photos by Tanya Marriott.

components clipped together with encased magnets. The toy breaks down into the “head”, “body”, and “limbs”. Each of these parts can be played with separately, and the arms and legs of the design can be attached to different parts of the head and body

the designs, Myco reflects the mystical nature of mycorrhizal fungus, where the main body is located underground.



Figure 117: Left, Myco with soft limb option, and right, hard limb option and in use as a habitat for other characters. Photos by Tanya Marriott.

Figure 118: A limb from Myco; the limbs have character heads and thus function as child characters to the Myco toy. Photo by Tanya Marriott.



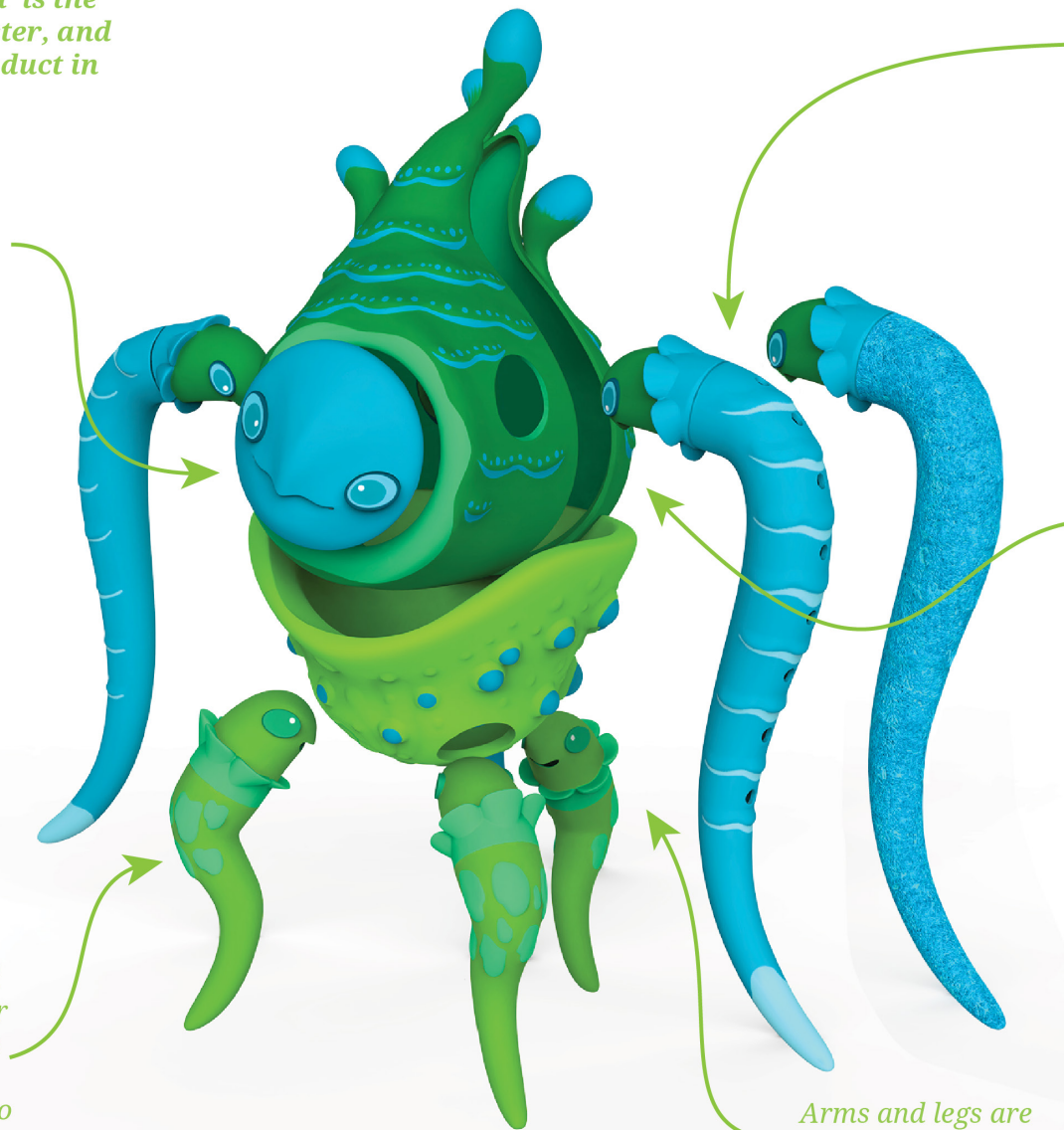
Figure 119: Myco's features: left, storage of natural materials within the body; centre, holes allowing adornment with leaves or seeds for growing plants; right, limbs functioning as discrete characters. Photos by Tanya Marriott.

Mycothe Mystical is the guardian character, and is the largest product in the range.

Myco's face can be removed to reveal a new character.

Myco's face is UV reactive and changes colour in the sun. This tells children when the character needs shade.

Legs can be embedded in the soil, stood independantly and filled with water or soil. Leg heads are removable and mouths are open so children can "feed" them.



Arms are removable and can be filled with soil and seeds to grow plants out of the holes. Leaves can be inserted into the holes.

There are two leg versions

1. Semi-translucent

2. Felt

The semi-translucent legs are hollow so children can see plants growing inside. The felt legs are flexible and posable.

The head's front and back sides can be clipped together or played with seperately to make hiding places for other toys.

The head is permeable so children can grow plants or drain water and is semi-translucent so light can pass through tomake a glasshouse for plants.

Arms and legs are interchangeable.

**Myco
the Mystical**

**under
foot**

Figure 120: Design sheet outlining components and features of Myco the Mystical. Diagram by Tanya Marriott.

5.4 Packaging

All Underfoot toys use a similar concept for packaging design. The design focuses on minimal waste, innovative display systems and valuing the backcard and all other packaging components as part of the product. The backcard has the toy narrative and an illustration of the design on one side and the name and product features on the other (Fig. 121). The

The toys will come in felt leaf-shaped carry cases that double as storage and carrying toys. The carry case has an eyelet at the top, so it can either be hung in foliage outside or attached to a surface inside with a suction cup (Fig. 123). The backcard is intended to be retained by the child as a collectable and displayed as artwork about the toy.

Packaging Design



Figure 121: Packaging concept design, showing, from left: 1) felt carry case, 2) front card, 3) backcard, and 4) front with felt carry case illustration. Visualisation by Tanya Marriott.

Figure 122: Packaging pamphlet design. Photo by Tanya Marriott.

packaging contains a pamphlet tucked in the case, which describes other toys in the range and how the mechanisms work (Fig. 122). The toy is attached to the front using cables that go through discrete holes in the packaging and tie around the toy.



Figure 123: Packaging design concept, showing: left, the toy in the felt case on the backcard; middle, the toy in the felt case hanging from a suction cup; and right, the toy in the felt case hanging from a branch. Photos by Tanya Marriott.

6. Evaluation

This chapter reflects how the design was evaluated and the design process reflected upon. The design was adjusted and refined based on feedback as it was measured against the initial project goals.

6.1 User Testing

Several user testing sessions were conducted to appraise The Underfoot design:

- Toy playtesting session 01: Grey models
- Toy design workshop
- Toy playtesting session 02: Final designs

There is no precedent for playtesting toys outside. The biggest concern for playtesting outside was safety, so playtesting was held at Centennial Park in Maupuia, with the site selected as it was easily accessible. The first playtesting session aimed to test children's cognition with the product and how the product encourages small world play. The toy design workshop explored how children used natural and found materials to make playsets in nature for the toys. The third and final playtesting session was an appraisal of the final design.

Research assistants were recruited to record the sessions with go-pro cameras and to gather data on play activities and nature engagement recorded in a checklist. The Sesame Workshop playtesting resource (Joan Ganz Cooney Center) was used to develop the toy-play checklist and plan the sessions. Also used was a similar system of observation in playtesting described by Justin Canty and Biret Adden in their presentation "Backyard Backstories: Building and Evaluating Nature Play and Learning Spaces". The focus group involved nine children across both playtesting sessions and ten children in the toy design workshop. Both playtesting sessions lasted 45 minutes. Six hours of go-pro footage

was analysed, and follow-up interviews were conducted with parents about continued play once the children returned home.

6.1.1 Toy playtesting session 01: Grey models

For the first playtesting session, children were introduced to the toys at ten to fifteen minute intervals. They were shown digital illustrations of the characters in the story world and given an overview of the character narrative. The grey models were used to test for story coherence, character engagement and product function. This session was used to observe how children wanted to use the toys. The toys were all grey models for playtesting, meaning that they had no colour or detailed surface patina, encouraging the children to focus on core function rather than aesthetics (Appendix 4).

6.1.2 Toy design workshop

Ten children from the Kiwi Conservation Club were recruited to take part. They were introduced to the story of The Underfoot characters. They were then introduced to four of the characters. They chose whatever character they wanted to play with and were given ten minutes to play with their toy first. Children were then brought to the design station to draw ideas, where lots of materials were laid out to make things from, and they were invited to design toy extensions for the characters they played with. This workshop aimed to see how children used natural materials and found material within the play, what shapes and connections they made and how these could be used within further iterations of the toy designs, the story world and the instructions. The children predominantly developed human-like habitats for their characters. However, four children used the toys to develop animal-centric playsets inspired by the toy's function (Appendix 4).



Figure 124: Photos from the first playtesting session, with grey models, showing engagement in nature play. Photos by Tanya Marriott.

6.1.3 Toy playtesting session 02: Final designs

In the colour playtesting session, children played with the final designs. All the children engaged with the toys. Half the children engaged in narrative character play and used the toys to develop independent stories. The other half used the toys in construction play and made ponds and water containments. Once children found a toy they preferred, they remained in play for 45 minutes and only stopped when they were called back by the researcher. The children used natural materials with the toys—predominantly dirt (mud), water and leaves—both off the trees and on the ground.

Most children read and used pamphlets with the toys to understand them. Several children were content to be in the forest, whereas others got into a flow state during independent play. Although most children did not play the prescribed narratives of the toy characters, they did use the toys to engage in nature play, which could not be achieved indoors. They observed some ecological phenomena during play—“the creek was deeper than last time”—or made narratives for the natural elements they interacted with—“The fungus are her children”, one child said. They fed water to the trees and observed spiders and other creatures in a manner that indicated some ecological awareness and respect.

One child became the character through play and was immersed in the natural space. Girl_03 (study name) was immersed entirely in small worlds and played with the characters. Her preferred toy was the Velvet Worm, and she collected all three versions to play with as a family. She walked the toys along branches and trees and played a story through the characters in her language. At one point, she saw a tiny spider and walked the toy up to the spider to observe it silently before continuing with her play. She made the velvet worms homes within separate hollows within a “family” tree and dressed the “home” with collected leaves and fern foliage to shelter them from the sun.

In a follow-up interview with Girl_03’s caregiver, the child announced that this activity was the best fun of the school holidays; she loved being in the forest. She took a velvet worm toy home and kept it on her special object shelf. She also took a small branch home with her and continued playing with the toy on the branch for several hours after returning home. At home, she continued to play with the toy indoors (due to the inclement weather) but only with natural materials, such as the dog’s fur and the branches and logs stacked around the fireplace (Appendix 4).



Figure 125: Photos from the second playtesting session, with toys. Photos by Tanya Marriott.



Figure 126: Photos from the second playtesting session, with toys, with case study girl_03. Photos by Tanya Marriott.

6.2 Exhibition at Spielwarenmesse 2023 (Industry Review)

The toys were previewed at Spielwarenmesse 2023 (the Nuremberg Toy Fair) to positive feedback. This toy fair was chosen because the event contained a heightened interest in nature-based toys and had an entire hall dedicated to sustainability within toys. Toy companies, ranging from the prominent players Hasbro and

the booth was maintained, and feedback notes were gathered from these discussions. Prominent feedback came from designers from LEGO, Goliath Games, Djeco, Happylines Toys and The Marketing Store (who develop McDonald's Happymeal toys). The Underfoot toys garnered positive feedback for the product, with repeat comments on the freshness and uniqueness of the range. There was an overall appreciation that the characters were a system combined with nature as the playset, as the play was ever-changing. The feedback appreciated the depth of the story world and that this could generate possibilities for further products.

There were concerns regarding the level of anthropomorphism of the toys; could they be too far from human representation for children to form a relationship? The appraisal from toy designers involved a range of thoughts, with the colour choices resulting in conflicting opinions. Positive feedback indicated that bright colours would appeal to children and enhance fantasy play and that colour would make it easier to find missing parts. There was a general assumption that nature is green despite the vibrancy of the natural world at a micro level. Another designer felt they were too much like designer toys and would be too precious for play. The need for children to go outside to use natural objects to complete the play was of great appeal and a pivotal selling point of the product. After many discussions with experts from the field and the challenges of designing into this area of play, the researcher was invited by LEGO to present and discuss The Underfoot range and design process with their interactive design team.



Figure 127: The Underfoot booth at Spielwarenmesse 2023. Photo by Garry Buckley.

Mattel through to small start-up toy designers, distributors and manufacturers, all have booth spaces to demonstrate their products.

The Underfoot's colourful characters and bold shape language contrasted sharply with the neutral tones of other nature-focused toys. A record of visitors to

6.3 Evaluation through Interviews with Toy Design Experts

The toys were evaluated by the same three toy industry experts interviewed earlier.

- Expert 1 (Matthew*): Toy designer and inventor UK (30+ years)
- Expert 2 (Michael*): Toy designer and mechanistic and inventor UK (20–25 years)
- Expert 3 (Sue*): Toy designer USA (20+ years)

The toys were not revealed until after the first part of the interview was conducted, so the appraisal was an honest response. The industry experts were impressed with the toy range and commented on the diversity of toy play opportunities. They enjoyed the range's colour and tactility with the diversity of materials. When looking at some of the playtesting and marketing material of the toys outdoors, they were impressed by the “little ways that you've got in there of exploring the natural environment; the way that they clip on to branches is beautiful” (Expert 2). They felt that “even if they (the children) do not really understand the principles of symbiotic relationships, it's just them becoming explorers in their own way with creatures that are fun and colourful” (Expert 3).

There were mixed views about the colours, with some thinking that they worked well for the toys as the range is fantastical and extends reality. The bright colours would make them easier to find outdoors if children lose them during play. There was initial concern that the toys read more like designer toys than children's toys due to the bright colours. However, our view of nature is tempered by the phenomenon that all eco-products are generally green and brown, that nature is more brightly coloured than we perceive and

that real creatures define the colour choices.

The key challenge was in the connection between the toys and the outdoors and how to convey this to the user. As this is a new genre of character toy, it had to look different on the shelves from everything else, and innovative packaging was crucial for achieving this. There was also a concern about the cost of manufacturing. Everything is tooled down during manufacture, and holding onto the core material, colour and textural elements that make the toys unique is essential. The packaging is a crucial selling point for building awareness for the toy's unique position for outdoor play and the environmental narratives The Underfoot toys embody.

A key selling point was “that it makes you go outside to find the element you need to complete it” (Expert 1). The story was vital to facilitating this, so children were primed for the outdoors before they took the toys out. They were excited by the methods of natural material collection and the ability to collect and grow or store things from the garden.

The interchangeable nature of the toys was a benefit. If parts did become lost, the toy would still be functional and fun to play with. In particular, the more significant Myco figure could be “put up onto a limb where the legs don't even matter” if a part were removed (Expert 3). The industry evaluation revealed several areas to explore further, particularly with packaging design and how the story within the packaging could change users' minds about taking the toys outside.

7. Conclusion

The implementation and effect of eco-fiction design criteria applied to designing a range of character toys is an important but under-evaluated field of research. This creative-based study aimed to develop character dolls or action figures, The Underfoot toys, to embody an eco-fiction narrative and to enable and embody a non-anthropocentric ecological perspective when in play.

As outlined in the Introduction and discussed in Section 2.2, today's children have less free time to play outdoors than in previous generations, and their primary modes of toy play, dolls and action figures, are designed for something other than outdoor play. Doll and action figure toys are one of the most popular agents of imaginative toy play. Building their own play narratives within the natural environment is crucial for children to build a stronger sense of self-actualisation and relationships with other living beings. Without this mode of character-centric outdoor play, there is a risk that children will become further disconnected from the natural environment. Enhanced by media narratives, character toys designed specifically for outdoor play have huge play potential for children to explore environmental themes through imaginative play when designed with eco-fiction criteria.

This research has demonstrated that character toys designed explicitly for imaginative small world play need redefining to be more effective in an outdoor play space. No genre currently exists for this mode of play despite its benefits. The development and implementation of eco-fiction criteria provided insight into the definition of an animal-centric world. This enabled The Underfoot character toy designs to demonstrate an animal-centric character design. The final designs are responsive to ecological principles,

embody an ecosystem narrative and manifest key processes within the nitrogen cycle within their tangible play mechanics.

Using an eco-fiction toy framework enabled ecological principles to be embedded within the character toy design process. The Underfoot toy designs demonstrate how a toy play set can embody an eco-fiction narrative and simultaneously be an ecosystem to encourage and stimulate imaginative play. The Underfoot toys' design development gave the toy designer greater agency to oversee the entire product pipeline from narrative to end toy, enabling seamless integration of the eco-fiction narrative so all media threads were enriched. This is evidenced in the visual and thematic cohesion between the pitch bible and the toys.

Toy design is an interdisciplinary design practice, and this project utilised a broad coverage of design insights to develop a depth of knowledge within eco-fiction toy design. Through this design method, the toy designer becomes a world-builder, storyteller and play object creator. The explorative nature of this design environment defines a set of strategies that come together to generate a new toy genre. The Underfoot designs benefited from diversity in prototyping and product testing and the use of narrative and natural materials and guiding tools within all aspects of the design process.

The Underfoot toys collectively form an ecosystem of toys that, when played with outdoors, enable children to explore ecological systems and processes tangentially. The toys respond to the natural environment and contribute to new knowledge and innovation in engaging children in sustained nature play.

The Underfoot characters' visual aesthetic reflects the natural world's colours, and each toy demonstrates an ecological system or phenomenon. Each design's interchangeable and integrated aspect stimulates imagination, where the environment becomes a playset of endless opportunities that The Underfoot toys unlock, and encourage children aged five to seven to develop unique environmental narratives in simultaneous play with the toys—using eco-fiction design criteria successfully engaged children in outdoor nature play.

This design strategy enabled me to step away from an anthropomorphic design mode and develop a range of characters for a more sensitive ecosystem worldview. During playtesting (Section 6.1) children found the characters' anthropomorphic design appealing and could use the visual and narrative cues from the toys to inform imaginative nature-influenced play. The playtesting sessions demonstrate a sustained interest in small world play with the toys and an ability for the toys to enable children to slow down and spend more immersive time playing in nature.

The findings show several areas for further development. Changing consumers' perceptions of outdoor play and how character toys can be used outside is challenging. As a design, The Underfoot toys demonstrate an ecosystem, both in the narrative and implied play cycles. However, this was only sometimes evident to the children, who still saw them as independent characters rather than a system.

The playtesting samples were small due to the bespoke nature of the prototypes, so testing with a larger group, where children have a more extended experience with the toys, would yield more conclusive results

as to the effectiveness of the toys in communicating environmental narratives. The appraisal from the toy industry showed a strategic interest in the design of character toys for outdoor play. However, the industry experts felt it would still be challenging to sell this idea to parents and questioned how the product would be promoted alongside similar character licensed toys.

This study extended research into eco-fiction media, adding toy design to the genre currently attributed to literature and games. In an increasingly anthropocentric world, children are seeking ways to understand climate change and what the natural world means to us. The Underfoot research opens up further opportunities to investigate how eco-fiction toys can be designed for children with limited access to natural spaces and the blurring of boundaries between indoor and outdoor environments.

The Underfoot design contributes to new knowledge and innovation in the genre of doll and action figure design. Designing toys with play in natural spaces as an integral feature challenges industry assumptions about the difficulties of designing outdoor toys. It proposes new integrated approaches to design development supportive of the need to create a new genre of toy design that sits at the intersection between outdoor toys and doll and action figures.

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9 Appendices

Appendix 1: Ethics

My Applications					
Template Category	Primary Investigator	Application ID	Application Title	Workflow State	Status
Human Ethics	Tanya Marriott	4000026968	Wild Play - An eco...	Complete (Low Risk)	Approved
Human Ethics	Tanya Marriott	4000026566	Wild Play - An eco...	Complete (Low Risk)	Approved
Human Ethics	Tanya Marriott	NOR 21/02	Wild Play - An eco...	Complete	Approved

1.1. Full ethics application - NOR 21/02: Wild Play - An eco-fiction toy design Playtesting and focus group work

The project used a screening questionnaire filled out by children and caregivers to gather basic user demographics and qualitative data regarding character toy play, outdoor play patterns and media consumption. Parents/caregivers indicated their child's interest in participating in a focus group at the end of the questionnaire. Nine children from the focus group were selected for the playtesting sessions and toy design workshop. After the focus group, participants were contacted via email and invited to participate; they received an event information sheet, a confidentiality agreement and a consent form. Once accepted, parents/caregivers and their child participated in any of the three (3) playtesting sessions at six-monthly intervals between 2021 and 2023 (starting in July 2021) and a design workshop in August 2022. During the one-hour playtesting sessions, play engagement was evaluated through observational analysis. A new iteration of the character toy range was made available for testing at each playtesting session. During a subsequent one-and-a-half-hour toy design workshop moderated by the researcher, children were provided with safe "making" tools and materials, which they used with natural materials to make playsets for The Underfoot toys.



27/04/2021

Dear: Tanya Marriott

Re: Ethics Application - NOR 21/02 - Wild Play - An eco-fiction toy design

Thank you for the above application that was considered by the Massey University Human Ethics Committee:

Ohu Matatika 2 at their meeting held on **Thursday, 25 February 2021**

On behalf of the Committee I am pleased to advise you that the ethics of your application are approved.

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely



Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

1.2 Low-risk ethics application - 4000026566: Wild Play - An eco-fiction toy design - Parent feedback

After each playtesting session, I conducted follow-up phone interviews with parents regarding any lasting impacts of the playtesting activity. Creative design iteration is an essential process for the project's success, and to continue developing the toys' design, I was keen to see if the children were still engaged in the toys beyond the playtesting session. Using the Sesame Workshop playtesting resource (Joan Ganz Cooney Center) as a guide, the follow-up interviews gave further insight into aspects of the design children might not have talked about in the observational session or that parents, being more familiar with their children, will have picked up on. This gave me another feedback perspective to consider and implement within the design process. The phone call discussions were five to ten minutes with each parent.

1.3 Low-risk ethics application - 4000026968: Wild Play - An eco-fiction toy design - Toy industry feedback

I conducted two in-person interviews and one Zoom interview and toy appraisals with designers in the commercial toy industry based in the USA and the UK. The purpose was to define the current level of eco-fiction design undertaken by commercial toy designers within their product development, their views on the need for an environmental focus on the doll and action figure design, and whether their doll and action figure designs were designed for outdoor play.

Appendix 2: Toy Play Questionnaire

2.1 Toy play screening questionnaire

This is the link to the screening questionnaire: <https://forms.gle/Yb2xmJ2qTst7dFXe7>

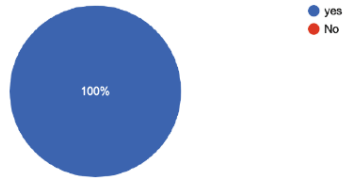
The questionnaire participants discussed the character toys they play with, whether they play with their toys outdoors and their curiosity about the natural world around them. The questionnaire participants were then eligible to participate in subsequent playtesting of the toy designs. Participants were originally to be sourced from local schools in the Miramar peninsula, but due to COVID-19 restrictions, this was not possible, so participants were sourced through Kiwi Conservation Club KCC¹. The questionnaire was sent out to members of the Kiwi Conservation Club and Wellington residents of the Miramar peninsula on social networks. The questionnaire attracted 19 participants, of which 58.8% (10 children) were Kiwi Conservation Club members, and 41.2% (7 children) were not Kiwi Conservation Club members. The results of the questionnaire are below.

¹ Kiwi Conservation Club was approved as a backup source to local schools in the ethics application.

Consent

I consent to my child and I completing this survey

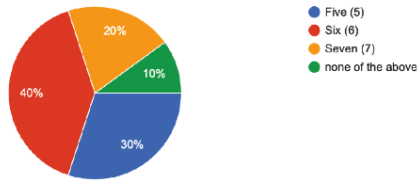
20 responses



Section 1 of 4 : Demographics

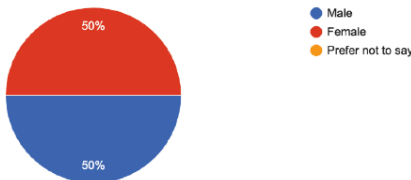
1. What is the age of your child

20 responses



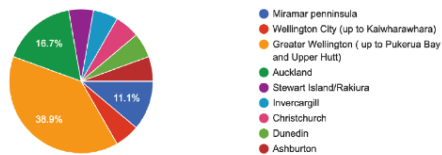
2. What is the gender of your child

18 responses



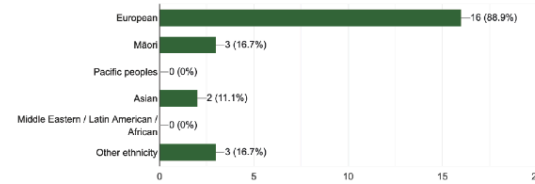
3. What community do you live in?

18 responses



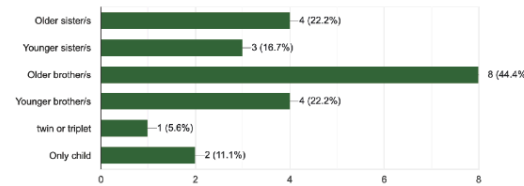
4. What is your family Ethnicity

18 responses



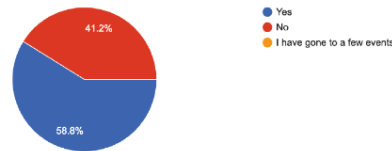
5. How many siblings does your child have

18 responses



Are you a member of Kiwi Conservation club

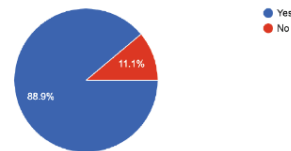
17 responses



Section 2 of 4 : Character Toy Play

1. Do you play with Character toys

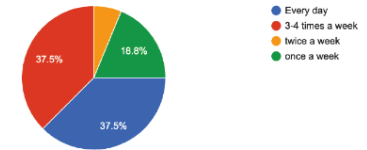
18 responses



Section 2 of 4 : Character Toy Play

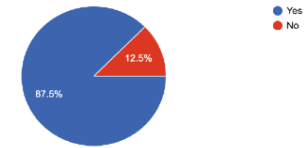
2. How many times a week do you play with character toys

16 responses



3. Do you have a favourite character toy?

16 responses



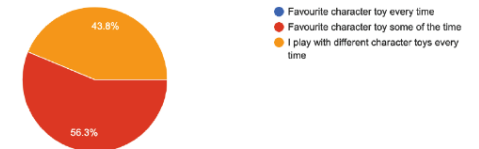
3a. Why is this your favourite character toy

13 responses

- Because he is cool (Spiderman)
- I like that you can move different parts of the body a lot
- Because I like bunnies because they are so cute
- Batman
- I like it because it's a robot and then it's a car
- Because I like it
- Because it can talk and is really cute. It's special because I got it from my dance teacher.
- Because I had it from when I was born
- Lego characters - Ninjago
- Elsa from Frozen
- Because I love ponies
- Cause I like her show
- Don't play with alot of character toys but love Spiderman, hulk and other superheros

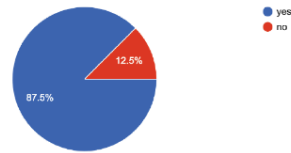
4. Do you play with your favourite character toy every playtime? or do you play with different character toys?

16 responses



5. Do you make up stories when you play with your character toys?

16 responses



5a. Can you describe one of the stories you have made up for your character toy?

13 responses

- Monster trucks were fighting the little cars!
- I have three stormtroopers and I like to pretend they are a family doing fun things together
- It's called the 8 monkeys, it's about 8 monkeys on a vine one said there is a cave down there
- Batman goes on a Star Wars Lego ship to fight the baddies
- Not really
- I make movies with dinosaurs, or sometimes dragons or lego characters from Jurassic world
- They go on rides with other toys
- When Pinky Pie was drinking her milk from her bottle she found something hard. She opened up the bottle and found a diamond. She took the diamond out and put it on her lab table.
- "We flew over Wellington together and saw all the buildings"
- I made up a game called Cars and Elsa was riding the cars and she was fixing the cars.
- Cooking some dinner and going to bed and waking up and calling for the mum.
- Play salons and dress ups
- Bank heist etc

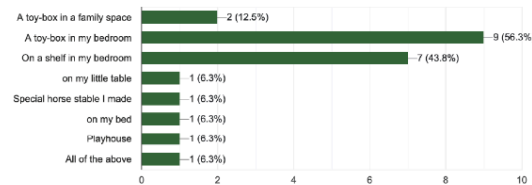
5b. Do you know what inspires your character toys story ideas?

13 responses

- I make it up in my head
- They always come from the treehouse books, because when they had the marshmallow thing I thought of the story that there was a swimming pool of marshmallows
- Things I have read and done, listened to and watched.
- Batman and the Star Wars movies
- Watching them on tv.
- videos or books
- From the movies and episodes
- Just from my thinking
- Nature
- the toys themselves
- Because you (mum) do that.
- From the tv shows
- Tv and dress ups

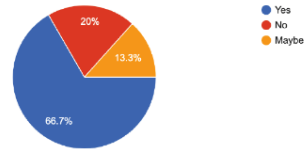
6. Where do you keep your character toys when you are not playing with them?

16 responses



7. If you display your character toys in your bedroom, do you make your own toy displays?

15 responses



7a. If you made your own character toy displays, what materials did you use to make them?

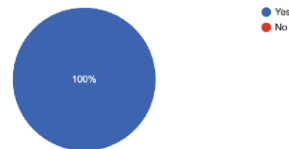
11 responses

- Box, egg carton, string for hanging
- My wool and my containers and my toys and boxes
- Lego, boxes, containers
- Boxes and wood and leaves and sticks and stones
- Toys and books lego
- Cardboard, paper, paint, pencils
- na
- anything like cardboard and stuff that was packets
- magnets and lego and duplo and playmobile and I also made them with paper and cardboard
- Shelves and playhouse
- Cardboard all sort

Section 3 of 4 : Outdoor Play time

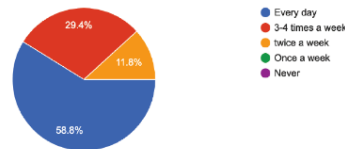
1. Do you play in a garden, park, forest, beach or other green-space?

15 responses



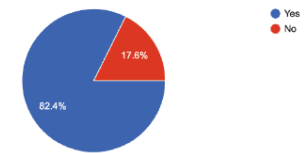
2. How often each week do you play in a garden, park, forest, beach or other greenspace?

17 responses



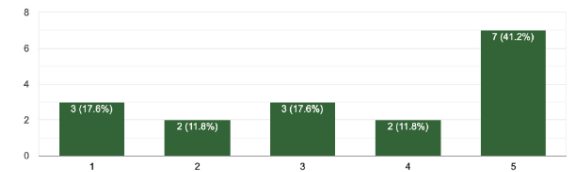
3. Have you ever played in mud?

17 responses



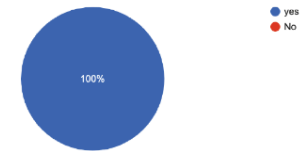
3a. When you think of the word mud what does that make you think and feel?

17 responses



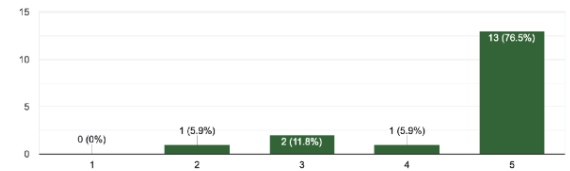
4. Have you ever held an insect/spider/bug?

17 responses



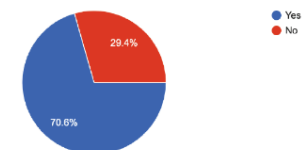
4a. When you think of the word bugs, what does that make you feel?

17 responses



5. Do you play with your character toys outside?

17 responses



5a. Can you describe one of the stories you have made up for your character toy?

13 responses

- Monster trucks were fighting the little cars!
- I have three stormtroopers and I like to pretend they are a family doing fun things together
- It's called the 8 monkeys, it's about 8 monkeys on a vine one said there is a cave down there
- Batman goes on a Star Wars Lego ship to fight the baddies
- Not really
- I make movies with dinosaurs, or sometimes dragons or lego characters from jurassic world
- They go on rides with other toys
- When Pinky Pie was drinking her milk from her bottle she found something hard. She opened up the bottle and found a diamond. She took the diamond out and put it on her lab table.
- "We flew over Wellington together and saw all the buildings"
- I made up a game called Cars and Elsa was riding the cars and she was fixing the cars.
- Cooking some dinner and going to bed and waking up and calling for the mum.
- Play salons and dress ups
- Bank heist etc

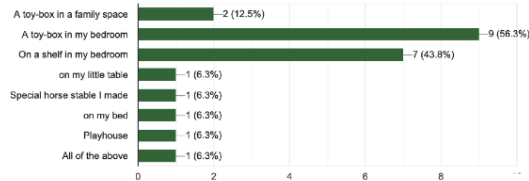
5b. Do you know what inspires your character toys story ideas?

13 responses

- I make it up in my head
- They always co.e from the treehouse books, because when they had the marshmallow thing I thought of the story that there was a swimming pool of marshmallows
- Things I have read and done, listened to and watched.
- Batman and the Star Wars movies
- Watching them on tv.
- videos or books
- From the movies and episodes
- Just from my thinking
- Nature
- the toys themselves
- Because you (mum) do that.
- From the tv shows
- Tv and dress ups

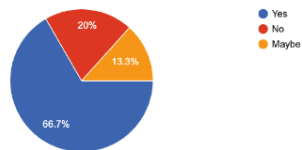
6. Where do you keep your character toys when you are not playing with them?

16 responses



7. If you display your character toys in your bedroom, do you make your own toy displays?

15 responses



7a. If you made your own character toy displays, what materials did you use to make them?

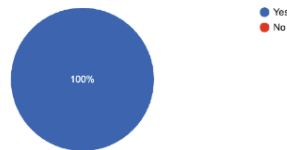
11 responses

- box, egg carton, string for nanging
- My wool and my containers and my toys and boxes
- Lego, boxes, containers
- Boxes and wood and leaves and sticks and stones
- Toys and books lego
- Cardboard, paper, paint, pencils
- na
- anything like cardboard and stuff that was packets
- magnets and lego and duplo and playmobile and I also made them with paper and cardboard
- Shelves and playhouse
- Cardboard all sort

Section 3 of 4 : Outdoor Play time

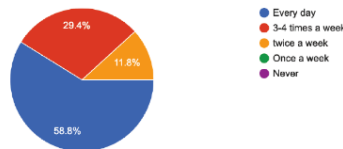
1. Do you play in a garden, park, forest, beach or other green-space?

15 responses



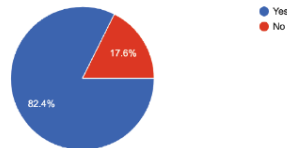
2. How often each week do you play in a garden, park, forest, beach or other greenspace?

17 responses



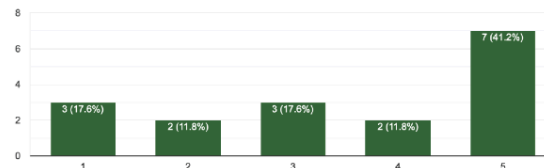
3. Have you ever played in mud?

17 responses



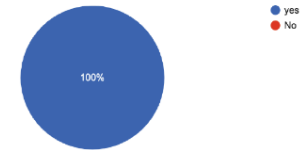
3a. When you think of the word mud what does that make you think and feel?

17 responses



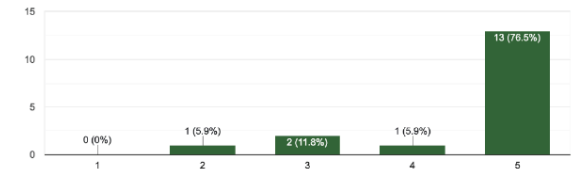
4. Have you ever held an insect/spider/bug?

17 responses



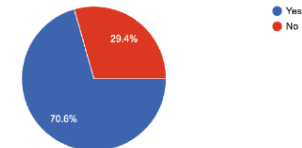
4a. When you think of the word bugs, what does that make you feel?

17 responses



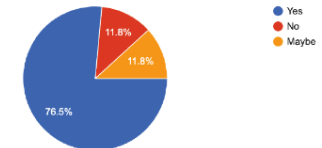
5. Do you play with your character toys outside?

17 responses



5a. Do you want to play with your character toys outside?

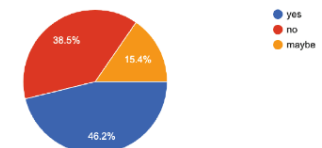
17 responses



Section 3 of 4 : Outdoor Play time

6. When playing with your character toys outside, Do you make play homes outside for your toys out of natural materials?

13 responses



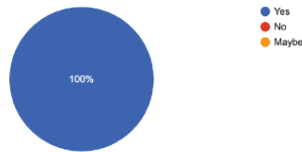
6a. If you do make play homes outside for your toys out of natural materials? what materials do you use?

9 responses

- I make things on the trampoline
- Twigs, bamboo sticks, leaves, grass, flowers, moss
- Sometimes leaves sometimes sticks and sometimes both.
- Sticks and stones and bushes and leaves and tree stumps and sometimes sand and mud pie slides
- Leaves, branches, grass, flower buds
- na
- I would use wood, leaves and bark
- grass and leaves
- Wood but i dont have wood

6b. Do you ever collect materials from outside such as leaves, sticks, shells, stones etc and bring them inside?

13 responses



7. Can you describe one of your favourite places outside to play with your character toys?

13 responses

- I rampoline
- In sand pit, muddy areas, grass
- At my fairy garden
- Down by the creek, in my hut, in the tramp
- In my tree hut or in the sandpit or in my secret bush hiding place or up in my climbing tree
- beach
- By my playhut
- If I could take my character toys outside, I would want to play with them in a quite pla flowers.
- outside at my house
- In the garden
- the deck
- By the castle (pretend castle) by the sunroom
- At the beach

8. Can you describe some other living things that are in the community around you?

13 responses

- My cat and neighbours
- Cockroaches, wetas, birds, wasps, spiders
- Dogs cats chickens fish fantails tul ladybug butterfly caterpillars foxy (toy foxy) lizards
- Bugs birds worms bees trees eels wasps
- Birds and insects and slugs and the lamblies and chickens and our cat. Sometimes thi bees
- skinks, sea gulls, octopus on the rocky shore, birds on the garden, stick insect in the trees a house
- Cats, bugs, birds, dogs
- Trees, flowers, grass, fantails, cockroaches, maggies, dogs, ants, worms
- people, birds, insects, cats and dogs, horses
- Monty (our cat), sparrows, birds, butterflies, dragonflies, plants
- birds, horses, bunny rabbits, trees, plants, lizards, skinks
- Bugs, birds, trees, dogs, puppies
- Spiders birds worms

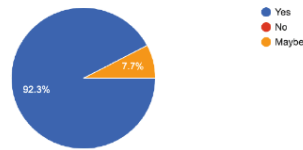
8a. From these, what are the most important living things in your community and w

13 responses

- My cat cos she's cute and we need to feed her
- Spiders because they catch bugs
- Lizards and cats and dogs and toy fox
- Everything its part of mother nature
- Bees make honey and I like honey. I love our chickens too because they make us eggs.
- skinks, they are rare and we should protect them. We shouldn't let cats outside and make lizard garden so skinks can hide
- Bugs, some bugs pollinate our flowers and make the food grow
- Worms. Cos the help our plants grow.
- animals, because if there were no animals there would be no us
- I dont know, plants?
- horses because I can ride them
- Tree's because birds live in trees and make nests and lay eggs In them
- Birds so they can take your food

8b. Do you think it is important to take care of all the living things in the community around you?

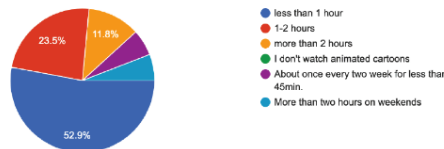
13 responses



Section 4 of 4 : Media and Toy demographics

1. How many hours per day do you watch animated cartoons either on TV or online

17 responses



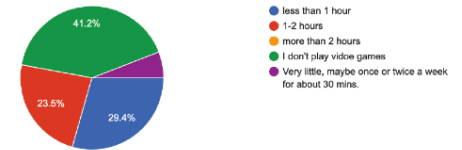
2. If you do watch animated cartoons, what is your favourite animated cartoon? and why?

17 responses

- Bugs Bunny coz it's funny.
- Archibald's great big thing. Because it's funny and adventurous
- PJ Masks
- Sunny bunnies
- Octonauts because they have bugs creatures and people
- Octonauts they travel around the world and help animals
- Star Wars - because my dad and I watch it
- Lego Ninjago because they're Ninjas and they have cool adventures
- Deep on Netflix, because they are always living an adventure and there are cool sea ani sometimes monsters!
- Bugs Life
- Mira Royal Detective. All the mysteries she solves are interesting. I like how she shows respect to everyone.
- Grizzy and the Lemmings, I like it because it's funny
- Team titans
- Bluey; because it's sooo soooo funny
- Beauty and the beast
- Roblox
- Spidey and his amazing friends

3. How many hours per day do you play video games?

17 responses



4. If you do play video games, what is your favourite video game? and why?

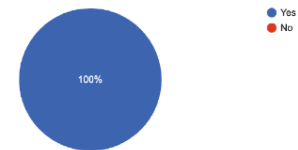
10 responses

- Prodigy because it's a maths game and you get pets and there's spells and cool missic wizard. And you get to spin wheels which get you cool prizes. And you get buddies which are different from pets but they're cute and follow you around just looking cute.
- Roblox and Minecraft because they are cool cos I can make stuff and in Roblox you can play anv game
- Mario Car (This is her favourite, but she doesn't play it. She plays Mine Craft with her brot' is shared).
- Monster hunter, because it is cool
- Snake io I like it because it involves creatures
- I don't play video games
- Minecraft, because you get to build your own things in creative you can never die. And it's fun
- The colouring game. I like to colour because it's interesting.
- Reading eggs because it's makes me learn and read
- Roblox cause you can be what you want

Taking part in the Focus group.

1. Would your child, with your permission like to express an interest to join the design focus group and participate in any play-testing and toy design activities?

17 responses



Appendix 3: Product Reviews

3.1 Toy product review

The toy product reviews were conducted between 2018 and 2023. My approach was to understand the competitor's product and in what way these products may fit my design criteria. I conducted eight (8) in-store toy product sample reviews. I used the following eco-fiction criteria to assess each toy.

- 1. The toy is a character licence.** Any toy with an accompanying licence in books, merchandise, TV series, films, games, etc., that expands on the narrative of the toy world.
- 2. Dominant non-human characters.** Human or humanoid characters can be in the range but cannot be the primary or dominant characters. Toy ranges without human characters or with human characters that demonstrated an understanding of human impact on the animal characters scored higher. For example, the researchers drilled ice core samples in the Playmobil Arctic Explorer with a Polar Bear toy. The product states they are looking for Ice crystals, but the ice drilling activity is core to climate science, where scientists drill Ice cores to access ice melt caused by global warming. Polar Bears are a prevalent creature used to discuss ice melt.
- 3. Evidence of an ecosystem or environment.** The toy playset needs to have an environmental theme; if it has other characters, it must represent other creatures within the habitat. A collection of toy animal characters combined with the playset starts to demonstrate aspects of an ecosystem.
- 4. Representation of human impact within the toy.** This criterion explores how humans are represented in the toys and whether their representation demonstrates human impact on the environment. For example, in the Barbie animal rescuer toy, Barbie is a doctor who cares for the animals; what is left open is why the animals need to come to Barbie to be rescued, which leaves scope for children to fill in the blanks. The Playmobil Arctic Explorer toy also shows humans as researchers studying the Ice. This is a tricky criterion to ascertain "human impact", but if children play with these toys combined with knowledge about climate change learned in school, the toy play can take on a deeper meaning where children can question the role of the human.
- 5. Characters are doing non-human things.** This criterion looks at play actions where animals behave like animals and not humans. The Sylvanian Family delicious restaurant (Fig. 1) is a good example, where swapping out the animal character to be another animal character makes no difference to the play as the animals are enacting the human action of running a restaurant.
- 6. The toy is designed for Outdoor play.** The toy has been designed to be used in outdoor play. No toy fits these criteria. The example below (Fig. 1) demonstrates a sample of how I mapped and analysed a toy range for eco-fiction criteria.



Figure 1: Eco-fiction toy product audit example.

Upon entering the toy store or department, I canvassed the aisles’ layout and character toys’ locations. Character licenced toys are generally pocketed across the store. I used this initial walk-around to ensure nothing was missed. In the second walk around, I photographed toys that first met the eco-fiction toy criteria in the list, which were a character licenced. I photographed anything that fit at least two of the eco-fiction criteria. The photographs were of the front of the packaging, but if there was a narrative on the back, I photographed that as well.

The toy images were collected and laid out in a Miro online canvas under each date heading, with the eco-fiction criteria formatted in 5 equal-sized circles. Each toy was accessed, and criteria circles were scaled based on a percentage of representation of each criterion - with small circles representing 50% or less and larger circles representing 50% or more. If a criterion was not represented, I then removed the circle. I then re-categorised each toy, placing the toys that most fit the criteria to the left and the ones

that fit the right. In this example, the toys that most fit the criteria included products that included environmentally focused playsets such as magical forests, the Arctic and coral reefs. The combination of playset and animal characters is demonstrated as an ecosystem. Toys at the other end of the scale presented animal characters as living in human houses, as pets of humans or behaving as humans. The mid-ground has toys with dominant human characters or no character narrative. None of the toys met the criterion for outdoor play.

3.2 Animation product review

This followed a similar assessment format as the toy product audit. The website Common sense Media was used to gather lists of potential eco-fiction animation series for children. Common sense Media provides an extensive review of all children's television and film media and is a reliable resource of media reviews for parents, education providers and researchers (Common Sense Media). Media can be filtered by child age and pre-made lists, including climate change and environmental. Children's TV shows were triangulated across various lists and keyword searches. External internet searches for environmental animation for children and nature or climate change shows also resulted in shows reviewed by common sense media. Once a sample was gathered, the animation shows were assessed using the following criteria:

1. **The show is a character licenced—The animation has an accompanying licence in toys, books, merchandise, etc.**, expanding on the toy world's narrative.
2. **Dominant non-human characters** - The main characters in the animation are non-human
3. **Evidence of an ecosystem or environment** - The animation narrative focuses on an environment or ecosystem narrative, or at the least, places the animal characters within an animal environment.
4. **Evidence of human impact within the show** - This is specifically relevant to animated series that include human characters, that the narrative makes human characters responsible for their impact on the other. An example of this is in the animated series *Fraggle Rock*, where Uncle Travelling Matt is a Fraggles who visits the human world, known as “silly people”. He documents their peculiar lives in sharp contrast to the interconnected ecosystem of *Fraggle Rock*.
5. **Characters are engaged in non-human activities** - Most animations anthropomorphise animal characters to a certain extent to make them relatable to the audience. In *My Little Pony: Friendship is Magic*, the ponies live in human houses in Ponyville, but the narrative also places them in more organic fantasy landscapes such as forests and mountains. The ponies run on all fours and behave like magical versions of normal horses.

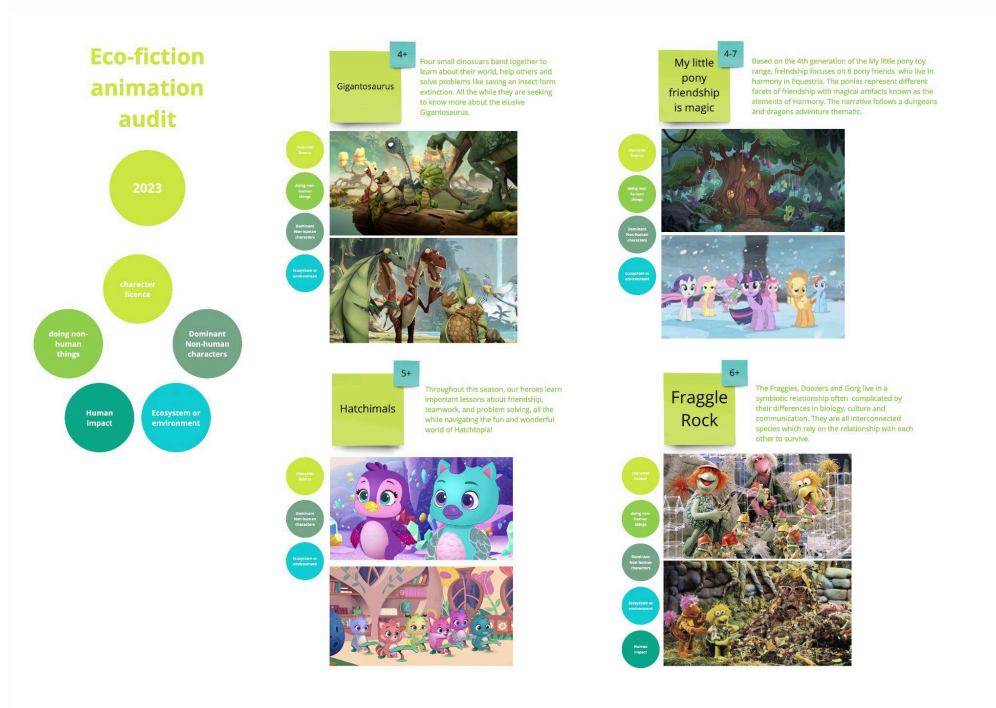


Figure 2: Eco-fiction character animation audit.

(Fig. 2) The above is a sample of the eco-fiction character animation assessment process. I watched trailers and episodes of each animated series to gauge the narrative understanding of the key characters, Figure 2 shows a sample. Each animation was assessed similarly to the character toys, where the show was assessed as to how many criteria it met for an eco-fiction narrative. The criteria were assigned and not scaled, as the selected animated series had already been screened to be an environmentally focused narrative. The assessment was to see how many of the criteria each show met.

Appendix 4 : Playtesting

“Wild Play” An Eco-fiction toy design

Design flowchart with consideration for ethical practice.

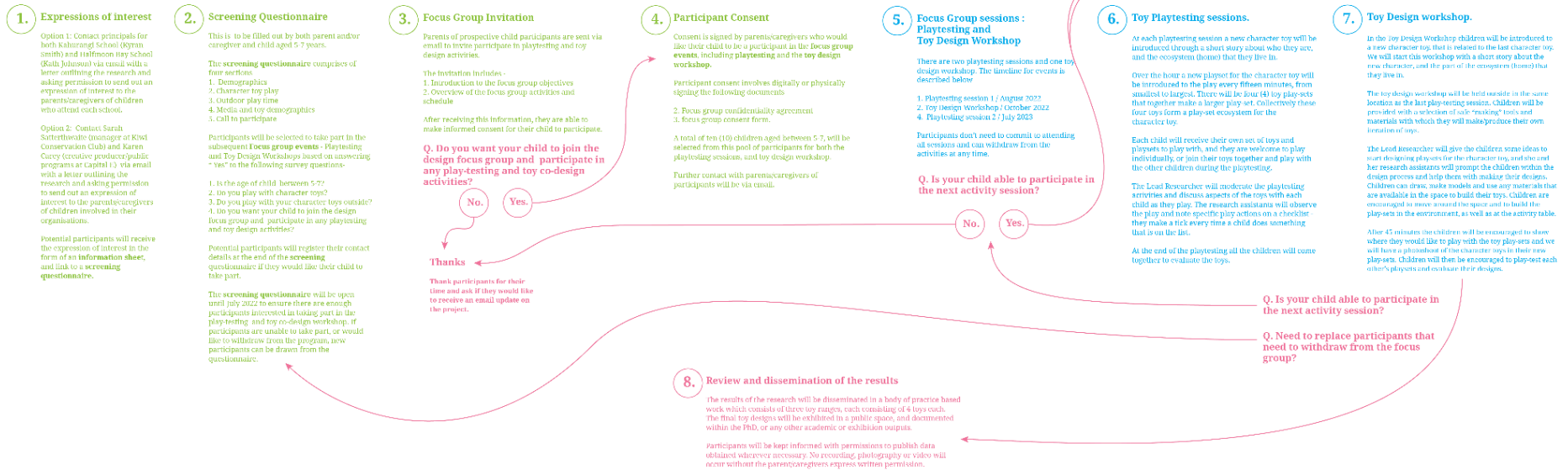


Figure 3: “Wildplay” The Underfoot Ethics workflow for playtesting and the toy design workshop.

Participants completed the Wildplay screening questionnaire and indicated their interest in participating in the playtesting sessions and toy design workshops. The questionnaire was sent out initially in 2021, and due to the COVID-19 pandemic restrictions in place at the time in New Zealand, Aotearoa working with schools was not viable. I pivoted to plan B as described above. I worked with my contacts within the Kiwi Conservation Club, who sent out the questionnaire/expression of interest to their networks via social media and email. I also shared the call on my own social media channels. Responses came in from across Aotearoa New Zealand, with the highest response from Wellington. Due to the ongoing COVID-19 pandemic restrictions and uncertainty around face-to-face research and travel, I narrowed my scope to participants in the Wellington region to ensure playtesting sessions and the toy design workshop would occur. I contacted the parents of all potential participants in Wellington and invited them to participate in Playtesting Session 01. Participants for the Toy Design workshop came from the Wellington branch of the Kiwi Conservation Club, and participants for Playtesting Session 02 were also drawn from the questionnaire participants.

The Playtesting sessions and Toy Design Workshop were held at Centennial Park in Maupuia, Wellington. This is a regenerated native bush area located at the northern flank of the Miramar peninsula. The area faces south and tracks up the valley. Popular with mountain bikers and hikers, it is also home to many indigenous insects, birds and plants, including all of the creatures the toys represent: Peripatus, Slater, Saphrobic fungus and Rangiora leaves. The terrain consists of low shrub plants and trees such as Kawakawa and Rangiora, flax and punga alongside larger, more established trees.

4.1 Playtesting 01 Summary and Data

Playtesting session 01 was held in August 2022, the middle of the Aotearoa New Zealand winter. It had been raining heavily for days, so the terrain was boggy and muddy. The children were happy to play in the space and were not dissuaded by the mud. Half of the participants sat in the mud and engaged in the small world play, whereas the other half did not sit in the mud and preferred to play standing up.

In the Playtesting 01 session, a new character toy will be introduced through a short story about who they are and the ecosystem (home) that they live in. Over the hour, a new character toy playset was introduced to the play every fifteen minutes, from smallest to largest. There were four (4) toy playsets were introduced during the session. Each child received their own set of character toys and playsets to play with, and they were welcome to play individually or join their toys together and play with the other children during the playtesting. As the lead researcher, I moderated the playtesting activities and discussed aspects of the toys with each child as they played. My research assistants observed the play and noted specific play actions on a checklist; they make a tick every time a child did something on the list. Playtesting can often be very fast-paced, and a simple method was employed to help us keep track of the children's play actions and plot the data.

At the end of the play session with each toy, all the children were brought together to chat about the toys and what they liked or didn't like about them. After this discussion, the children were given the next toy to play with, but they could also continue playing with the previous toys. At the end of the session, the children chose two toy prototypes to take home. A follow-up interview was conducted with available parents regarding continued play with the toys.

This is a summary of the play actions checklist for playtesting session 01 (please note that toys Mix and Myco were not used in this session as they were still in development).

Figure 4: (Overleaf) Results from the first playtesting session.

**Playtesting 01
Grey models**

- 4 children
- Aged between 5-7
- 2 x boys, 2 x girls (mix gender siblings)
- 15 minute play with each toy
- 4 x toys Oke velvet worm, Wriggle Pillbug, Sift and Rangiora Leafy
- Toys are grey models.
- Playtesting is primarily to check toy function, and if and how children play with the toys.
- Play location was at Centennial park beside a creek.

- Girl_01
- Girl_02
- Boy_01
- Boy_02

Favourite toys

Oke and Sift were the most popular toys due to character cuteness (Oke) and function (Sift).

Wriggle and Leafy were less popular. Children did like them but challenges in functionality was a factor in their popularity.



General comments

fills the toy squirter in the creek	●●●●	Uses the toy to punch leaf shapes	●●●●	Finds a leaf to use with the boat	●●●●	Uses the toy to sift soil and leaves	●●●●	Children generally needed some help in order to work out how to "activate" the toy function.
Repeats the action	●●●●	Repeats the action	●●●●	Repeats the action	●●●●	Repeats the action	●●●●	Most children gave the toy several tries to get it to function. One child used the leaf boat in the creek once, and then played with it already set up on trees and branches instead.
Sits on the ground	●	Sits on the ground	●	Sits on the ground	●	Sits on the ground	●●	Children sat on the ground for the longest time when playing with the Mix toy.
Plays with the toy on the ground	●●	Plays with the toy on the ground	●●	Plays with the toy on the Creek	●●●●	Plays with the toy on the ground	●●	More than half of the children played with the toys on the ground or creek. These children had no aversion to mud/water.
Uses natural matter with the toy	●●●●	Plays with the toy in a tree/bush	●●●●	Uses natural matter with the toy	●●●●	Plays with the toy in a tree/bush	●●●●	A majority of the children used natural materials in play, this was predominantly dirt/mud/water/leaves. The leaves were mainly off trees, with some leaf litter used.
Can't get the tail back in the squirter	●●	Can press the punch button	●●●●	Can't get the leaf and the toy	●●●●	Can reassemble toy parts	●●●●	The punch was stiff, leafy boat plugs hard to align and the tail squirter fell out of the toy. No issues with Mix
Plays with other children	●	Plays with other children	●●	Plays with other children	●	Plays with other children	●●	Most children played independently. Two children who didn't know each other played in parallel
Did not play with the toy		Played with several toys together	●●●●	Played with several toys together	●●●●	Played with several toys together		No child played with multiple toys, however several put toys in their pocket and swapped them out during play
		Did not play with the toy		Did not play with the toy		Did not play with the toy		All children played with all toys for at least 5 minutes and up to 15 minutes (when they were called back)
The tail kept falling out of the toy when the children tried to squirt it. They likes the character and chanted "Oke" They all tried filling it with water and played somewhat independently. Put finger in tail hole to use as a puppet. One child continuously walked the character up a Punga tree frond. Children put Oke in their pockets after play. Total play 5 minutes		One child called it an armadillo, and a little machine. They all liked the little legs. The mouth was so small and the punch was a bit still so they all had some difficulty getting the punch button to work. Two children remarked on the furry belly " so soft!" and pulled the belly fluff out. counted the legs and wiggled the body. The head came off, but most of the children could put it back on without parent help. Total play - 10 minutes		They struggled to get the leaf sandwiched between the top halves, the plugs are too stiff. The all put the boat in the creek. Those that put it in gently noticed it stayed afloat. They liked putting the Oke character in the boat. One child held the leaf stem like a tail to hold the boat steady in the creek. None of them found a quieter part of the creek to play in, preferring the rapids. Total play - 10 minutes (could have gone longer)		This was a well structured toy with no obvious issues. children enjoyed filling Sift up with matter - leaves, dirt water etc. They used the sift function wet. Some children enjoyed the mortar and pestle grind aspect, others likes to shake the toy to mix up "potions" Total play - 15 minutes (could have gone longer)		Children played with all toys and have no obvious aversion to being out in nature and the mud. only one child made the toy a character and spoke as a character, but all children became completely immersed in play with at least one toy. Some children understood cycles of nature, but they all understood mud as poop. It was not clear that the children understood the toys were an ecosystem, but they did understand that they were non-human creatures. It was very wet and muddy which may be why most children didn't sit on the ground

4.2 Transcript and selected screenshots from Playtesting 01 video footage

Each research assistant had a GoPro camera, which they used to record footage of the play. Of the 4+ hours of footage, here are some highlight photos from the Playtesting session 01. Ethics approval precludes the playtesting session transcripts from being publicly available.



Figure 5: Photos from the first playtesting session.

4.3 Follow-up interview with parents about Playtesting 01

After the playtesting, each child was asked to choose a toy or two to take as a gift for participation. The following transcript is an interview with a parent who had two children in the playtesting session about any continued play with the toys at home.

Parent 01 - (Girl_01, Boy_01)

1. Did your child talk about the playtesting activity in the days after the event?

yes

1a. what did they talk about?

A few days afterwards, imaginary stuff, they both selected the same toys, so they discussed what each character they were going to be. They painted the toys almost immediately. Comparisons about what they would do with them took them to school to show people. Talk about getting a buddy, they both go to nature school one Friday a week. Talked about the playtesting session, rather than the toy. Obsessed with robots and minecraft. Boy is systems focused. Girl is more story-focused, nurture and baby-focused - imaginary-focused.

1.b Did they mention a favourite part/ least favourite part of the experience of playing outside with the toys?

They loved the squirting, taking the Papapa apart and putting them back together. Boy knows the character names. Boy had drawn a cartoon that included the worm. Reads graphic novels. Revenge of the Worm story, tells a narrative through the character.

Girl: She loved the squirt worm. She can take Rolypoly apart and plays a lot with the belly fluff. She is not so driven by building, but she loves painting and customising.

2. Did your child continue to play with the toys at home?

Yes - Boy - Had drawn a cartoon that included the worm.

2a. What play activities did they engage in with the toys?

Painting the Rolypoly. Numbers of legs. Taking the belly fluff off and on.

2c. What stories did they create while playing with the toys?

Boy - worms visiting a house. Saw the slips in the paper and drew the worm rescuing the people. Girl - is obsessed with animals - tactile - interested in soft materials. Match things - that goes with that. Needs to have all pieces of toys.

2d. Did they play with the toys inside or outside?

Both. "Tanya said these were outdoor toys". On the grass, walk them around the garden.

Boy - put the toy in his bag and took it to school. Not allowed to take toys to school but wanted to show his friends.

3. Have they adjusted the toys or made any additional designs for the toys?

Painted the toys and made stories for the characters.

4.4 Toy Design Workshop

The toy design workshop was held in October 2022 with children aged five to seven from the Kiwi Conservation Club. In the Toy Design Workshop, children were introduced to The Underfoot character toy with a short story about the Underfoot characters and the ecosystem that they live in. Children were then invited to use natural materials from the environment and a selection of safe “making” tools and materials to create playsets for the toys. They were asked these three questions to respond to:

- Where does your character live? Can you design your character a home?
- What does your character like to do for fun? Can you design an activity for your character using natural materials
- How can your character protect their home from rain and flooding?

The Toy Design Workshop was also held at Centennial Park in Maupuia, Wellington, in a glade just above the stream. The children could draw, make models and use any materials that were available in the space to build their toys. Children were encouraged to move around the space and to build the playsets in the environment. Children were encouraged to collaborate with other children. However, many recruited their parents and guardians to help with their designs. After 45 minutes, the children presented their design ideas and discussed their creations. Each participating child was given a Velvet Worm toy to take home after the workshop.

A third of the children developed habitats and homes for their characters, and many of these homes consisted of house-like structures with at least four walls, and they looked very similar to commercial tree house toys. Most children used natural materials within their designs, especially in the treehouse designs; the materials were used for adornment and decoration rather than structure. Four (4) children were apparent exceptions; their designs are demonstrated in Figure 6. Two children made homes for their toys using either predominantly natural materials or those materials were used in a unique structure where the sticks held the home together, sheltered the character or held the character. One child made an elaborate water system from the bucket of soil and leaves—she described it as a filter feeder system for the Sift toy, where she could control how much water came into the character’s home based on a series of funnels that slowed the water process. The last child designed a series of swings for the Oke Velvet Worm and Sift out of sticks and leaves. Sift was too heavy, so they made a little platform off the trunk of the tree for the toy to sit using leaves and tape. The children actively engaged in the design workshop with the toys. They contributed to the next phase of iterative development by providing unique methods of using and engaging with the toys that aided in decision-making for further toy refinement.

Overleaf is a selection of images from the Toy Design workshop, with some final designs at the bottom.



Figure 6: Photos from the Toy Design Workshop.

4.5 Playtesting 02 Summary and Data

Playtesting session 02 was held in July 2023, early in the Aotearoa New Zealand winter. The bush was dry with minimal rain up until this time, and the creek was low, so we used a bowl of water as a backup for play. The playtesting was conducted in smaller groups over several sessions with two children at a time due to the limited range of completed toy sets for playtesting. In the Playtesting 02 session, The children were briefed on the characters' stories and then given a pamphlet for each character, explaining how they could be played. They were then shown all the toys and could choose what they wanted to start playing with. Each child had their own set of toys, but both pairs joined the toy sets together and played with duplicate characters. The play activity lasted 40 minutes, and then the children were called back for a brief discussion about the toys. My research assistants observed the play and noted specific play actions on a checklist—they make a tick every time a child did something on the list. At the end of the session, the children were given a grey model Velvet Worm to take home. A follow-up interview was conducted with available parents regarding continued play with the toys. This is a summary of the play actions checklist for playtesting session 02. (this playtesting session included all toys in their finalised state).

Figure 7: (Overleaf) Results from the Second Playtesting session.

**Playtesting 02
Final models**

- 5 children
- Aged between 5 - 7
- 3 x boys, 2 x girls (2 x Girl cousins played in one session, 2 x Boy friends played together, 1 x Boy played solo)
- Play with all toys for 45 minutes, choose what they like
- 5 x toys Oke velvet worm, Wriggle Pillbug + Tilly, Mix and Sift, Rangiora Leafy and Myco.
- Toys are final coloured models.
- Playtesting is to observe if and how children play with the toys, and how they bring nature into their play.
- Play location was at Centennial park in a forest clearing slightly away from the creek. Water was provided in a bowl

Toys chosen first

- Boy_03
- Boy_04
- Girl_03
- Girl_04
- Boy_05

● Oke Velvet worm
● Wriggle Pillbug and Tilly
● Rangiora Leafy
● Mix and Sift
● Myco

Favourite toys
Myco was the most popular toys, children tended to gravitate to this toy first, and named this toy as their most favourite as either a first or second choice. There was an even distribution of favour to the other toys, with Wriggle Pillbug and Tilly as the least favourite toy with only one child choosing this toy. They played with Tilly more than Wriggle.



General comments

	Oke Velvet worm	Wriggle Pillbug and Tilly	Rangiora Leafy	Mix and Sift	Myco	General comments
fills the toy squirter in the creek/water bucket	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	With the toy revisions from the gray scale stage, most of the toys functioned well. There were still challenges with the worm tail and where to put the leaf in Wriggle. The magnets were not strong enough in Myco to hold the arms on, but this did not appear to impact on play.
Repeats the action	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	Half of the children repeated the action. As they could choose what they liked they tended to move on to a toy they likes and played for the duration with that toy.
Sits on the ground	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	Three children sat on the ground constantly, and two children preferred to play standing. The two standing children tended not to get as hands-on with messy nature during play.
Plays with the toy on the ground	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	All children played on the ground or in water at some stage during play. The children that were the most immersed in solo play tended to sit closed to the ground.
Uses natural matter with the toy	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	Everyone used some form of natural during play, the most popular materials was dirt (mud) water, a variety of leaves and sticks. They all actively used the natural materials in and on the toys during play.
Can't get the tail back in the squirter	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	Still some issues with the worm tail popping out when squirting, but all children could put it back in. Other issues were more around a dissonance with explicit cues - eg the boat comes apart, feed Wriggle the leaf into it's mouth.
Plays with other children	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	All children engaged in parallel play, but in their own worlds. The communicated with each other, to show what a toy did, or share toys, but playing collaboratively minimally.
Did not play with the toy	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	As the play session increased the children introduced more toys into play as extra tools or agents for the play that they had started. The boys dominated the environment with the toys as tools. The girls fitted the toys into the natural environment as agents within the space
	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	The children played with all of the toys, but one child did not play with Wriggle.
All children played with the velvet worms. the bright orange worm was the most played with - one child referred to it as "the red fire dude" All children still had issues with tolerancing on the tail mechanism, one boy commented that they didn't play with the brown version of the worm as "it didn't do anything. All boys stopped playing with the worm once they had completed one squirt, and did not play with the character further. Once girl collected all three velvet worms and played with them as the primary toy for over half an hour. She walked them up branches, made nests for them in sapling knots, washed them in water, and used them to "see" the natural world. She walked one toy up to a small spider and "observed" the spider through the toy.	The mouth was enlarged from the initial playtesting so punching the leaf was much easier to achieve. Both girls understood you needed to "feed" the character, however one boy required prompting from the researcher to put the leaf in the characters mouth. From observation of the playtesting video footage this toy had the least amount of play time. Children like the furry belly, the wiggly feel, and most managed to get the toy to punch the leaf. One girl played with this toy for 10 minutes. Her primary play was to put leaves in Tilly and mix them up. She punched leaves a couple of times but then left the toy on a log. One child did not engage with this toy at all.	The Rangiora leaf was another challenging toy. The use of Magnets made the toy much easier to use and children were able to put it together easily. Most children works out that the boat was in two parts. Finding the right sized leaf was a challenge but all children achieved this with some researcher prompting - they needed to do a bit of exploring to find the right leaf. One girl played with the leaf boat in shallow water, with a character in the centre without using a leaf. One boy found the right sized leaf, but proceeded to break it up to push it into the cavity - he didn't intuitively work out the toy broke into two halves. The boys were very keen to get the boat to float, but did not pursue this mode of play after several attempts. Both girls used the boat as a "vehicle" to carry the velvet worms in, and as a component of a "house" for other toys. Most children tried to fit different characters in the boat. The playtesting space was slightly elevated from the creek. All children wanted to go to the creek and take the toys. Had playtesting been right beside the creek they would have likely played with leafy boat more.	This was a very popular toy with a majority of the children playing with it for 10 minutes or more. Children preferred Sift (blue) to Mix (Orange) as they liked the sift function. Both Girls liked the flower toy located within Mix - they referred to it as the baby, and were disappointed when there was not a "baby" inside Sift. All children could pull both toys apart and put them back together. Both genders used Sift as a water transporter. A Girl mixed leaves in Sift, a Boy mixed dirt. Both referred to Sift a potion-maker, with both boys referring to scientist, whereas the girl used the potion to conjure a fairy. One girl used Mix to scrape fungus off the branch saying they were babies being sent back to ground mum. All Boys used both Mix and sift on the ground, whereas the Girl tried to balance Mix on a leaf. She wanted to build it a home in the tree. She used the leafy boat to build a home on the ground. The Boys used Mix and sift in conjunction with Myco as construction tools to dig and make mud pools. They liked how Mix can be used for digging.	Most children gravitated to this toy first. One boy commented that it was a giant walking thing. One girl reached out and touched it. All children were able to pick up Myco, pull it apart and put it back together. There were some issues with magnets not holding, but the children did not appear to notice. The Girls liked the softness of the arms, and pulled the "baby" out from the middle. They thought the holes in the body of Myco were windows for the "babies" (legs) to peak out. The Girls didn't play with the body so much, but did put it in the water. The wiggled the legs and used a leg to build a house. One girl liked how she could pour water out of the mouth of the Myco legs. One Boy used Myco as a mud pool. He plugged up the Myco body holes with an arm and filled it with water. He held the arm in place so he could carry water. He also took the body with an arm attached down to the creek and back. he plugged holes in the pelvis with mud and leaves so that he could fill it with water. He did not use any characters (worm) in play, but did use sift to carry water.	All of the children immersed themselves in toy play within the natural space for 45 minutes. Once they found a toy they preferred they engaged in sustained play for the duration of the play time until called back by the researcher. All of the children used natural materials with the toys - predominantly dirt (mud) water and leaves - both off the trees and on the ground. Most of the children read the pamphlets that came with the toys and used them to understand what the toys were. The girls put the pamphlets in their pockets to read later. Three children were just content to be in the forest, but two children got into flow during independent play. They did not engage with the researchers unless asked and played in their own world. The boy focused on construction play, using the toys to make ponds and water containment. His toy play was not character focused. The Girl used the three velvet worms in imaginative character play. She walked the toys along branches and trees and played a story through the characters. She made the velvet worms homes within separate hollows within a "family" tree and dressed the "home" with found foliage to shelter them from the Sun. Although most children did not play the prescribed narratives or characters of the toys, they did use the toys to engage in play with nature that could not be achieved indoors. They did not engage overtly in ecosystem play, but they did observe the creek was deeper than last time, and noticed fungus, spiders and spider webs and engaged with them in a respectful manner.	

4.6 Transcript and selected screenshots from Playtesting 01 Video footage

Highlight photos from the playtesting session 02 are documented below. Ethics approval precludes the playtesting session transcripts from being publicly available.



Figure 8: Photos from the second playtesting session.

4.6 Follow up interview with parents about Playtesting 02

After the playtesting, each child was asked to choose a toy or two to take home as a gift for participating in the playtesting. The following transcript is an interview with a parent who had two children in the playtesting session about any continued play with the toys at home.

Parent 02 - (Girl_03)

1. Did your child talk about the playtesting activity in the days after the event?

Yes

1a. what did they talk about?

Being in the bush, she enjoyed hanging out with REDACTED in the forest, and she loves being in the bush playing with the toys.

1.b Did they mention a favourite part/ least favourite part of the experience of playing outside with the toys?

Just that she loved being in the bush - no negative effects. It was the most favourite activity of the whole school holidays

2. Did your child continue to play with the toys at home?

Painted her toy with sharpies. Loves playing with the toys. Near the fireplace, putting it on the sticks, play with it on the dogs. Girl_03 took her toy to the zoo, took the branch from playtesting session to the zoo, for the toy.

2a. What play activities did they engage in with the toys?

She took a stick from the bush and took it with her to the zoo after play-testing. She showed her toy to all the animals and continued playing with it on the stick. She played with the toy at the zoo and over lunch for over an hour. The stick was left in the car.

At home, she played with the velvet worm toy on sticks in the wood bin near the fireplace. She has also walked it along the dogs fur. When Girl_03 has something that is special, she puts it on her table, this toy has made it to her table. She has lots of toys, but when there is a toy that she loves and reveres, she will take care for it and nurture it. She has lots of Barbies that she does not care about, they end up being left everywhere because she does not value them.

2c. What stories did they create while playing with the toys?

Not clear if she is making stories, Mum wasn't listening for stories.. At the Zoo she was talking to Mum through the toy.

2d. Did they play with the toys inside or outside?

At the zoo. Since playtesting, it has been muddy, so they have not taken toys outside. Girl_03 is finding natural elements in the house to play on—sticks and the dog's fur.

3. Have they adjusted the toys, or made any additional designs for the toys?

Girl_03 has customised her toy by colouring it with sharpies. She continues to add to the patterns she has made.

Appendix 5: Industry interviews, appraisals and reviews

5.1 Industry interviews

Interviews were conducted with three Industry experts. The interviewees are toy designers with 20+ years of experience, each working in the global toy industry. Respondents' names have been changed to retain anonymity and to protect the respondents privacy.

Expert 1(Matthew*): Toy designer and inventor UK (30+ years) 55 pages

Expert 2 (Michael*): Toy designer and mechanistic and inventor UK (20-25 years) 45 pages

Expert 3 (Sue*): Toy designer USA (0+ years) 53 pages

Ethics approval precludes the interview transcripts being publicly available.

5.2 Toy Fair review notes.

Discussions with industry visitors to the Underfoot booth at the Nuremberg Toy Fair in 2023.

Ethics approval precludes the discussion transcripts from being publicly available.

Appendix 6: Pitch Bible and Design Development

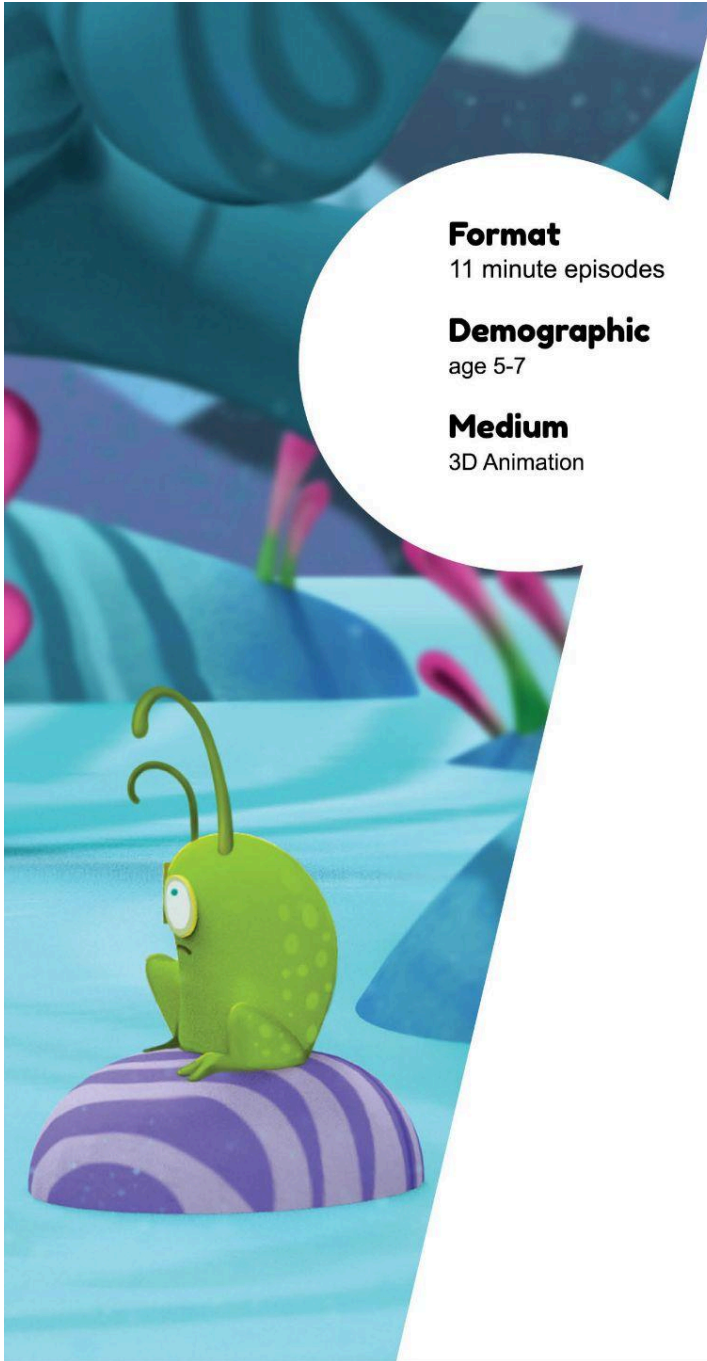
6.1 Pitch bible spreads

underfoot

Can the Underfoots
bring balance back
to their world?







Format

11 minute episodes

Demographic

age 5-7

Medium

3D Animation

Logline

At the bottom of the garden, the Sister Trees stand on the stream's banks, the magical home of the Underfoot. Guardians of the forest floor they help keep everything balanced. The Underfoot creatures toil in the soil to make the garden flourish with life. But the world of the Underfoot is in turmoil. The stream water has been rising, and the Sister Trees are starting to worry that something is coming that could change their way of life forever.

Summary

Guardians of the magical world of the Sister Trees and all the creatures living at the bottom of the garden, the Underfoot community is diverse. Velvet Worms, Rolypolys and the Fungus Nation maintain a tenuous balance to maintain their home's food supply and protection. Oke, the Velvet Worm, is a rebellious adventurer. They would far rather be off with their mates Leafy and Rolypoly exploring the outer reaches of the garden basin than doing chores; that's if they can drag Wiggle away from their bed!. But that all changes when Oke and Leafy encounter something shocking that will turn their world upside down. Back home, the stream that used to flow gently through the garden basin is starting to flood, and increasing rain and encounters with strange creatures threaten the fragile existence of the Underfoots and their home. The Sister Trees have stood for a century but are now sickened by the constant floods drawing soil away from their roots. They feel their world is changing, and only help from the mystical Myco creature can save them.

The Underfoots fear their home has already fallen to the human's desire to turn the magical wilderness into a concrete jungle. Can Oke and their friends find Myco in time to heal the Sister Trees and save their home?

Characters



Oke Velvet Worm

Oke is a risk-taker! He's a nutrient courier and zips around the valley floor with his friend Leafy, delivering everything the ecosystem needs. Oke is curious about what lies beyond the Underfoot. Oke is brave and reckless, which can get them into trouble.

Leafy

Leafy is one of the leafy creatures that live in the Sister Trees. Leafies seek adventure, and when the Sister trees are napping, they jump from the home tree to ride the waves within the stream. It was on one of these trips that Leafy met Oke. They both share the same excitement for adventure and explore their home's outer reaches.

Wiggle Rolypoly and Tily

Wiggle is a Rolypoly, more commonly known as a Slater. They enjoy the comfort of their home, nibbling on tasty leaves and branches. Oke is their best friend and the only one to drag them out of their burrow. Tily is a tiny bacteria that rides on Wiggles back wherever they go. They process the nibbled pulp and store it for later.

Fuchsia Velvet Worm

Fuchsia is a weaver. She collects and transforms used velvet worm silk into useful tools to store food and supplies. She has been blind since birth, but as she sees the world through her mind, this has never held her back.



Terra Velvet Worm

Terra is a fungus expert. They know the secret language of the Fungus Nation and how to communicate through vibrations. They are a ferocious hunter and are stoic and dependable. They are cautious of creatures they don't know, so they never venture far from their home tree.



Mix and Sift

Mix and Sift are members of the Fungus nation. They transform matter into nutrients and work with the Fungus kingdom to keep the valley fertile and lush. Mix is more outgoing and a great storyteller, whereas Sift is shy and doesn't say much. Oke visits them to learn more about the world beyond Underfoot.



Myco the Mystical

No one knows much about Myco except they are ancient and remember the sister trees when they were little acorns. Myco is a powerful creature who uses his magic to protect the roots from the cold and help the trees find healthy food in the soil. He lives by himself and doesn't like surprise visitors!



World

Roly Poly Log

Rolypoly's are slaters, and they make their home in the carcass of a fallen Sister Tree. Rolypoly have an important role in keeping the ecosystem healthy. They nibble leaf litter and fallen trees into vital nutrients in the soil for plants to grow. They share their log home with Tily's, tiny bacteria who help process the pulp they chew and prepare it to send to the Fungus Nation. Rolypolys work closely with the Fungus Nation to keep the nutrient-making process flowing smoothly. Rolypoly and Tily don't like to leave the safety of the burrow.





Velvet Worms

The Velvet Worms are an ancient culture of fierce warriors, powerful magicians, and skilful gardeners who cultivate balance within the ecosystem. They are the apex predators in the Underfoot community and are always hungry! But they have worked out a balance: they only eat unwelcome intruders to Underfoot, and their ferocity at the boundaries protects the rest of the community.

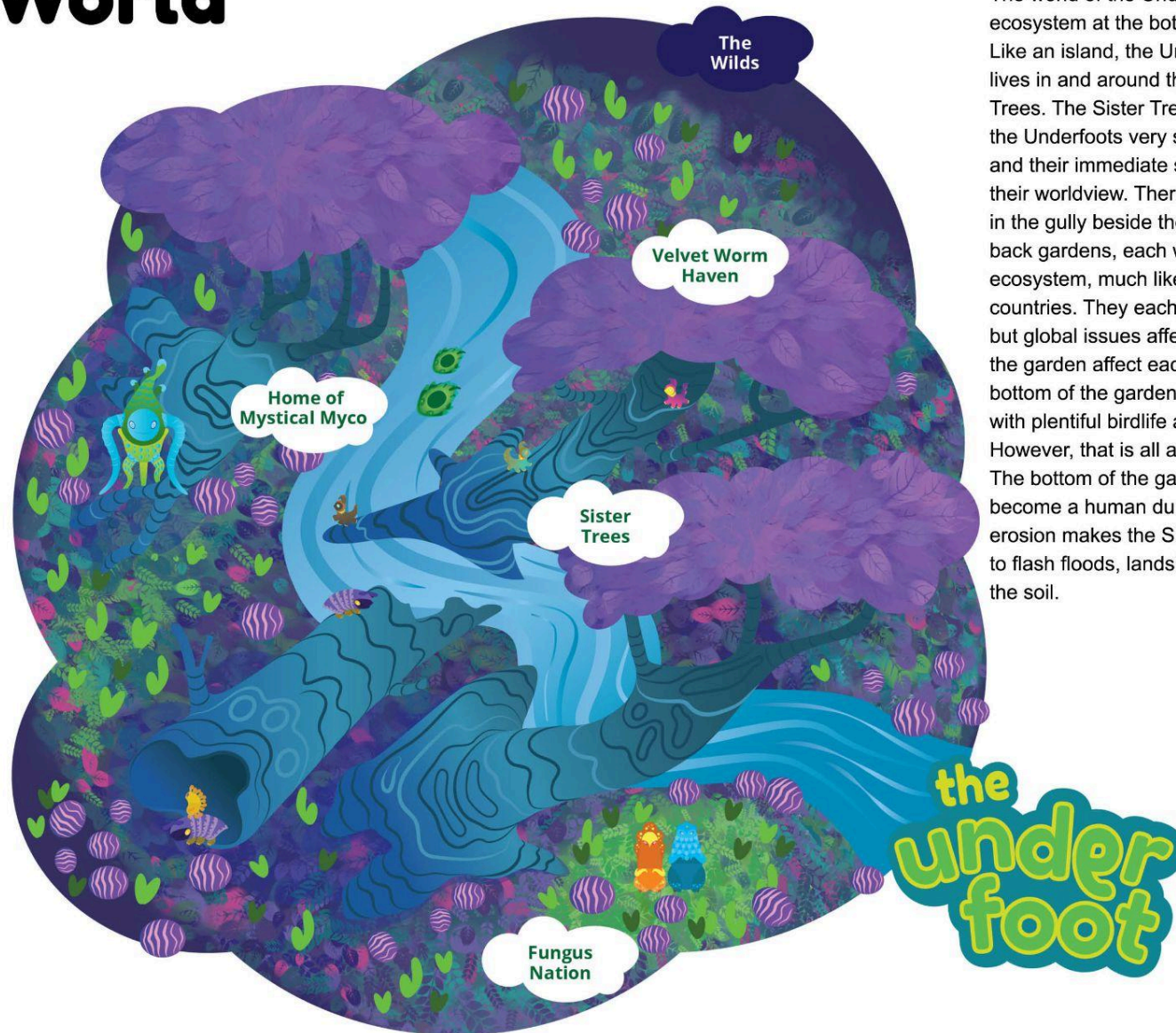
The Leafy Communities

The Leafy Communities are the leaves of trees and plants in Underfoot. They are a diverse community that comes in all shapes and sizes. Leafies hang upside down like bats on the mother tree. They love to sunbathe, which gives energy to the mother tree until they are free to adventure on their own; at this point, Leafies ride the wind and the waves on their grand adventure.

Fungus Nation

The Fungus Nation runs the Underfoot nutrient transfer centre. It magically transforms the pulp the Rolypolys bring into juicy food for the Underfoot communities. The fungus are a quirky bunch that live underground, pop up, and get to work every time it rains. The Fungus Nation have a hive mind; when you talk to one, you speak to them all.

World



The Underfoot

The world of the Underfoot is a miniature ecosystem at the bottom of the garden. Like an island, the Underfoot community lives in and around the three Sister Trees. The Sister Trees are vast, and the Underfoot is very small, so the trees and their immediate surroundings form their worldview. There are other trees in the gully beside the creek in other back gardens, each with its own defined ecosystem, much like separate islands or countries. They each work autonomously, but global issues affecting the bottom of the garden affect each tree's habitat. The bottom of the garden is boggy and lush, with plentiful birdlife and good weather. However, that is all about to change. The bottom of the garden landscape has become a human dumping ground, and erosion makes the Sister trees vulnerable to flash floods, landslides and toxins in the soil.



Sister Trees

The three Sister Trees grew up by the stream from little Acorns into flourishing ecosystems that protect and nourish the entire Underfoot community. They are old and no longer talk, preferring to snooze quietly in the dappled sunlight.

The Gouge

The Underfoots have yet to encounter The Gouge, but they have heard it whispered by the Fungus Nation. They have heard that the earth opens up and whole plants and trees disappear, leaving gaping holes in their wake.

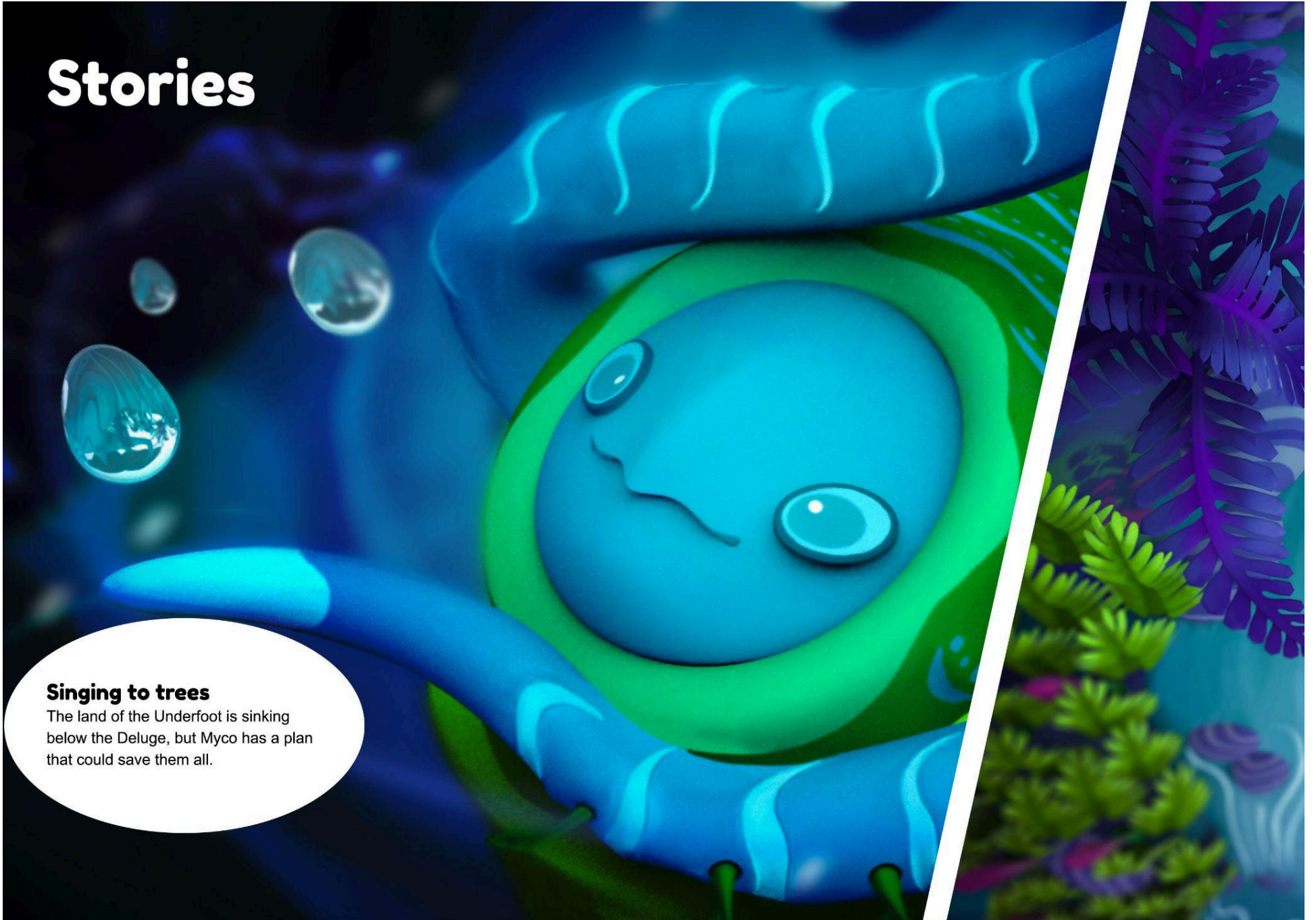
The Deluge

The main adversary is The Deluge, which manifests as a water elemental in many forms. Flooded water forms as a crazed creature or an army of fierce droplets from the sky that smothers everything in its path. It leaves behind strange creatures that consume organic matter and turn it black with the disease.

Stories

Singing to trees

The land of the Underfoot is sinking below the Deluge, but Myco has a plan that could save them all.



The race is on

Oke and Leafy reached the Underfoot's outer edges and discovered something terrible. They must quickly retrace their steps to warn the others before it's too late.

Potion of life

Mix and Sift believe they have the recipe right to save the Underfoot. They need that one crucial ingredient.





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6.1 Link to the project website for additional design development

For more information regarding the project: <https://tanyamarriott.co.nz/underfoot/>