

**An Approach for Teaching Children
Swimming Through Product Design**

By

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Abstract

This thesis looks to explore and employ a new approach of teaching swim to children through product design and play. By observing a child's play and learning habits, a design tool will be developed to teach a child to swim through simple play like games and drills, making them more comfortable and better swimmers. These products that will be developed from this thesis may be composed of devices and toys that help in facilitating the learning of swimming. Previous methods of teaching to swim will be observed and used in helping improve the experience of learning to swim for a new swimmer. Using play, the idea of learning to swim for a child can become easier and more enjoyable, which in return can keep this child safe. This thesis looks to use product design to make learning swimming easier for the new swimmer.

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Chapter 1 – Introduction

1.1 Problem Statement

Children every year struggle to learn to swim and they often find it difficult to swim. Many children across the United States have never taken swim lessons and all their swimming skills are based on how much time they spend in the pool, which for many individuals is not long. Those who do not learn tend to stay away from water as they fear not being able to swim. This leads to those in adulthood who have never learned to swim to never go out and learn it themselves. Many that do learn to swim, however, learn via an instructor, who usually uses toys and other products to teach swimming.

Unfortunately, the number one cause of accidental death among children is drowning (CDC, 2021). Even though swimming has been around since at least the Greeks and Romans, it is still a prominent issue in the United States and across the world. Improvements have been made to the methods of teaching swimming, but many of those methods are outdated and were created decades ago. There are many new and intuitive products and methods that could be created to ease the process of learning to swim for a child. Many of the products used by swim instructors are simple, basic toys that just teach the child the basics of swimming, but do not entertain the person who wants to learn to swim and continue to work on this skill. By changing this feeling of a chore to a fun activity, swimming could be made easy to learn through new products that connect with the person.

1.2 Need for Study

Aquatic pool product design has been around for a long time but has remained relatively unchanged in the products on the market. Research has shown a relatively stable percentage of drowning deaths amongst children in the last 20 years (CDC, 2021). This is mostly due to the lack of swimming being taught to children. Drowning is the leading cause of accidental death among children of all ages and the single leading cause of injury-related death among children ages one to four (CDC, 2021). It has been overlooked due to parents' other fears, like their child being kidnapped or dying from drugs, despite drowning being the number two cause of death amongst children (Cuffaro et al., 2006). These numbers show the importance of swimming as a life-saving skill that should not be overlooked.

The method and products used to teach swimming have remained primarily unchanged in the last 20 years. Most people experience considerable fear and frustration learning to swim, even with an instructor. New products and improving current products could be created to help ease this process and make learning to swim fun. Observing the play of both children and adults and applying it to the design of aquatic products could bring more people to the pool and save many lives. These pool toys and devices could make it easier for parents to get involved and watch over their child as they play with them in the water. Because many of the current methods of learning to swim have remained unchanged for years, changing how it is taught and appeals to a new swimmer with products that make a child excited to swim can make all the difference.

1.3 Objectives of Study

The objectives listed below will develop a design tool to teach a person to swim through product design. The combination of objectives below will help to further develop, strengthen, and reiterate the idea of using play to teach swimming. This thesis will also provide insight and examples into furthering play design in the aquatic industry.

Objectives:

- Research play design
- Research the importance of learning to swim
- Research the process of learning to swim
- Research the emotional aspects of learning a challenging skill for a child
- Research the important movements and strokes for being a strong swimmer
- Investigate the existing market for failed and successful aquatic design
- Research material selection in an aquatic environment
- Develop a design tool to create products tailored to improving a person's swim ability

1.4 Definition of Terms

The following definitions below help in the understanding of this research. This list only acts as a guide for the key terms used in this thesis and is intended to be used as guidance and further understanding of the topic as one reads this work.

Buoyancy - (Noun) the tendency of a body to float or to rise when submerged in a fluid

Comfort – (Noun) one that gives or brings comfort

Drowning – (Verb) to suffocate by submersion especially in water

Fear – (Noun) an unpleasant often strong emotion caused by anticipation or awareness of danger

Floating – (Adj) buoyed on or in a fluid

Freestyle – (Noun) otherwise known as the frontward crawl, a swimming stroke usually regarded as the fastest of the four front primary strokes (Maglischo, 2003)

Frustration – (Noun) feeling discouragement, anger, and annoyance because of unresolved problems or unfulfilled goals, desires, or needs

Play – (Noun) recreational activity (especially the spontaneous activity of children)

Unless otherwise indicated all definitions were taken from the 2023 version of the Merriam-Webster dictionary.

1.5 Assumptions

It is assumed that most people can be taught to swim, except for those with significant impairment that impedes cognitive or physical abilities. Many people are not taught to swim at a young age and struggle when put in dangerous aquatic situations. Those that have learned mainly did so through a swim instructor. Another assumption is that children in different parts of their development will determine how effective the toy or device is on their ability to swim. Children at a younger age, like a three-year-old, will need simpler toys and devices than that of an eleven-year-old who can understand complex games. It is also assumed that all products created for the education of swimming must use materials safe when in contact with water, chlorine, or other pool chemicals, yet not be a choking hazard to a child. There are many existing safety laws around pools for these reasons and failing to follow them could end in a faulty product. These assumptions can help industrial designers to make better decisions and evaluate how to create a good product for people learning to swim.

1.6 Scope & Limits

This study primarily focuses on the use of products to teach people to swim through product design. Cases of having a swim instructor and learning on their own via parental supervision will be explored as the products created could be specifically for one method. The area of swimming, whether it be teaching to float or improving a person's swim ability, will also be explored. This study does not aim to completely revolutionize how swimming is taught, but only seeks to make learning to swim easier and more enjoyable for a person through product design. Material selection will also have to be considered as some materials do not do well when exposed to water or chlorine and can become dangerous to the child and their surroundings. The main goal of this study is to provide designers with a tool to create new products for people to learn to swim. The effectiveness of this tool can be tested in the field for further research to further improve the experience of learning to swim.

1.7 Procedures & Methods

The following procedures are used to conduct the study:

Step 1. Study methods of swim instructing, play habits, psychology of fear and frustration, and existing products on the market.

- Research methods currently used by swim instructors, including products they may use.
- Research the play behavior of people and their ability to cope with fear and frustration.
- Summarize these areas of study and what information from them can be used moving forward.

Step 2. Build connections between research findings and the design approach.

- Compare and contrast what has worked in the past with what has not.
- Find areas undiscovered or unexplored that could be useful to the design tool.

Step 3. Develop a design approach for the product design of a toy or device for teaching swimming.

- Apply information learned through researching a person's emotional and learning process to best teach swimming.
- Apply all safety guidelines and proper materials to the product.

Step 4. Apply the design approach to create a new product for teaching someone to swim and discuss the conclusions of the findings.

1.8 Anticipated Outcomes

The intended outcome of this study is to create a design tool for industrial designers to utilize, which will help to design products for swimmers to learn, be comfortable, and thrive in the water through play and any other means. This study will describe the child psychology behind overcoming fears and learning new skills at a young age. It will apply this information to designing products for people to help facilitate the learning of swimming. This study will provide all the tools to create a new product specific to the person's needs to produce a device or toy that helps facilitate the education of swimming and its importance for safety in water.

Chapter 2 – Literature Review

2.1 Literature Review

This literature review will look at many aspects of the scope of this thesis and what can be learned from them. Starting off with the history of play, it will investigate its mental benefits and the mental developments. It will also include the history of swim instruction and how it evolved to what it is today. This review will look at the mental development of the ages of children 3 to 11 and how they can be taught swimming by their developmental age. It will also investigate the behavioral patterns and the benefits they can receive from play. The main goal of this review is to seek out how to turn work into play to make the process of learning to swim as easy as possible through product design. It will observe current methods and games while considering safety regulations and overall safety of the swimming product user. Materials will also be looked at to increase the effectiveness of this thesis. This thesis will also look at the most important areas of swimming like floating, body mechanics, and breath control. These are the key skills in swimming and need to be looked at as these are the skills that will be targeted throughout this thesis as we approach the design application.

2.2 Play History

It is first good to understand what play is. Play, according to the Oxford Languages (2023) dictionary, is defined as engaging in activity for enjoyment and recreation rather than a serious or practical purpose. The key part of the definition is “for enjoyment and recreation” because play is done by choice, but also out of one’s desire to engage in an activity. Take for instance playing catch with someone. It may have no real purpose in the real world, yet those playing catch are gaining social skills and practicing working together.

The issue is that schools have been ignoring the importance of play for decades by shortening recess, enforcing stricter rules in the classroom, and taking away the little things that get children through the day. The Best Schools Magazine (TBS Staff, 2022) writes, “Maybe we haven’t been prescribing enough drugs. Or, better yet, maybe we haven’t prescribed enough recess.” This was referring to the huge rise of ADHD amongst children throughout the United States. Big pharmaceutical companies have profited deftly off it, when it could more easily be fixed by giving children more time to play throughout the day. The CDC (2022) in collaboration with the Springboard to Active Schools (2022) states that recess is only required in eight states and since the mid 2000s, up to 40% of school districts across the nation reduced or cut recess. This means in the last 20 years, recess across the United States has begun to diminish. “On average, elementary schools schedule students to have 27 minutes of recess each day” (CDC, 2022; Springboard, 2022). This is concerning because it is only 7 minutes more than the national guidance (CDC, 2022). This is an ongoing issue that is negatively affecting children across the United States, and it only seems to be getting worse.

Play has been around for millennia. It was thought about by the Greeks including Plato and Aristotle, by the Romans, and even the Middle Ages where children were expected to work. Plato wrote about play stating:

Children learned best in playful activities that attracted their enthusiasm, that ‘turned the eye of their souls’ to the Good and True. Similarly, play was the best way for adults to learn and do philosophy, and it was the only way to discover new truth.

(Hunnicut, 1990, p.211)

Plato saw the benefits of learning through play not only for children, but also to adults and used it as a teaching method for philosophy. His goal was to make individuals curious about the world

and explore the ins and outs of how the world works. Similarly, Aristotle presented play as a sort of bodily pleasure that was a necessity to the human body (Kidd, 2016). It is interesting that two of the foundational philosophers of modern Western civilization saw the importance of play long before it was truly discussed. They both saw it as vital to human well-being and to learning.

In Germany, Fredrich Froebel founded the first kindergarten where the children learned through play. He opened the Play and Activity Institute in 1838 believing that young children should be nurtured and nourished “like plants in a garden” (Koblin, 2021). This was the beginning of play being taught. Froebel also introduced the concept of “Frei-Arbeit” or “free work”. In Frei-Arbeit, children were allowed to work on things by themselves. This allowed them to focus on their concentration skills and resilience, while also learning about engineering, logic, and physics (Koblin, 2021). This realization helped combat the growing number of ADHD in Germany as kids could spend hours focusing on what they wanted to do, truly increasing their attention span. Froebel was also well known for his educational toys known as the Froebel Gifts. They were carefully designed to help children in his kindergarten recognize and appreciate common patterns and forms found in nature (Koblin, 2021). Froebel used design to create and help facilitate learning and understanding of the world. He understood that children did not learn by being told how things work, but by figuring it out on their own. He knew the best way for a child to understand was to give them the tools and let them experiment with the toys. Froebel believed that kindergarten was not for correcting behavior as he saw children as good natured, but for them to understand the world around them “through creative, imaginative, and spontaneous play” (Eschner, 2017). Froebel was an inspiration and is the reason kindergartens exist around the world today. His ideology of teaching children through play has made a monumental difference and is a common practice across the entire world.

Another issue regarding play in recent years is that it is being threatened as parents and children themselves have limited playtime due to overpacked schedules to “set their child up for success” at a young age (Cleveland Clinic, 2018). Pediatrician Deb Lonzer, MD. says, “Kids whose time is overly organized don’t have time to be kids, and their family doesn’t have time to be a family. They typically don’t eat well, sleep well, or make friends properly” (Cleveland Clinic, 2018). This has been shown in studies and the negative benefits are usually not noticed until later in life. Overly organized schedules can be detrimental to children’s health as they do not have time to find what they enjoy or what they want to learn. Rather they are learning what their parents want them to learn. The idea of being book smart, the most athletic, etc. has never come from rigid schedules for children as it does not teach them discipline, but rather can make them despise the scheduling because it took away all their fun time growing up as a child.

Dr. Lonzer had some solutions to fix this. Lonzer believed kids shouldn’t have an activity scheduled every day, but instead sit down with the parents and let the child choose their three top activities. “When helping your child choose activities, weigh the benefits for both the child and family against the time everyone will have to invest” (Cleveland Clinic, 2018). One of the most important aspects that parents play in the development of their child is time management. Parents should work to find time for their children to unwind apart from their busy schedules. The development of kindergartens began to allow this to happen as parents could still work while their child was safe and could play freely. However, as stated earlier, this idea has been slowly fading away as many kindergartens require children to be able to read and do simple math to even be allowed into them. This strays from the idea of learning from play.

“The balance of fun, organized activities with plenty of down time will help kids see that all of these things are important” (Cleveland Clinic, 2018). It is still good to have organized

activities, especially if they are fun or seen as fun to the child. Finding the balance between the two can be difficult. There is one caveat to what activities children can do; avoid screen time. Overscheduling is better than letting kids park on the couch with a phone, tablet, or TV (Cleveland Clinic, 2018). It is important that their down time is filled with actual play. Screen time does not allow them to learn about the world and make discoveries on their own about how it works. They will learn a lot more from the physical world than through a screen and giving them screen time takes away from them learning through play.

It is also important to not force children into group activities and to ensure that there should be scheduled family time. “Forcing an unwilling child into group activities will backfire; instead support their individual pursuits” (Cleveland Clinic, 2018). It is important to note that children learn through play and not work. When a child is forced into doing something, it feels like they must work, and they do not see the enjoyment in it. Eventually the time will come for children to want to be part of the group and not feel left out. Their individual pursuits are what they care about and what they want to learn. As they grow older and develop more sometimes their individual interests could become group interests where they have a place to share and play. Another important thing to do is schedule play with the family 5 times a week for at least 20 minutes. “This practice has proven effective in developing imagination and increasing family bonding, which decreases risk-taking behaviors and even weight problems as kids get older” (Cleveland Clinic, 2018). This is understandable as the parents are the first to care for a child and they want to see the child blossom and grow as a human. Risk-taking is lowered because children develop an understanding of love and desire safety. Parents showing that they care and want to spend time with their child help the child to achieve this feeling of being safe from the outside world.

Play has always been important to children's development mentally and physically. Play has been discussed for hundreds of years and its importance is ever growing. As written about by ancient philosophers, play should be continuously looked at and questioned. The fear of play being stripped away by schools to what they believe will further increase a child's success is wrong for both the child and parents. This idea of taking away play time will only be shown with time to come as more and more young adults struggle with ADHD because of this. Making sure play is not structured but free and open where children can choose what they want to do can make an everlasting difference to their health and well-being for the rest of their lives. Play connects families, improves social skills and much more. Therefore, it should be further looked at as the best way to learn and understand the world around.

2.3 Swim Instruction History

Swimming is one of the oldest sports and activities for human beings in their history. The question is, where did it begin? The ability to swim predated that of any human writing. One of the first records of swimming was in Greek and Roman civilizations. It was often a part of martial training for boys to help with strength and overall fitness (Webb, 2022). Swimming has changed, especially in the past few centuries, and learning to swim has become ever more important with drowning deaths every year. At St. John's College in Cambridge in 1587, Everard Digby published *De Arte Natandi* (The Art of Swimming). It was split into two sections with the first covering the theory of swimming, explaining that swimming improved health and prolonged life by preventing drowning. The second section covered technique and was the first illustrated how to book in the English language (Chaline, 2018). Specific techniques covered in the second section were (Chaline, 2018):

- Safe entry into the water

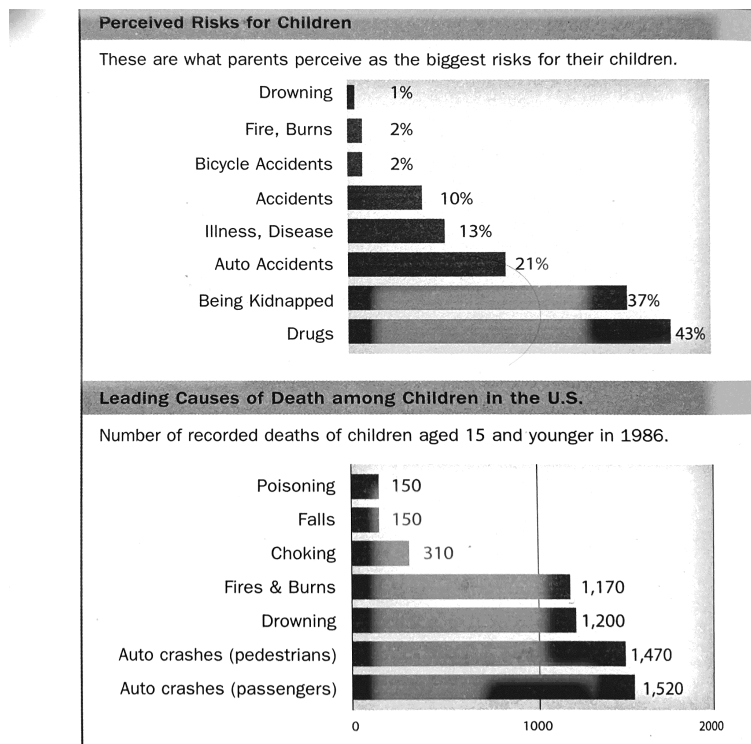
- Propulsion
- Turning
- Floating
- Swimming underwater
- Diving

This book was very important to the development of swimming in the world today. Many of these teachings were used later to fully teach swimming as it is today. There was an issue though as many European countries did not like the idea of swimming.

One issue of the lack of learning to swim started in the Middle Ages in Europe. Swimming was explained by some authorities as having been caused by a fear that swimming spread infection and caused epidemics (Webb, 2021). This led many people to avoid swimming and avoid bodies of water, which subsequently led to more people not learning to swim. The only problem is that some of this was untrue and nowadays it is much safer due to chemicals put into the water to prevent the spread of diseases and infections. Each year almost 360,000 people die from drowning - over 90% of them in low- and middle-income countries. More than half of these deaths are among those younger than 25, with children aged under 5 facing the greatest risk (World Health Organization, 2017). This shows that many of the drownings occur because these people do not have the resources to survive. Too many individuals, particularly in lower- and middle-class countries, die of something they can be taught to avoid. Although swimming had briefly not been taught during the Middle Ages it still seems to be a major area of death, especially among children, so what happened?

According to the World Health Organization (2017), drowning is the third leading cause of death worldwide for those aged from 5 to 14. Despite these tragic facts, drowning prevention

gets relatively little attention and few resources. There is far more we can do to prevent drowning. Many parents are far more concerned with other issues like their child being kidnapped or being killed by drugs when drowning happens much more frequently, yet swimming ability gets little to no attention in schools across the United States. The chart below (Figure 1) is a survey of parents and their fears of what may cause their child to die versus what causes most children's deaths.



Interestingly, there are great statistical differences in our evaluation of risk. Actual risks and perceived risks are very different, especially in the likelihood of injury or death. It is essential to differentiate between actual and perceived risks when designing for children.

Figure 1: Perceived Risk VS Deaths Among Children (Cuffaro et al., 2006)

As one can see, few parents feel that drowning is a major concern despite it being one of the leading causes of death. The Center for Disease Control and Prevention, or CDC, has been keeping tabs on the death rate compared to the population of drowning in the United States since 1999.

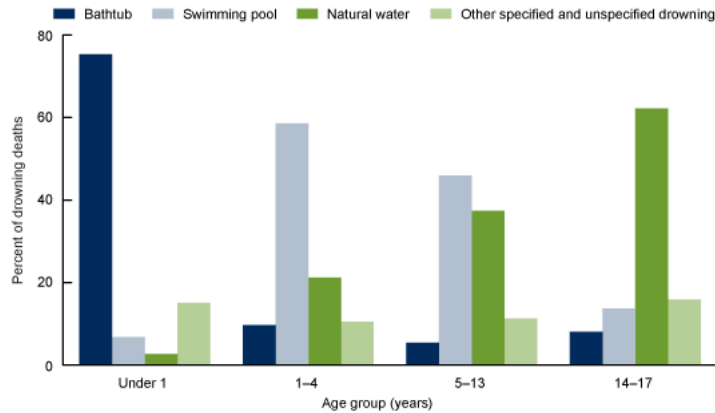


Figure 2: Drowning Percentages of Children (CDC, 2022)

As shown in the chart from Figure 2, children ages 1 to 4 years old have a significantly higher death rate in pools. This is partially due to their ability to roam freely and explore the world. Children this age have not been educated on the dangers of water yet and may have not learned to swim yet. Also shown in the chart is that many teens' causes of death is from natural water or rivers, lakes, oceans etc. This issue may be caused by early on not learning to become strong swimmers and the freedom to swim without parental supervision.

Stop Drowning Now (2019), an organization devoted to swimming safety, notes that on average 10 people drown per day. This is a staggering number considering the number of resources available to learn how to swim. The root of this problem could be the fear or frustration of learning to swim. Many see it as a daunting task, but making the process more fun could lead to this amount being decreased and seeing an increase in the amount who learn to swim. "Drowning is the leading cause of accidental death among children of all ages and the single leading cause of injury-related death among children ages one to four" (Stop Drowning Now, 2019). This statistic shows the importance of learning to swim. Many children are curious at a young age and their safety around water is very serious. It is also interesting that it is the single leading cause of injury-related death. This means that in some cases they have survived

the initial drowning but may not have survived the injuries they incurred while drowning. The goal is to stop it from ever getting to this point.

Drowning not only kills but can leave long-term health problems and costly hospital stays for those who survive. “For every child under age 18 who dies from drowning, another seven receive emergency department care for nonfatal drowning” (CDC, 2022). Drowning is a leading cause of death for children and can be costly to those who survive. These families of those other children who are taken to the hospital must pay the expensive fees that go along with a hospital visit. “Nearly 40% of drownings treated in emergency departments require hospitalization or transfer for further care. Drowning injuries can cause brain damage and other serious outcomes, including long-term disability” (CDC, 2022). Of those seven children, at least three of them need further care meaning they have a serious injury. This cannot be overlooked and reiterates that learning to swim should be standard practice across the world. A report by the Consumer Product Safety Commission (2001) found that 88% of child drownings occurred with at least one adult present. This means that parents as well as children need to understand the importance of water safety and that adults need to ensure the safety of the children around them. Even some children who have learned to swim may not be strong enough yet to save themselves. This could occur in the case of an injury, such as hitting their head, occurring. Improving a child’s swimming ability and encouraging the idea of learning to swim could prevent these moments from happening.

How did teaching swim begin and how has it evolved today? The origin of swim instruction can be dated back to as early as 2500 BCE in Egypt and in the Assyrian, Greek, and Roman civilizations (Britannica, 2022). This makes a lot of sense seeing most of the world is made up of water and having the skill to swim in ancient times was a key part of survival. “In Greece and Rome swimming was a part of martial training and was, with the alphabet, part of the

elementary education for males” (Britannica, 2022). The martial training was their standard military training; including swimming gave soldiers the edge in aquatic combat. Greece and Rome are also surrounded by water, so knowing how to swim was probably key in their daily lives. “Among preliterate maritime peoples of the Pacific, swimming was evidently learned by children about the time they walked or even before” (Britannica, 2022). In other areas surrounded by water in this historical period, many children learned swimming at such a young age that it became instinctive to them. This ability gave more freedom and more safety to the people of the Pacific. “The Romans built swimming pools, distinct from their baths and in the first century BCE the Roman Gaius Maecenas is said to have built the first heated swimming pool” (Britannica, 2022). The Romans relied heavily on swimming not only to learn water safety and the Greeks as a skill in war, but for the exercise benefits it had.

During the Middle Ages, there was a lack of swimming in Europe because some authorities believed that swimming spread infection and caused epidemics (Britannica, 2022). This led many to be afraid of the water and only increased the fear of learning to swim. The amount of people who learned to swim or knew how to swim significantly decreased in this period and many still fear swimming because of the potential to spread diseases and infections today. People in Europe in that time did not yet have advanced medicine like today and an infection could kill them. “Social life, in some times and places, has depended on being able to play swimming games and splash in the water, and swimming has often been a passport into the avant-garde and the upper class” (Carr, 2022, p.8). Swimming was learned by many in the upper class, and the ability demonstrated higher status. In these times many people wanted to learn to swim, but only those who had the resources and class status could. It was a way of separating the

classes, and swimmers could have private conversations in a pool where those who could not swim did not know of these conversations (Carr, 2022).

In the United States, swimming was first nationally organized as a sport by the Amateur Athletic Union (AAU) in 1888, and the beginning of swim instruction for lifesaving purposes began under the auspices of the American Red Cross in 1916 (Britannica, 2022). This was the true start to swim instructing in the United States. It later evolved during World War I and World War II. Swim lessons in the United States first appeared through the YMCA. This was done by a man named George Corsan at the Detroit YMCA. Corsan would start by teaching the strokes on land, starting with freestyle or the frontward crawl (YMCA, 2022). This would go on to be the first main stroke taught by any swim instructor nowadays but was not initially the first stroke taught to a child.

The first stroke taught back before the freestyle was the breaststroke. By the early 1700s American colonists had seen Native Americans swimming with overhand strokes, where the colonials had only known of the calmer stroke, the breaststroke (Carr, 2022). Virginia's William Byrd took lessons from local Native Americans and later wrote, "One of our Indians went in along with us and taught us their way of swimming. They strike not out both hands together, but alternatively one after another, whereby they are able to swim both further and faster than we do" (Carr, 2022, p.398). This was the first evidence of learning the frontward crawl. The frontward crawl is a much more effective stroke than breaststroke and it was noted immediately by Byrd when he was introduced to it by the Native Americans. This frontward crawl is also the first stroke taught by swim instructors today.

The curriculum for teaching swim today was largely influenced by college student George Goss who wrote the first American book on the topic in 1913 as his thesis, *YMCA*

Swimming and Lifesaving Manual, which was later adopted by all branches of the United States Military (Bolin, 2017). This showed how new and important learning to swim was, not just for human safety, but for military training and warfare. Goss's thesis was later transformed into *Warfare Aquatics* by Dr. Thomas K. Cureton, and the military used this book as their sole guideline for learning to swim. It is still used by the military today (Bolin, 2017). This new revolution of learning to swim pioneered in the United States military led to requiring members of all branches to be able to swim before World War II. This showed how important swimming was and just how integral it was to society and survival.

2.4 Mental Development

The mental development of children, or even older people like a teen or adult, is an important aspect to educate oneself on before attempting to teach them a new skill. Many factors influence children's development, and technology is causing significant, ever-evolving changes. One issue with new technology is children's attention span. "As we struggle mightily to develop kids' stamina to ten, fifteen, or twenty minutes of reading and writing, we watch these same children deeply engaged in play during recess and choice of time for long, extended periods of time" (Mraz, Porcelli, & Tyler, 2016, p.8). Keeping a child engaged when they are distracted with all the bright lights and technology today is a very hard job. If an individual is going to teach a child a new skill, one must figure out how to have their attention for long periods of time. "Perhaps, we need to look at play from a different perspective; if the feeling of active movement toward a goal is what we call work, then play is the work of children" (Mraz, Porcelli, & Tyler, 2016, p.8). The goal is to change what may feel like work to play, making it a fun enticing game rather than hard work. In addition, as the child journeys along in learning to swim, it is good to show them what they have accomplished each time.

The development of the brain also has lots to do with emotions. "[Designers] usually regard emotional components of a system as too vague to be useful. But play inevitably has an emotion-laden context that is essential for understanding" (Brown, 2010, p.16). The emotional aspect as Brown writes is one of the most important aspects of creating the sense of play for children. Tapping into the emotional side of a child unlocks the potential to learn new things and create a better understanding of the world around them. "Play takes on the myriad of forms and is defined more by the mindset we achieve when we engage in it than the materials or actions involved in it" (Mraz, Porcelli, & Tyler, 2016, p.11). Play is a mindset. Differentiating play and work can be very difficult to do. The goal is to be in the mindset of play because that's where one learns while enjoying the activity. This mindset of play can be engaged by materials or actions but can also be spontaneous in nature.

There are many aspects of play that greatly contribute to simultaneously learning and having fun. Dr. Brown (2010) writes his list of what he believes are the properties of play:

- Apparently purposeless (done for its own sake)
- Voluntary
- Inherent attraction
- Freedom from time
- Diminished consciousness of self
- Improvisational potential
- Continuation desire (p.17)

Some may be concerned with the first item, the apparent lack of purpose. It is difficult to make swimming apparently purposeless but making the idea of learning to swim more optional could be a way of getting around this. One would still need to find a way to make it seem

enjoyable enough for a child to play. Doing so increases the properties of voluntary action and inherent attraction. Another important element is the freedom of time where instructors must make learning to swim not just by setting a specific time but giving children freedom where some days they learn more and other days they learn less. If all these properties can be included, learning to swim can become very easy to do. But what kind of impact does this mental development have at an older age?

Play, as talked about earlier, affects not only the children, but also who they grow up to be. “While twentieth-century jobs valued competitiveness and top-down organizational structures, today there is a shift towards collaboration, relationships, and shared purpose. If everyone is not pulling on the same end of the rope, quality and productivity suffer” (Mraz, Porcelli, & Tyler, 2016, p.71). This is one of the key aspects of how play is important to mental development. It teaches children to work together and learn new things on their own. This quote also indicates that it may be easier to learn to swim when learning with other people. It allows one to see what works and does not work by observing others. There is more to the mental development of play, which will be broken down by age group below.

It is important to understand the different stages of play for a child. Understanding this will help in understanding how to teach a child. Here are Mildred Parten’s six stages of play:

1. Unoccupied Behavior: randomly observing anything of interest if nothing, they will occupy themselves by fidgeting or engaging in repetitive behavior.
2. Onlooker Behavior: watches other people play and may question them, but does not join
3. Solitary Play: a child choosing to play alone

4. Parallel Play: a child chooses to play with the same materials as another child, such as two children playing alongside one another in the block center
5. Associative Play: children choose to play together in a group with same materials or activity. There tends to be no planning or organization of roles.
6. Cooperative Play: children plan how their play will go. They discuss and negotiate roles, and they role-play and dramatize scenarios. Children often need to compromise and forego their individual goals in order to sustain the play in the group activity.
(cited in Mraz, et al., 2016, p.24-25)

The first two stages of play are likely not the best ones for learning to swim as children are more engaged with what they want to do. They may be made curious if put in aquatic environments. The youngest stages where a child can begin to learn to swim is in the solitary and parallel play ages. In these stages, if a child has a desire to learn to swim, they will be able to. In associative or cooperative play, children may be most encouraged to learn to swim due to their peers being able to. This also is an age where they can learn to become stronger swimmers on their own by playing with others. Games and activities heavier on swimming for some children in the group helps them to become stronger.

Once they reach the later stages of play, children can begin to have rules. These rules limit them, but also give them more freedom to explore on their own. “For play to flourish, you need to establish solid structures for children based on clear expectations and rules. These rules should be in children’s language, reflect their best thinking, and include common principles” (Mraz, et al., 2016, p.36). One of the key words from that quote is “in children’s language.” If the rules are put in a child’s language, it can be a lot easier for them to understand what they can

and cannot do. The children must understand what they need to avoid, or it can become very bad. Though rules can be helpful, the rules and their discipline need to be done properly.

We might think back to our childhood classrooms where the rules were a litany of “don’ts.” Those are the kinds of rules that are imposed by an authority and, truthfully, are often ineffective. When rules are a list of “don’ts,” kids are less likely to feel free to try new things...The purpose of rules is not to address every negative action. Rather, we want rules that are proactive and will encourage thought and discussion (Mraz, et al., 2016, p.36).

Just the way a rule is worded can make a big difference to a child. If rules are properly put in place, then it gives the child more freedom to explore the pool.

2.4.1 Ages 3-5 (Preschoolers)

This is probably the earliest age for a child to learn to swim on their own and one of the most significant mental developmental ages as well.

Children continually push their physical limits, often imitating the adult world, which can provide a helpful basis. Physical skills learned now will seldom be lost, such as swimming, learning to ride a bike, or skating. This is the time they master basic games like hopscotch or skipping (Cuffaro, et al., 2006, p.144).

This reiterates the idea that preschool age is an ideal age for children to learn to swim as they likely will not lose the skills to swim. This also shows that it is an age of curiosity about the world. It is important for children to begin the process of learning to swim at these ages. At this point a child is close to Mildred Parten’s sixth stage of play. Some children will develop quicker than others and this should be considered when designing for a child who has not yet reached Mildred Parten’s sixth stage of play.

2.4.2 Ages 6-8 (Middle Childhood)

The next big age group includes children from six to eight, where play is a major part of their day and learning. “Motor development milestones: Year 4: effective control of stopping, starting, and turning, rides a bicycle, learns to swim, can descend stairs unaided” (Cuffaro, et al., 2006, p.146-148, emphasis added). This is the age where it is recommended that they should know how to swim. They may not be strong swimmers at this point, but they are good enough to swim out of any trouble and not panic. Learning to swim is a similar skill to riding a bike. In both, children can use a type of training wheels with the one for swimming being a flotation device like a life vest. Children also have many mental developments in these ages as well including:

- *Gross motor skills (large movements including swimming)
- *Fine Motor skills (Small movements: building blocks, etc.)
- Expressive language (speech and hearing)
- Receptive communication skills (receiving messages and understanding)
- Social Skills (relationships with others: emotional development)
- Self-help skills (leading to independence in “looking after oneself”)
- *Cognitive adaptive or personal reasoning skills (thinking and involving learning through one senses) (Cuffaro, et al., 2006, p.158)

These developments are very important in the process of learning to swim, especially the gross motor skills. A lot of these skills are also important when it comes to playing games in the pool. Playing games creates play and life skills. This type of play can be used to strengthen a child’s swimming ability without them even noticing. Instead of playing at home, they could be

playing at an aquatic setting, making them used to their surroundings and becoming stronger swimmers.

Eight-year-olds are the most developed of this age and have the biggest range of play at a pool or aquatic setting. “Toys that interest the eight-year-old are construction sets, doll collections, science kits, arts-and-crafts kits, sports equipment, and board games. They love any kind of collections as they satisfy their developmental need to classify and organize their world” (Cuffaro, et al., 2006, p.158). Finding the right toys is a major part in encouraging children to swim. Children who are given toys that are meant to be used at a pool may be encouraged to go to a pool and swim.

Another thing to consider for eight-year-olds is group play.

Active group play, such as sports, clubs, and table games may become the eight-year-old child’s favorite play activities. Often, pastimes that are enjoyed with others attract them. They are very organized in their play, for instance organizing a group for a club or arranging elaborate doll play. Boys and girls enjoy all kinds of sports (Cuffaro, Paige, et al., 2006, p.146).

As mentioned earlier, eight-year-olds are fully in the cooperative play stage where organized games are played. Having games where children want to go to the pool and play will only further increase their desire to become a better swimmer. Some of these games include the use of a product that can be used as an objective. Children ages six to eight still have a lot to develop mentally but could become very strong swimmers all on their own.

2.4.3 Ages 9-11(Upper Middle Childhood)

The next age group of development is nine- to eleven-year-olds where play is a lot more structured. It is important to remember that they still think like a child despite having highly developed reasoning for children this age.

The contrast between how we, as adults, imagine how to design a space for. Play and learning and how children want to design a space for play and learning can be vastly different... Adults' desire for safety, order, and visibility contrast with children's desire for disorder, cover, loose materials, and so on (Mraz, et al., 2016, p.28).

It is important to make the area of play enticing to a child. Places like water parks can especially help. These fun and whimsical places can help spark imagination and make a child want to go play there. Another option, pools, where children have the freedom to make a mess and do what they want, is also effective for getting them to go to the pool in the first place. Although most pools are square in shape, there are still lots of creative ways the space can be used in this setting.

Upper middle childhood is also the age where children start to take on more responsibility inside and outside school. "This is an important time for children to gain a sense of responsibility along with their growing independence" (CDC, 2021). Children at this age should seek to swim at their own will and their surroundings can heavily influence this. If they are around the pool often because of friends and family, they are more likely to play there as well. These children are on their own and choose what they value and how they spend their time. If they are not a strong swimmer, they may be discouraged from going to places like the pool or a water park in fear of drowning or their peers making fun of them.

2.4.4 Mental Benefits

There are a lot of mental benefits when it comes to play. “The challenge in defining play is that almost anything can be play if it fulfills certain characteristics, and it is these characteristics that make play so essential for brain development” (Mraz, et al., 2016, p.12). Play is essential to mental development, but it cannot be forced, which makes managing it difficult. The idea is to create spontaneous play and a desire to swim by creating products that make children want to swim.

The emerging evidence from the brain sciences suggests that playing, as a spontaneous, flexible, and goalless ‘as-if’ behavior, plays a significant role in the development of the brain’s structure and chemistry, which gives the rise to emotional and physical health, well-being, and resilience, as well as laying the foundations for cognitive functioning and social competence (Lester & Russell, 2008, p.45).

This result can apply to all ages of children and even to animals.

“Play has evolved over eons in many animal species to promote survival. It shapes the brain and makes animals smarter and more adaptable. In higher animals, it fosters empathy and makes possible complex social groups” (Brown, 2010, p.5). Play does not just exist in humans but in animals too. It has helped teach us many things about the world from a young age. Dolphins are a good example of this. “Some researchers hypothesize that these intelligent animals, dolphins, ride the waves for social bonding and communication...They’ve even been reported using their strength and agility to aid humans – which possibly points to signs of compassion” (Nunn, 2022). Although this conclusion may be speculative, many reports have shown that dolphins surf for fun. They also have similar qualities to humans in compassion (Nunn, 2022), which is learned through play. This idea connects the idea that play fosters empathy and helps in creating complex social groups.

Play can also be very helpful to positive brain health. “Play may be a way of shaping the brain, maintaining plasticity and potential, and developing a positive emotional orientation and disposition that will enable more complex and playful interactions with the environment” (Lester & Russell, 2008, p.44). Play connects one to the environment and helps one to understand and feel how others feel because individuals can connect with one another. However, there is a slight problem with play nowadays.

There is often such a desire in schools to focus on what children need next that we forget what children need now. Play gives children exactly what they need now, which will help them develop into the kinds of people who can handle what comes next (Mraz, et al., 2016, p.14).

Parents generally want to set their child up to succeed early and ignore the idea of play. The children who play may not become as book smart as other children because they did not start their academic education as early, but they will have stronger social skills and awareness than their counterparts, a characteristic companies now value (Mraz et al., 2016).

2.4.5 Emotions

Emotion plays a major role in the learning process of a child. When dealing with learning to swim, the main two emotions are fear and frustration. “If a child has a fear of drowning or fear of deep water, it may be a result of the parents fear about their safety in the water” (Ryan, 2019). Many childhood fears are picked up from parents’ fears. A child will fear something if their parent fears it. If they do not or no longer fear the water, the next emotion they tend to feel is frustration learning to swim.

Frustration happens to everyone, especially when one is trying to learn something new.

If you see children expressing frustration or boredom in play, or in other, more academic parts of the day, take that as a sign that time should be spent on developing better habits of mind. Refusal, fear, or reluctance can all signal that a child needs support in understanding that failure and frustration are part of their learning, not part of their personhood (Mraz, et al., 2016, p.90).

Learning to swim can be a very frustrating process for a child because it takes time to learn. If a child is continuously struggling and there is no aspect of play to their swim, it could be smart to have them take a break and try again later. Trying to force swimming upon the child will not only not help them but may make them dislike the water even more.

2.4.6 Behavioral Patterns

Behavioral patterns are important to understand especially when trying to teach or creating a device to swim.

When it comes to learning a new skill most individuals tend to adopt one of two mindsets—a fixed mindset or a growth mindset—or a mixture of both. In a fixed mindset one believes that intelligence is static—either you are smart or you are not (Mraz, et al., 2016, p.88).

The fixed mindset can be a very dangerous one as it limits the child's ability to simply believe that they do the task. Often associated with this mindset is frustration, especially if they believed they could do it beforehand. On the other hand, the growth mindset gives possibility to learning and can make a major difference on children's paths to becoming a good swimmer.

2.4.7 Connecting with Children

Connecting with children is one of the most important aspects of getting through and teaching a child to swim. This can also apply to connecting with adults. Swimming is not

something that can be necessarily learned instinctively, so individuals need guidance on how to do it properly. “Teaching is a political act, and every day we bring our beliefs and values to the children we teach. Sometimes in play, we will see children acting in ways that may push against our own personal belief system” (Mraz, et al., 2016, p.21). Instructors need to know that every child is going to learn differently and that teaching them the way they want to be taught can be the most successful way. Take for instance a child who likes water guns. It may go against the moral beliefs held by the instructor, but it could also be used to get them comfortable in the pool. “Studies have also shown that children have not forgotten how to play, rather that we as adults may have forgotten how to see how they are playing or remember what it feels like” (Lester & Russell, 2008, p.45). Play is ever evolving, and parents may not understand when their child is playing. Defining play to a parent may help them to see when it is a prime opportunity for their child to learn.

It’s important to for adults to differentiate between what violent games mean to children and what they mean to adults. Children look for ways to feel powerful and strong, and play is a safe way to achieve a sense of power. From a child’s point of view, violent play can be alluring. It is often children who feel most vulnerable and powerless who use aggressive play to help them feel safe. Play is their way of sorting out complicated messages that they absorb every day. In fact, research has found that children at risk for violence show a decrease in aggressive behavior when allowed to engage in rough-and-tumble play (Mraz, et al., 2016, p.21).

This quote aligns with the water gun example, suggesting that we must not stop a child from learning because of one’s moral compass. Letting children choose their path at a young age may help them learn as well as teach them a lesson down the road about their safety. “Learning what

makes our students tick, from their styles of learning to their loves and pet peeves, enable us to tailor curriculum in ways big and small” (Mraz, et al., 2016, p.107). Just understanding what a child likes and dislikes can be monumental in the learning process. If a child is known to like superheroes or sports, it makes it easier to plan how a child is going to learn to swim.

2.5 Play in Swim

Play comes in all sorts of forms, but swimming can be different. Swimming is not as safe as playing on land or in a bathtub.

For children who haven’t experienced what it feels like to be underwater comfortably it is a terrifying prospect... Swimming ideas recommends that you take a gradual and slow approach to encouraging children to go underwater at their own pace. Provide multiple opportunities to go underwater through games, activities, challenges, and asking questions to get kids to put their face underwater (Napolski, 2019, p.4).

The first time a child is face down in the water it can be daunting, and the feeling of drowning could be very real. The best way to teach this skill is to almost sneak it in as if they do not even notice the instructor is teaching them. If the child gets so encapsulated in their activity, they could forget the feelings of fear and have the strength to hold their breath and look down into the water.

When first starting this process the most important thing to do is make them comfortable in the water.

Spend time in the lifejackets and even do the glides and floats with the jackets on. They can provide a great sense of safety and comfort for beginning swimmers. Take advantage of lowered anxiety and encourage swimmers to use their hands and feet to move themselves around the water (Napolski, 2019, p.4).

Learning by gradually moving them into the water makes a big difference. Once a child is comfortable in a life jacket, they will be a lot more comfortable learning to swim without one.

2.5.1 Existing Games & Sports

Existing games and sports should be observed and used as a tool for creating products in the aquatic industry. There are many simple games like using dive rings to get a child comfortable underwater to more advanced games like the sport of water polo. Water polo is a good example of the final stage of play: Cooperative play. The children must work together to achieve the goal or score and defend their territory. “Games are also important because they distract swimmers from their fear and if we join in their imaginary worlds, we can encourage high levels of participation from swimmers” (Napolski, 2019, p.4). Putting the child into this fantasy world can make learning very easy for both the one teaching and the child learning. These games can lead to new and unique products that can be turned into games to further children’s education in swimming.

2.5.2 Safety Considerations

Safety in aquatic settings is one the most highly regulated areas of play for a child. “Safety laws are almost always the result of tragic circumstances where a product led to the death or injury of young children” (Cuffaro, et al., 2006, p.139). Many laws were created based on previous instances where something went wrong. Everyone knows of the mean lifeguard telling one to walk or not dive headfirst, but those laws were put in place for a reason. Abiding by the safety guidelines of the pool can be difficult for a child to understand at first, but learning the consequences it can make it much easier for children to follow those rules.

2.6 Designing a Product

There are many things to consider when designing a product as further discussed below. The product needs to meet these requirements to be successful. It should also be considered that the product should be designed to prevent choking, as some children like to chew on toys and can sometimes swallow pieces that are not meant to be swallowed. The product should appeal to the user so that it has a maximum effectiveness when it is in use.

2.6.1 Material Selection

Material selection is very important when designing products for an aquatic atmosphere. One must think about how materials will interact with the water and the chemicals in the water. The worst thing that could happen is faulty material that could lead to injuries or lawsuits. “Coatings are essential to the majority of our products, offering multiple functions: to protect from water, staining, sun, corrosion, fingerprints, slipping, to enhance the look and feel of the product; but also, increasingly, to offer improved mechanical properties” (Dent & Sherr, 2014, p.43). These are all vital factors when selecting a good material for the pool. Many forget about the sun, slipping, and other factors one may face at a pool.

Another thing to consider is electronics. “Water and electronics do not mix. Water damage is the number one reason for malfunctioning phones (mostly dropped in toilets) and a constant concern for newer lifestyle products that are expected to go everywhere we do” (Dent & Sherr, 2014, p.46). If designing a product with electronics it must be considered how well insulated the electronics are. Another consideration needs to be the weight of these electronics. Nobody wants to be hit in the head by a ball of metal, for example. Many heavy and hard objects tend to be banned from swimming pools for this reason, so design of a product should avoid using these heavier materials. Any electronics used need to follow the pool rules and if the electronics can cause danger to a person, it should be kept away from the pool.

So, what are some good materials for the pool?

PTFE (Polytetrafluoroethylene, or Teflon) type coatings have been the solution for water repellency for many products but are challenged with concerns over the “slick” feeling of the material, and the use of large amounts of fluorocarbons. In addition, they are unable to cover the complex surfaces typical of products such as this headset (Dent & Sherr, 2014, p.46-47).

The slickness of a product can be very dangerous in aquatic settings, and many pool rules already pertain to it. Another good material is the coating p2i, which is a revolution in water resistance in that it uses plasma – the fourth state of matter that is a gas-like cloud of atoms – to infiltrate tiny crevices so that even the sensitive electronics inside the product are made resistant to water. The manufacturing process uses a vacuum chamber, in which every surface of the product can be coated (Dent & Sherr, 2014). This is good because one rough edge can be dangerous and the difference between a child being injured or safe. Another good material is polyethylene foam or ethylene vinyl acetate, which is a material that pool noodles are made from. It is important to avoid using Polyvinyl Chloride (PVC) as heat in contact can release harmful toxins and is found in many traditional pool flotation devices (American Home Shield, 2018). It is important to consider the impact of sun and heat on any material being used to create a pool toy or device as many swimming pools across the United States are outdoors.

Pool chemicals are also a big factor when deciding what materials will be used in a newly developed product. The two most common types of pools are chlorine and saltwater pools. Chlorine pools utilize liquid chlorine, which helps get rid of algae and break down nonliving substances like oils and organic waste, and Trichlor, a form of chlorine that is stabilized to withstand ultraviolet rays. Pool shock is another commonly used chemical that helps keep the

water clear, eliminating pool odors, and eliminating bacteria build up. Algaecide is another chemical used to help keep algae growth at bay, while other chemicals like using a water clarifier or a scale, metal and stain formula help keep the pool clear and safe from buildup and stains. Then there is using pool salt, which should be almost pure sodium chloride (Graham, 2023).

It is important to consider these chemicals when designing a pool toy or device. A designer should contact a local chemist to test the material against these chemicals to ensure the safety of the product. The material used can be an important factor for a newly designed process, especially if the product is intended to float, sink or be neutrally buoyant. The safety guidelines at a pool require consideration of all related factors.

2.6.2 Designing for Play

The main goal of this thesis is to design a product for play in the aquatic setting so that a person can learn to swim more easily. “Playing games gives [children] confidence and unleashes their imagination. More importantly, it teaches how to lose and come back for more. As much as children want to win, they instinctively understood that there was always another game to play” (Breslow & Beebe, 2022, p.15). Creating a game that a child can play repeatedly can create a bond with the water. The game will also encourage children to go swim on their own in their quest to win. However, there is one catch to designing a product for play. “The last hurdle was selling to the parents. It was our job to convince them to say yes” (Breslow & Beebe, 2022, p.67). Children typically are not the ones buying the toys for the pool. Creating a convincing product to the parent could be the difference between a successful and an unsuccessful product.

2.7 The Body Mechanics

This section will look at the main body mechanics of floating for extended periods of time, the main strokes associated with being a strong swimmer, and the breathing technique

associated with swimming. This is an important area of this thesis as products developed from this thesis will target these skills.

2.7.1 Frontward Crawl or Freestyle

The frontward crawl otherwise known as freestyle is the most widely used swimming stroke worldwide. It is known to be the fastest and arguably the easiest swim stroke for a new swimmer to learn. In freestyle, the head body and body should follow a straight line, while the head should always stay in the water unless turning to breathe (YMCA, 2021).

2.7.1.1 Body Position & Rotation

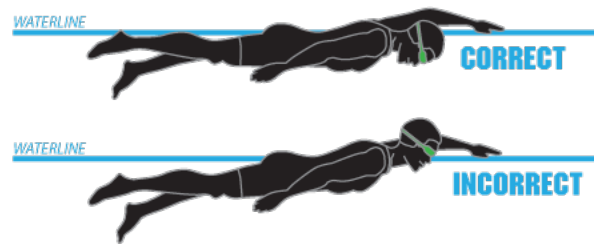


Figure 3: Frontward Crawl Body Position (Lewin, 2018)

The illustration above Figure 3 shows what the correct body form should be when performing freestyle. Another key aspect of freestyle is body rotation. While a swimmer performs freestyle their body, except for the head, should twist from side to side.

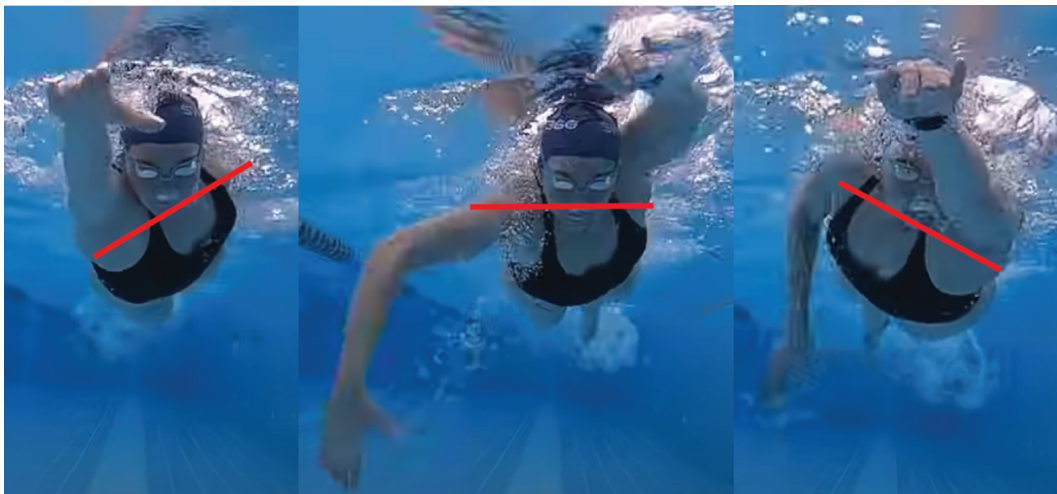


Figure 4: Frontward Crawl Body Rotation (Swim360, 2019)

This motion involves the shoulders and hips moving together as one, but not too much as the swimmer should not be rotating fully to the side. Another key element of freestyle is proper and effective use of the hands. This rotation is the same movement as the backstroke but reversed.

2.7.1.2 The Hand

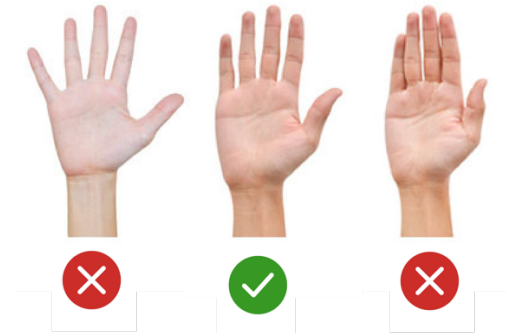


Figure 5: Finger Separation (Hall, 2012)

Many start out by cupping their hands to push the water, but it is much more effective to slightly bend the hand at the knuckles and slightly spread the fingers apart to maximize the push on the water (YMCA, 2021). Using this technique will allow the swimmer to pull more water and move forward quicker with less energy used. According to Gary Hall Sr. (2012), ten times world record holder and World Swimmer of the Year in 1969 and 1970, this finger separation slows the water to the point where the position acts as if the hand is solid across the separation, which increases the surface area. This hand separation should remain the same when performing any other stroke in swimming.

2.7.1.3 Arm Position & Movement

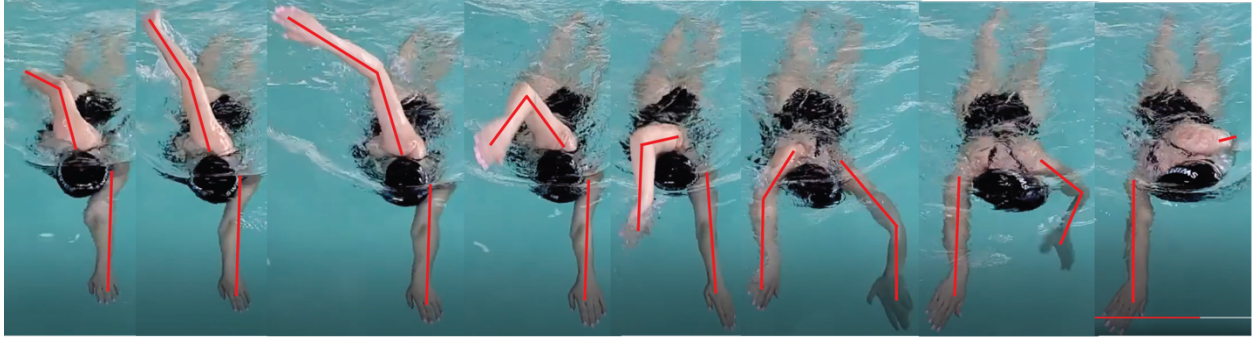


Figure 6: Frontward Crawl Arm Movement (SWIMVICE, 2023)

As shown above, the arms should be in a high position when out of the water and reach forward, but not too far forward as this can lead to overextension and shoulder tension (YMCA, 2021). Properly using the arms is a vital factor in becoming proficient in swimming as it is the driving force in speed in the water. The pulling motion with the arm still in the water should begin once the other hand hits the water as seen in the fifth image. Once the arm is in the water it should bend at the elbow to help pull as much water as possible as seen in the illustration above (Figure 6). This helps to quickly get the arm out of the water and back to swimming as soon as possible.

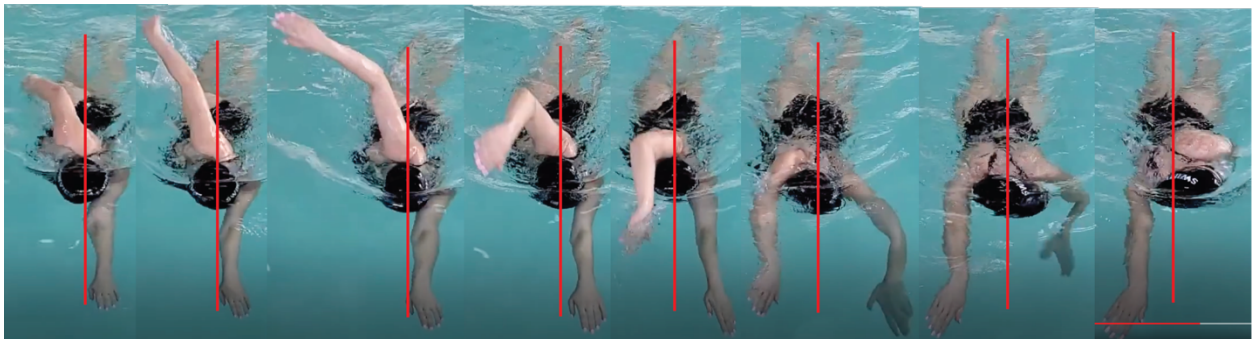


Figure 7: Frontward Crawl Hand Position (SWIMVICE, 2023)

The hands should not cross over the body but reach straight out as far as they can. The recovery of the arm and hand where it exits the water is also very important. The hand and arm should be as relaxed as possible. “This means letting the wrist bend and the fingers relax as the

arm swings over for the next stroke” (Hall, 2012). Letting the arms and hands briefly rest in between each stroke can conserve great amounts of energy making the outer movement of the arms much more effective.

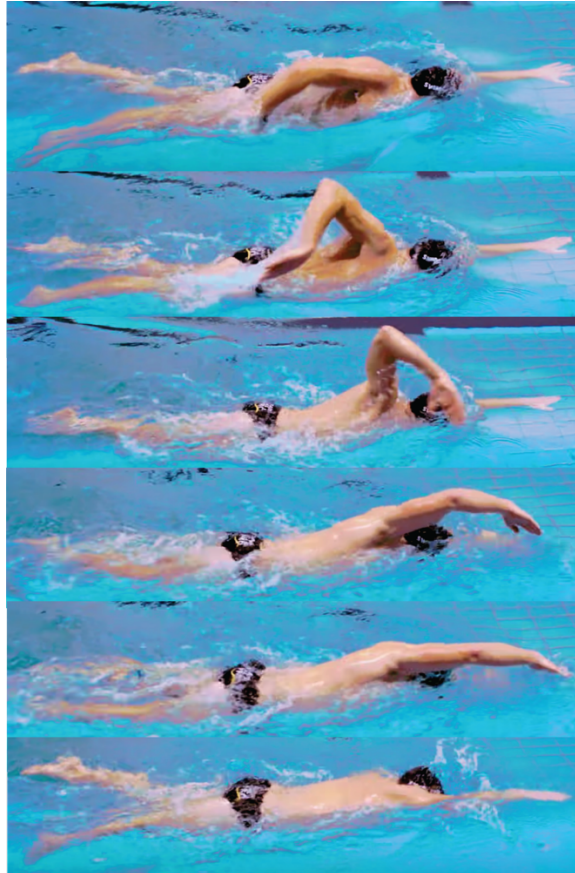


Figure 8: Frontward Crawl Side Arm Movement (SwimGym, 2019)

The arm should be extended before it reenters the water and should hit the water aggressively. If the hand hits the water and enters too slowly, then it will greatly slow down the speed of the stroke (Hall, 2012).

2.7.1.4 The Flutter Kick

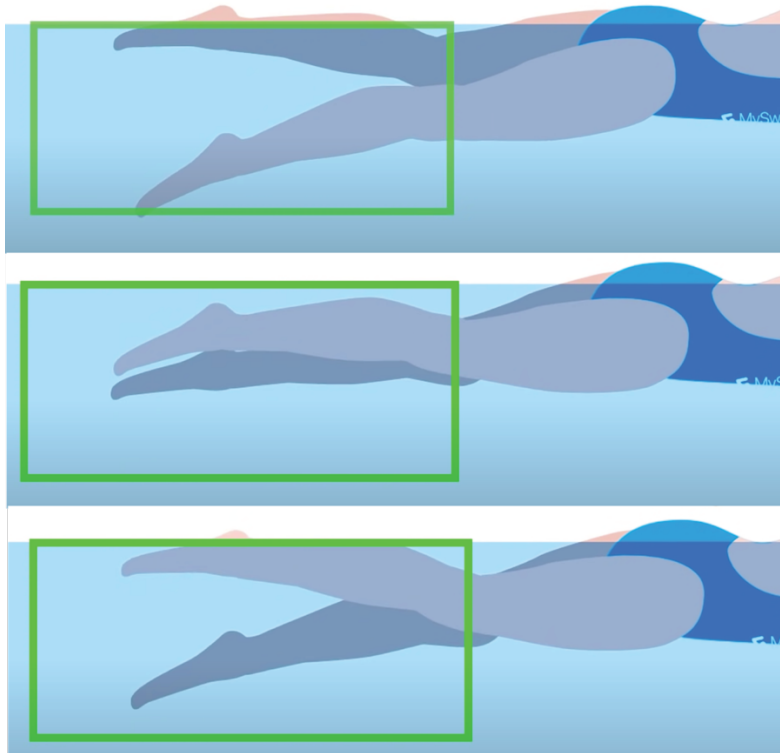


Figure 9: The Flutter Kick (Holmes, 2022)

The final aspect of the freestyle stroke is the kick. This kick is very similar to that of backstroke where the main difference is which side the swimmer is facing in the pool. The kicks should be small, controlled, and quick with the power coming from the hips and not the knees. The kicks should come just barely out of the water to allow for a quicker kicking motion with the toes pointed and legs straight (YMCA, 2021).

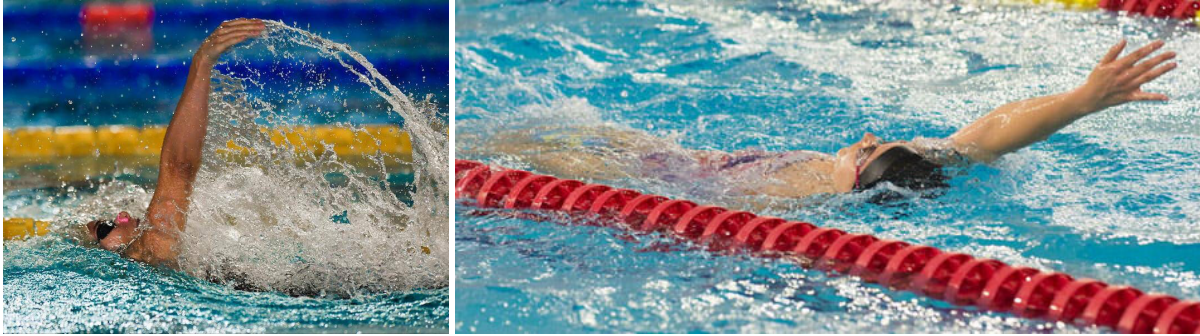


Figure 10: Wrong Flutter Kick (Holmes, 2022)

It is also important to make sure the kicks do not crossover one another as this can significantly slow down a swimmer and take a lot of power out of their stroke as seen above in Figure 10. The swimmer should also look to stay inside the green zone as kicking too deep or too high will also slow a swimmer down as they have to correct their body position. This kick helps propel the swimmer up and through the water.

2.7.2 Backstroke

Backstroke is commonly the second stroke learned by a new swimmer as the freestyle and backstroke have many overlapping movements. In backstroke, a swimmer needs to maintain the same flat line on the surface of the water. Another overlapping skill is the flutter kicks as the motion is the same, with which way the head is facing the only different aspect. The hands should also be the same in terms of finger separation, but how the hand enters the water differs.



(Left) Figure 11: Backstroke Arm Straight Up (Arena Coaches, 2022)

(Right) Figure 12: Backstroke Arm Entering Water (Ong, 2021)

The arm should remain fully extended when out of the water throughout the stroke as it is a quicker motion than bending them. This is seen in the first image where the arm is straight up as the swimmer is taking the stroke. When the hand is entering the water, the first finger to enter the water should be the pinky finger. This allows the hand to cut into the water and begin the sweeping motion of pushing the water. This is because the arms are moving in reverse compared to its freestyle counterpart.

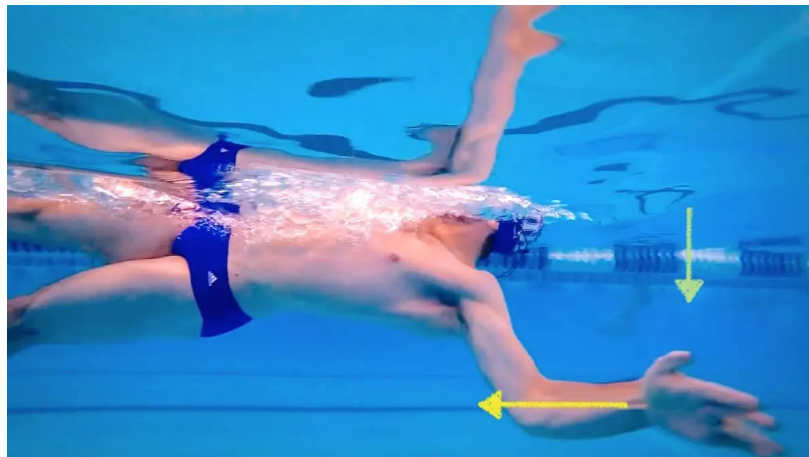


Figure 13: Backstroke Pull (SkillsNT, 2018)

The hands also need to go outward to pull inside and underneath the body. This is because of the shoulders' mobility range as pulling from the side generates the most amount of power (SkillsNT, 2018).

2.7.3 Breaststroke

Breaststroke is a fundamental stroke that is a very slow, but energy conserving stroke. Its movements differ quite vastly from the freestyle or backstroke. There are also many different and unique body movements associated with the breaststroke.

2.7.3.1 The Breaststroke Pull

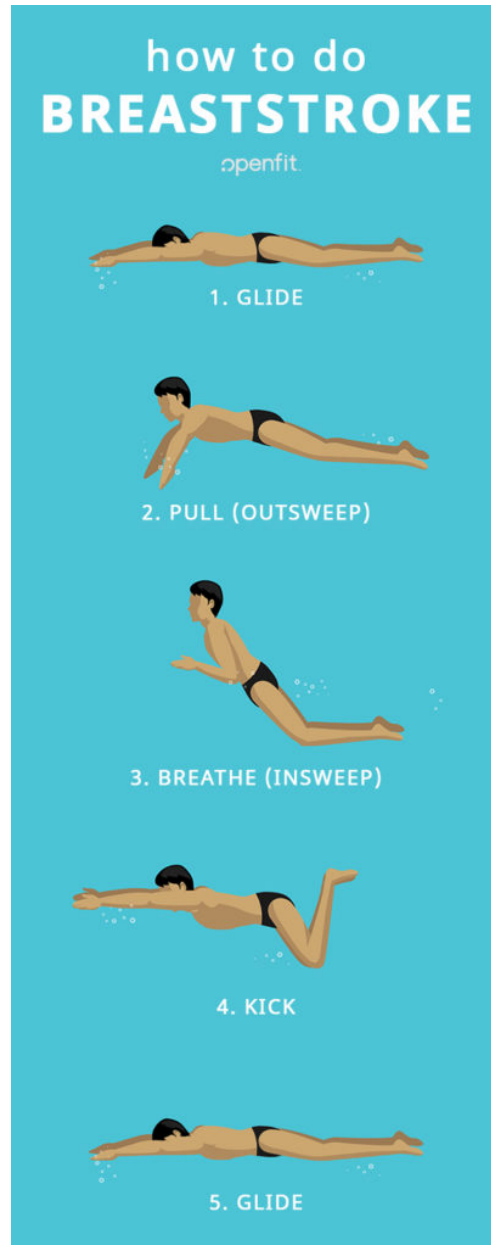


Figure 14: Breaststroke Pull (Lidbury, 2023)

The pulling of the water motion is very similar to that of freestyle, where both arms pull the water at the same time instead of alternating like in freestyle. This is a hooking motion where the swimmer wraps their arms around the water and pulls in (Sheaff, 2022). The swimmer should also shoot the hands forward on the top of the water to begin the next stroke. Once fully the arms are fully extended the swimmer should position their palms outward to perform the pulling motion (Sheaff, 2022).

2.7.3.2 The Breaststroke Kick



Figure 15: Breaststroke Kick (Amos, 2022)

Next up is the kicking motion, which is one of the most important aspects of breaststroke as it is the driving force in the stroke. The goal of the kick is to put as much pressure on the feet and shins and force the water backwards (Sheaff, 2022). As shown in Figure 15, the breaststroke kick involves an outward kicking motion where the knees bend, and the swimmer uses the shins and feet to push the water. This kick, called the eggbeater kick, will not only propel a swimmer forward but also upward. This kick is an alternative to the breaststroke kick, which is discussed in further detail below. This kick allows the swimmer to drive themselves forward where proper

timing of the arms and breathing motions allows for one fluid stroke to be performed. As the kicking motion pushes the water back, the arms should shoot forward, using the propulsion of the kick and then grabbing the water and pulling it forward.

2.7.4 Keeping Buoyant in the Water

Keeping buoyant in the water is a key skill to swimming as it can be one of the most lifesaving skills to be learned. Keeping buoyant is knowing little things that can keep you afloat for longer like holding in air and not panicking, which can lead to panting. When treading water, there are two main body movements that can help one stay afloat for extended periods of time: the eggbeater kick and sculling.

2.7.4.1 The Eggbeater Kick

The eggbeater kick is a type of kick similar in motion to the breaststroke kick where the kicks alternate, compared to in breaststroke where the kicks are simultaneous. The eggbeater kick is seen as a pretty easy way to tread water since the swimmers do not bob up and down (Edde, 2014).

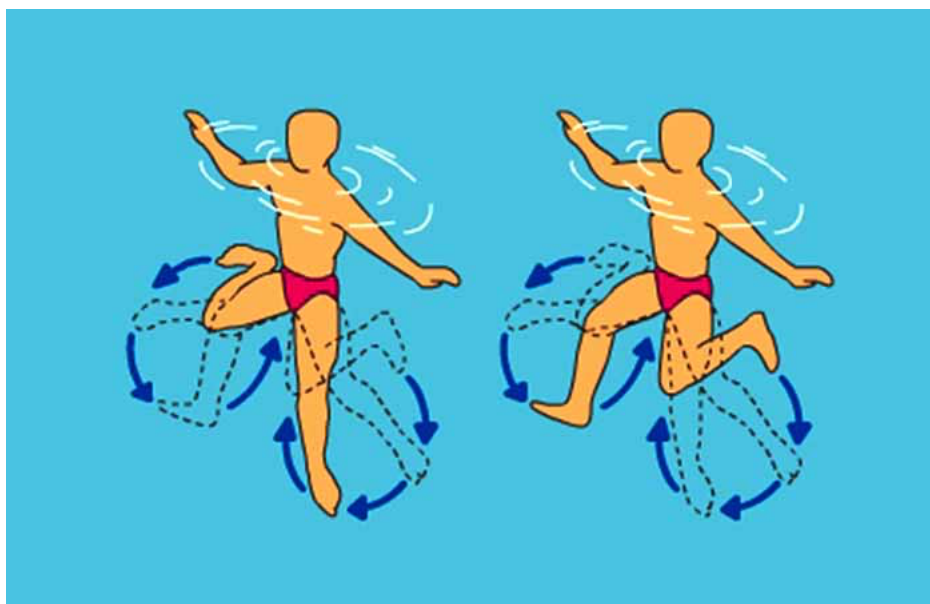


Figure 16: The Eggbeater Kick (Amos, 2022)

This kick is intended to be done vertically to keep the head out of the water, as it is not meant to move you forward but instead upward. The eggbeater kick is one of the most effective ways to stay afloat in the water.

2.7.4.2 Sculling

The eggbeater kick is not the only swimming motion that can allow a swimmer to stay afloat in one position for a long time. The other form is called sculling.

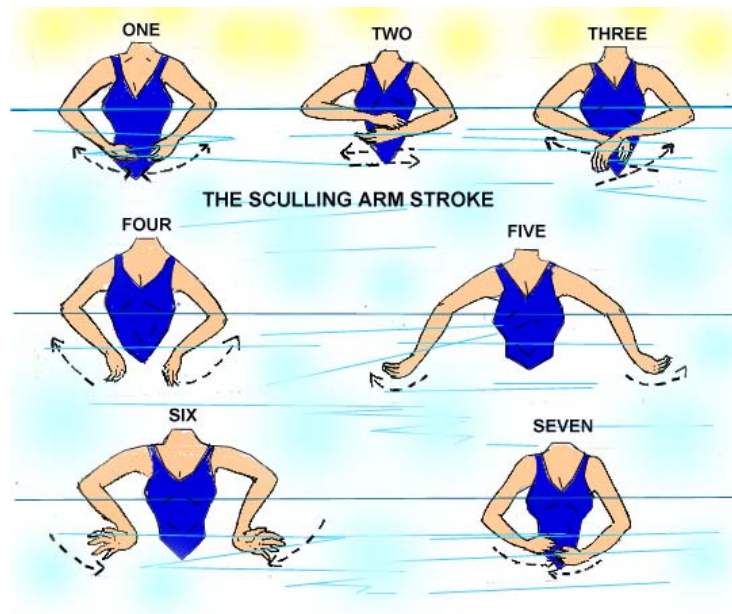


Figure 17: Sculling (Fluid Movement Baltimore, 2012)

Sculling is the motion used by the hands to tread in place in water. The technique is simple as the swimmer moves their forearms back and forth pushing the water with their hands. Sculling is a low energy movement allowing a swimmer to tread water for long periods of time. The hands when brought in should barely overlap as seen in Figure 17. The palms should then face outward and push the water. The arms should stay in a relatively straight line.

2.7.5 Breathing Technique

Freestyle has one of the trickiest breathing techniques to learn as it involves rotating the head and the entire body to the side as the swimmer goes to take a breath. The head should turn a bit further as the body rotates side to side while performing freestyle.



Figure 18: Breathing to the Side (Keller, 2021)

This method of breathing may feel uncomfortable to a swimmer at first, but overtime it becomes easier and more natural. Many new swimmers may try to bring their head up forward instead of to the side. A good rule of thumb is that when breathing during freestyle only one eye should be able to see out of the pool (YMCA, 2021).

2.8 Conclusion

In conclusion, there are a lot of aspects to be considered when designing a product for a person to enjoy and learn to swim. A look at the history of swimming and swimming instruction gives one a good understanding of what has worked and not worked in the past. The review of a child's development and play stages also teaches one how to connect with a person on a deeper level and create a sense of play over work. This is useful in creating a product that can be fun but can also teach the person to become a better swimmer. Safety rules and materials can make a big difference in the success of the product. The information provided in this review is to help in

further understanding the problems experienced in enjoyable learning to swim, therefore finding the gap to improve the quality of life for new and existing swimmers. The easier the process of learning to swim is made, the more lives that can be saved because of it. This review is intended to act as a guideline and a historical background for the remainder of this thesis.

Chapter 3 – Case Study

3.1 Product Identification

This chapter will focus on studying existing products around swim development. It will look at popular pool toys, training equipment, and supportive equipment in the aquatic industry, mainly focused on the pool. This chapter will also analyze these different products to help give a better understanding of the design guidelines being proposed in this thesis. Below is listed some of the most popular pool toys and devices used today.

3.1.1 Pool Noodles



Figure 19: Pool Noodle (Amazon, 2023)

Pool noodles are one of the most iconic pool toys. They are long cylindrical tubes usually made of polyethylene foam, a material that is safe for water and buoyant (IQS Directory, 2023). Pool noodles have a multitude of uses spanning from floating to rescue reaching, and it is commonly used in the process of learning to swim. Its simplicity makes it a very versatile product that can be used in several games, activities, and workouts.

3.1.2 Goggles



Figure 20: Goggles (Academy, 2023)

The first known use of goggles was by Persian pearl divers in the 14th century. Thomas Burgess used goggles like motorcycle ones while crossing the English Channel. In 1926, Gertrude Ederle used goggles sealed with paraffin wax to protect her eyes from salt water. Although some swimmers used goggles for training or for recreational swimming in the 1960s, they were not used in international competition before 1970 (Britannica, 2022).

Goggles are almost synonymous with swimming as they are commonly used both recreationally and professionally. Goggles allow the user to see underwater, which can give the swimmer a sense of comfort in the water. Goggles come in all different shapes, colors, and materials. Goggles can also be used in playing pool games and have opened many doors in the pool toy industry by creating the ability to see underwater.

3.1.3 Snorkel



Figure 21: Snorkel (Atomic Aquatics, 2023)

The earliest written mention of people snorkeling describes the practice of using tubes made of reeds. They were used to hide underwater in warfare. Texts dating back to the 15th century describe the use of helmets integrated with snorkels for underwater fishing (Brown, 2022). Snorkels are commonly used to work on swim technique by focusing the user on the stroke and easing the focus on breathing. One of the most difficult challenges new swimmers struggle with is fear of drowning. The snorkel gives the ability to breathe with their head in the water, making learning swimming techniques much easier. Its importance in the aquatic industry is evident as snorkels are still commonly used to this day.

3.1.4 Fins

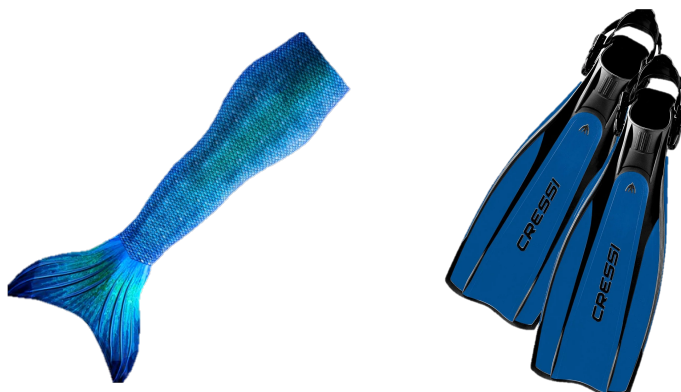


Figure 22: Mermaid Fins (Amazon, 2023), Figure 23: Swim Fins (Divers Supply, 2023)

Benjamin Franklin is accredited with inventing swim fins at 11 years old although they were attached to his hands more like the common day swim paddles (Independence Hall Association, 2023). Fins, otherwise known as flippers, are used to propel the user in the water by attaching to feet and increasing the surface area used when kicking. They are lightweight and flexible, making it easier to move them up and down. They are commonly used in swim training but can also be used as a toy. An application of fins in the pool toy industry are mermaid suits, which go up to the waist and lock the legs together, while still giving an extra fin to propel the user in the water.

3.1.5 Kickboard



Figure 24: Kickboard (Amazon, 2023)

Kickboards are primarily used in becoming a stronger swimmer. It helps swimmers to have stronger legs, which helps increase endurance and speed. It is also helpful in practicing proper kicking technique. These kickboards are usually made from a plastic material which floats in the water, easing the use of the arms to swim.

3.1.6 Pool Inflatable Devices



Figure 25: Pool Inflatables (Amazon, 2023)

Pool inflatables are iconic to the pool and are one of the most popular pool toys in the market. This can range from wacky designs like a pineapple to more simple designs like a hammock. The most notable pool inflatable is the donut shaped inflatable. They can be very useful to weak swimmers and provide them with upper body support. Pool inflatables can also be seen on the arms to help keep a weak swimmer afloat. These kinds of inflatables are like a lifejacket as their purpose is more about keeping a weak swimmer above the water rather than being a pool toy.

3.1.7 Dive Sticks/Rings

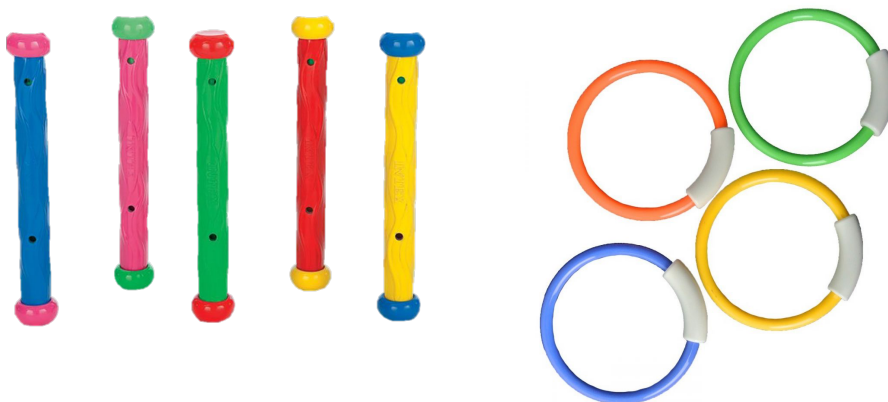


Figure 26: Dive Sticks & Dive Rings (Amazon, 2023)

Initially invented as a training aid, diving toys have become a staple at the pool and a top seller across the world. They greatly help swimmers improve their basic swim skills and gives children confidence all while having fun (Consumer Product Safety Commission, 2001). Dive sticks and rings are composed of a material that will float, but they have a weight inside it that forces the stick or ring to sink. The combination of this weight distribution causes one end to stick upward while the weight inside holds it at the floor of the pool. Dive sticks and rings are commonly used by swim instructors as it is a fun way to get a person used to swimming underwater.

3.1.8 Lifejacket



Figure 27: Life jacket (Amazon, 2023)

The modern life jacket is generally credited to the inspector of Lifeboats at the Royal National Lifeboat Institution in the United Kingdom, Captain John Ross Ward. He created a cork vest in 1854 to be worn by lifeboat crews for both weather protection and buoyancy (Royal National Lifeboat Institution, 2017). The “Mae West” was the first inflatable life preserver invented in 1928 by Peter Markus and was commonly used in World War II (Kelly, 2023).

The lifejacket has many different applications and scenarios where it can be used. In terms of swimming in a pool, it can be used to get a child used to being in the water and floating. One of the biggest steps to getting someone to swim is making them feel comfortable in the water, so it is not only a lifesaving device but is also a device that can help in the facilitation of learning to swim.

3.1.9 Water Gun



Figure 28: Water Gun (Party City, 2023)

The water gun, or squirt gun, is another timeless pool toy that has existed since 1896 (Wolff, 2023). It was designed to model a gun and its purpose was to soak another person. Water guns can be used at the pool or elsewhere outdoors. Many different games can be and have been created using water guns, which can all help someone to become more comfortable at the pool as it gives someone play. As talked about earlier, play is an important part to the learning process and could get someone out to the pool more often as it gives them something to play with.

3.1.10 Splash Basketball Hoop



Figure 29: Splash Basketball Hoops (Amazon, 2023)

Splash basketball hoops are commonly seen at many recreational pools nowadays. They are commonly seen installed off to the side of a pool but could also be floating in the pool. This product was based on basketball, despite users not being able to dribble the ball in the water. The hoop is also at a lower height, allowing users to dunk. This is one of the most popular pool toys and is seen almost always in use in pools that have one. The splash basketball hoop is primarily seen in shallow ends of the pool as a swimmer would need to be a very strong swimmer to play it in a deeper area of the pool.

3.1.11 Robotic Swim Fish



Figure 30: Robotic Swim Fish (Amazon, 2023)

Robotic swim fish are very popular with young children, and they usually require goggles to enjoy. The toy is usually modeled after a fish, shark, turtle, or even modeled after a mermaid. It usually uses a twisting method to crank it up and then is released to make the product swim on its own. It also is neutrally buoyant meaning it does not sink or float in the water, allowing the propeller to be the only guide of where it goes in the water.

3.1.12 Torpedo



Figure 31: Toy Torpedoes (Amazon, 2023)

The torpedo is a very well-known pool toy. It can help someone get used to swimming to the bottom of the pool to retrieve them, increasing a new swimmer's confidence in the pool, or as a game like that of ultimate frisbee. It is modeled after a torpedo, which is otherwise known as a

missile that can be fired by a submarine. This toy is also usually neutrally buoyant but tends to be slightly heavier so that it slowly sinks to the bottom of the pool.

3.1.13 Pool Volleyball



Figure 32: Pool Volleyball (Amazon, 2023)

This pool toy is very similar to that of the basketball hoop. There are inflatable versions of pool volleyball as well as ones that can be installed into the pool deck or filled with water. Pool volleyball can also utilize a volleyball made for the pool or could use a beach ball. This is another game that would encourage users to go to the pool and play. This allows them to get increasingly used to swimming and being around the pool. Like pool basketball, this game is predominantly played in the shallow end of the pool, where if tall enough a swimmer could stand up to play the game.

3.1.14 Splash Balls



Figure 33: Splash Balls (Amazon, 2023)

These soft, squishy balls are usually used as an alternative to harder balls, like tennis balls, that can be used in a multitude of ways. These tiny balls when wet and filled with water can be thrown far without hurting others trying to swim at the pool. It also serves as an alternative to tennis balls as the fuzzy outside of a tennis ball can block drain filters, in turn causing significant and costly damage. It is a ball designed specifically for the pool and is usually used in a fun activity at the pool.

3.1.15 Watermelon Ball



Figure 34: Watermelon Ball (Amazon, 2023)

The watermelon ball was designed after a popular pool game where users would grease up a watermelon and then split into two teams where whoever could get the watermelon to the other side first wins. The watermelon ball is also neutrally buoyant, making it more difficult to move in the water. This product is great for the aspect of play and teaches skills beyond swimming like teamwork. This game is like the land game of rugby, but much safer.

3.1.16 Diving Boards

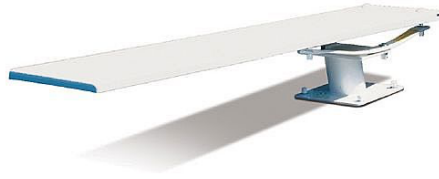


Figure 35: Diving Board (SR Smith, 2023)

Diving boards are the pinnacle of almost every deep end of a pool. Diving boards allow users to jump high and make crazy jumps in the air. This could include splash contests, catching a football in midair, training, etc. Diving boards come in all shapes and sizes. The diving board is also one of the most dangerous pool attractions as many issues like hitting the board, landing wrong in the water, or not being a strong enough swimmer to get to the side of the pool are all very common.

3.1.17 Swim Paddles



Figure 36: Swim Paddles (Amazon, 2023)

Swim paddles are utilized like swim fins but for one's hands. It helps the user to propel themselves much faster in the water. It can help correct hand movements while in use. Paddles have been around for a long time and are one of the most popular tools used by competitive

swimmers to get stronger arms. The goal of the paddles is to increase the power in the arm muscles.

3.1.18 Pull Buoy

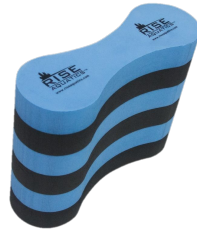


Figure 37: Pull Buoy (Amazon, 2023)

Pull buoy is a device that is put in between one's legs that prevents the user from being able to kick, while allowing their legs to stay afloat, so that the user can maintain proper body position. This is vital in focusing on the pull of the arms and can be combined with something like paddles, like using a kickboard with fins, to give even more focus to this area.

3.2 Analysis of Popular Pool Products

This half of this chapter will look at comparing the important features of what each product is trying to accomplish and help us better understand how we can improve existing products and create new products in this field. Each product will be looked at for the area in which the toy or device is used, what it is trying to teach or help with, if the product is more drill or game based, whether it targets the upper body or lower body, and the materials used and the level of buoyancy. All these factors vary depending on what the product was designed to accomplish. Taking a better look at these factors may help to build a better understanding of how to improve this market of products.

Product Analysis of Case Study

3.2.1 Pool Toy/Device Mapping

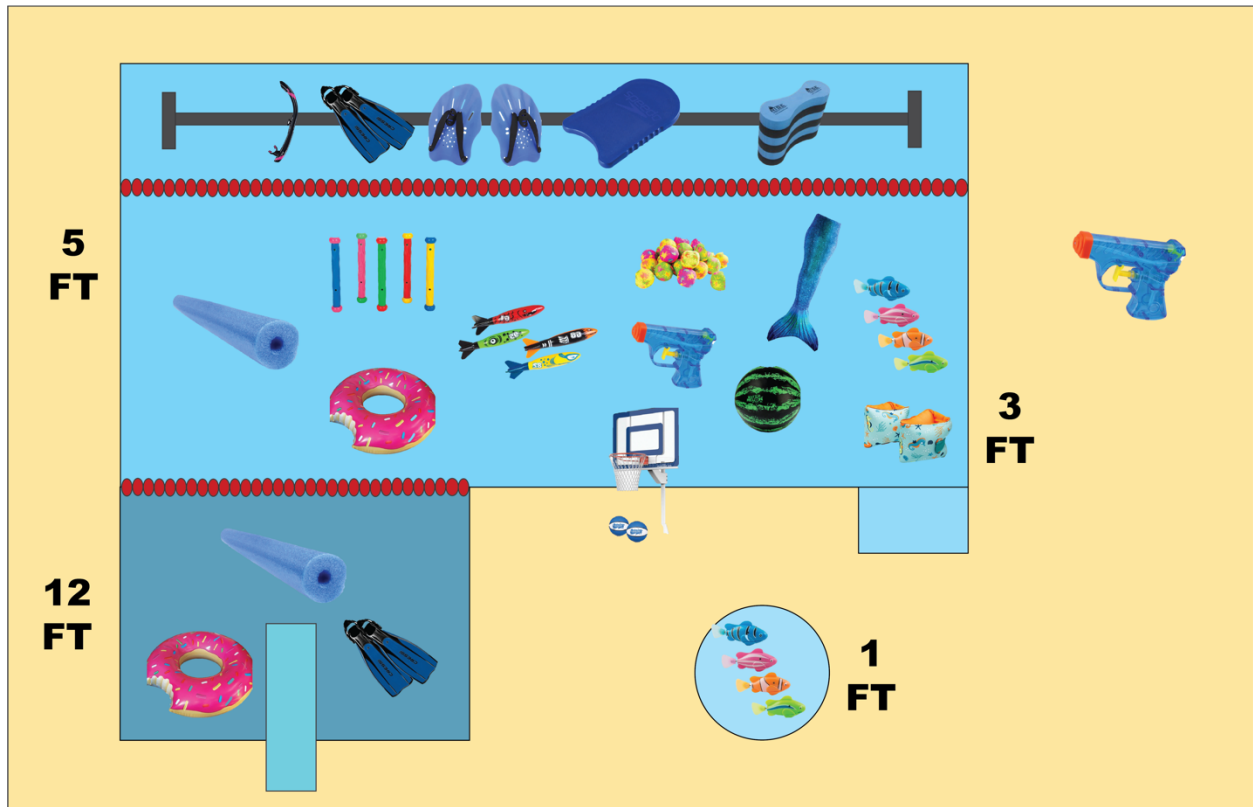


Figure 38: Pool Toy & Device Map

The map in Figure 38 represents where these different pool toys are likely to be found in a pool. This sets up different categories in which to group the products into including dry land (yellow), baby pool (1 FT), shallow end (3 FT), lap lane (black line), moderate end (5 FT), and deep end (12 FT). Some products can be categorized into multiple zones as they might have more versatility as a product. Products like goggles can be beneficial anywhere within the pool and can also enhance other products, such as those used in the deeper ends of the pool. These categories can help a designer to hone in on one part of the pool to target their product.

category as sneaking in the work can be much more difficult if trying to have the product target a specific body movement. This category is also concerned with all body movements within the three main strokes: freestyle, backstroke, breaststroke. Products designed for this area of swim improvement should all focus on one of the movements within these strokes. Products designed for this area can also be combined with other products in this area or other areas, like flotation devices, to help accomplish what the product is intended to teach.

3.2.2.2 Design Considerations for Breath Control

As seen in the products categorized in breath control (Figure 39), all the products share one similar goal: keep the head underwater. Goggles can be used as a great tool in learning breath control as it gives the young swimmer a chance to see underwater and give a sense of comfort. All the others could be considered as toys designed for challenging a swimmer to dive underwater. This requires them to hold their breath and breathe out through their nose.

3.2.2.3 Design Considerations for Comfort in Water

The products designed in this area help to accomplish confidence and happiness. Confidence can be seen with the flotation devices as these give a sense of comfort and take away the fear of drowning. This is especially useful in getting someone into the pool to be comfortable. The other side of comfort in and around the pool is the aspect of play involved. Learning to swim should not just be work but also fun to a new swimmer. A swimmer may be more encouraged to go to the pool if they want to play with their toys. This is seen with the toys in the graphics being seen as pointless to improving a child's swim ability directly but may help them to feel much more comfortable in the water. Understanding the developmental stages and play can make designing a game or toy much easier. Because being comfortable in the water

around water. As talked about above, the more gamified products tend to target making someone more comfortable in a pool than they are intended to target the body mechanics of swimming. Some of these products sit in the middle of the chart as they can be used to play games and have fun at the pool but could also be used in a more drill-like sense. Examples of this includes goggles, pool noodles, dive toys, etc.

3.2.4 Upper Body Versus Lower Body



Figure 41: Upper Body Versus Lower Body

Figure 41 helps to better show which products help the upper body and lower body more. There are some important distinctions between a product that is designed for the lower body and a product that is designed for the upper body. These differences can most easily be portrayed in products that are designed as a drill-based product.

3.2.4.1 Design Considerations for the Upper Body

Designing for the upper body can be challenging as swimming uses the whole body. A device or toy being designed for the upper body could utilize the use of a pull buoy, pool noodle, or other flotation device that help keep the upper body in line with the water as seen in Figure 3. This is not always necessary as the swimmer can also kick to keep the upper body in line with the water, but it should be considered. When designing for the upper body the lower body may be in use, but the focus of the product should always be on improving the upper body. Dry land and the shallow end can help eliminate the use of the lower body as they can stand on the bottom

of the pool without needing an external device. There are also lots of considerations when it comes to the different strokes. Arm positioning as well as hand placement are key in all three strokes, making for easy areas to target in the upper body.

3.2.4.2 Design Considerations for the Lower Body

The lower body mainly focuses on the kicking motions. Backstroke and freestyle utilize the flutter kick and hip rotation where the orientation of the body is the only difference. These can be targeted in many areas of the pool as swimming from point A in the pool to point B means the swimmers have to swim. In areas like the shallow end where the user can touch the bottom, the swimmer could be tempted to bounce or walk across. A game-based product could expose this idea by introducing the idea of speed to get across the pool. A game-based product could also utilize the hands taking away swimmers' ability to use their arms in the pool. Drill based products can also work well for homing in on the lower body. A device could be used to support the upper body, like a kickboard, so that the swimmer can focus on improving their lower body strength and speed.

depending on his mass. This method is commonly used in science to measure objects with unique shapes mass. The other component is buoyancy or the upward force that objects feel whenever partially or fully submerged into water. The displacement of an object is equivalent to how buoyant the object will be (JD Power, 2023). This concept can be more easily understood by how an object is easier to lift in water than on land.

It is important to distinguish that the weight and density of the object combined with Archimedes Principle is what allows an object to float. To calculate the density of the object the mass, or weight, needs to be divided by the volume. If two objects have the same volume, but one weighs more, then the heavier one will be denser (JD Power, 2023). The materials used must balance each other out to float. Ships are usually constructed of heavy metal but because of the air held inside plus any other materials used that are not as dense as the water, the design allows the ship to float. This can be demonstrated by putting a bowl in a bathtub. The bowl floats on top of the water because of the air it holds on top of the water. Air is much less dense than water, therefore allowing the bowl to float. However, as water is added into the bowl the bowl begins to lower in the water till it sinks, assuming the bowl is made from a material denser than water. If the product utilizes air to allow the product to float, then the air used should be firmly enclosed. If this air gets displaced by either water, a human body, or other significant weight source, then it can make the product sink. It should be noted that water has a density of 1 g/cm^3 (American Chemical Society, 2023).

3.2.5.2 Materials and Styles of Flotation Devices & Toys

Plastic pool floats come in a range of materials and styles, the first style being inflatable pool floats seen in Figure 25. These products are mostly made from PVC or polyvinyl chloride according to pool floats manufacturer Floatie Kings (2022). PVC has a density of 1.38g/cm^3

(British Plastics Federation, 2023). This means when a pool float is completely depleted of air it will sink. It floats due to the air inside having an approximate density of $.001225\text{g/cm}^3$ (Skybrary, 2023). Taking the volume of air in the product and the PVC used will give an estimate of how well it will float in the water. The designer must then decide how much weight the flotation device needs to support by finding the density of the human they are attempting to hold. Pool inflatables can also be made from TPU or thermoplastic polyurethane, which is highly resistant to abrasion and is considered more environmentally friendly than PVC (Floatie Kings, 2022). These materials can also be combined with polyester mesh to create a seat or hammock. Polyester mesh by itself does not float and needs the support of the other materials.

The other material commonly used to make toys and devices float is EVA foam, a closed-cell foam coated with vinyl for extra durability (Floatie Kings, 2022). This material, unlike its inflatable counterparts, will hold its shape and does not have a hollow interior. This is better for toys and devices that are intended to float in the water as it gives the product a consistent shape and hardness.

3.2.5.3 Design Considerations for a Neutrally Buoyant Product

As previously discussed in 3.2.5.2, to make a product float, the product must have a density smaller than that of water. When designing a product to be neutrally buoyant, a designer should aim to be as close to water's density as possible. This can make designing a product that is neutrally buoyant difficult.

3.2.5.4 Design Considerations for Products that Sink

Designing a product that is meant to sink to the bottom of the pool needs to follow the Archimedes Principle. The product needs to have a density higher than that of water. Many plastics and rubbers make for good materials when designing a product to sink. It is best to avoid

any parts being hollow, but if hollow parts are included, they should be easily able to fill with water so that the product sinks to the bottom. According to Target (2023), toy torpedoes utilize a thermoplastic rubber material which has a higher density than water, making the product sink. In the case of dive rings and sticks, these products have one end which is denser than water and one end that is lighter. This allows these toys to stand up on the bottom of the pool but still sink to the bottom.

Chapter 4 - Design Guideline

This chapter will look at the design guideline and the flowchart in Figure 43. This is broken down in to four categories of swimmer who all vary in design factors. This was decided based upon the different level of swimmers seen at a pool. This process will also decide what area of the pool as this can greatly change how a product is used. Next the flowchart is broken down into 4 main categories of teaching or improving swim. These are the four key skills to be a good and confident swimmer.

4.1 Understanding Designing for the Aspects of a new Pool Product

1. Unfamiliar Swimmer

What it means: A swimmer who is classified as unfamiliar means that they have little to no experience around water. This might mean they have heightened levels of fear or frustration when learning to swim.

Design Considerations: Unfamiliar swimmers do best with objects and ideas that give them a sense of comfort. These objects and ideas could be as simple as reminding them of their religious beliefs, favorite movies/tv shows, or just reminding the unfamiliar swimmer of nature. Designing for comfort or buoyancy is best for this level as it can help these swimmers get a feel for the water before learning to swim. If a designer wanted to help them with the other aspects of swimming like breath control or body mechanics, it would be best to do so on land or in areas of the pool where the person can stand. The designer should avoid any products that deal with deep water.

2. Assisted Swimmer

What it means: This is a swimmer who cannot swim on their own and needs either a lifejacket, a flotation device, or swim trainer to help them swim. An assisted swimmer is comfortable being in the water at this point, but not able to swim on their own.

Design Considerations: As is in the name, a good way to design for assisted swimmers is by creating devices that assist them in the water. This could fall under the buoyancy category, but a product like a kickboard, which is used for training the legs, can also assist the swimmer, allowing the user to both be assisted by the device while simultaneously helping them improve their swim ability. All parts of the pool can be designed for this level of swimmer as they will always have something on them or nearby to take off any of the pressure individuals might feel in terms of swimming.

3. Own Swim (Short)

What it means: This level of swimmer refers to those who have learned the basic mechanics of swimming but can only swim for short periods on their own. A designer could identify one of these swimmers if they see the person having to stay near the walls in deeper ends of the pool to rest or in shallow enough areas where they can easily bounce off the bottom of the pool if their energy starts to get low.

Design Considerations: Swimmers in this category give a designer a lot more freedom when it comes to design. This is a critical step for someone learning to swim, and all areas of product focus (Figure 39) should be considered. Products designed for deeper ends of the pool must consider that the product can only be used for a short period of time to allow the user rest along the wall.

4. Own Swim (Long)

What it means: These are the swimmers who are very proficient at swimming and can fully swim anywhere in the pool on their own. They have a good understanding and execution of the body mechanics.

Design Considerations: Designing for these kinds of swimmers looks at all four of our product focus categories (Figure 39). There are also few limitations to this kind of swimmer. A designer could look to further improve their body mechanics or breath control. They could also create fun games that are not directly correlated with making the user a stronger swimmer but gets them excited and wanting to go swim at the pool. The goal is always to keep them swimming consistently so that they do not begin to go backwards in their swim ability.

5. Dry land / Baby Pool

What it means: Dry land and the baby pool refers to the areas of the pool that no swim level is needed to use. Dry land refers to doing activities on land rather than in the water. This is helpful especially to someone who fears learning to swim as it gives them a sense of comfort in the water. The baby pool refers to the area of the pool where the water is only one foot deep. This area is good for getting a new person comfortable being in water without having to worry about drowning or sinking in the water.

Design Considerations: Designing for dry land and baby pool is much different than other areas of the pool as there is little to no water being used. Dry land can be effective for teaching body mechanics as it takes the person out of the moment of learning to swim on the spot and allows them to learn it before they even step into the water. The baby pool is very effective at introducing the concept of water especially to a younger child or toddler. It gives them a chance to explore moving around in the water.

6. Shallow End

What it means: The shallow end of the pool refers to the area of the pool that is between three feet to five feet. This area of the pool is deep enough that a swimmer may not be able to touch the bottom of the pool but could easily bounce off the bottom of the pool and return to the surface to catch their breath. In shallow areas, like in pools where it is three feet, swimmers may even be able to have part of or almost their entire upper body out of the water.

Design Considerations: The shallow end is one of the easiest areas of the pool to design for as there is a lot of flexibility with the products that can be created. It is deep enough to help teach breath control and teach buoyancy in the water. It also can be used to teach body mechanics in a more gamified way than a product designed for a lap lane. A product can also be designed to be used over lots of space as most community and neighborhood pools are largely made of a shallow end when not being used only for lap lanes. This area of the pool is the most typical for the average swimmer with little or no experience as well. Designing for areas of the pool where a swimmer can stand with part of or all their upper body out of the water opens a new variety of games and drills as the user will have freedom with their upper body. This is good when designing for comfort in the water because individuals do not have to worry about the depth of the water. The goal instead is more concerned with getting swimmers used to swimming around and being in a pool.

7. Lap Lane

What it means: The lap lane is the part of the pool that is designated for circle swimming or lap swimming. This area of the pool can sometimes be very deep or very shallow depending on the pool. This part of the pool is meant for continuous swimming with few short breaks in between.

Design Considerations: This part of the pool is good for swimmers trying to become stronger swimmers quicker. It is probably the most effective and direct ways to work on one's swim

ability. When designing for the lap lane it should be considered that designing drills is the most effective as the lap lane is usually used for running drills. Games can be designed in the lap lane, but it is much more difficult to engage in them. Body mechanics and breath control are especially good areas to design for lap lane swim as the size gives ample time to work on these skills.

8. Deep End

What it means: This area of the pool is where a swimmer would not be able to touch the bottom of the pool. This area of the pool is anything seven feet and deeper as it would be difficult to bounce off the bottom of the pool to catch one's breath. Newer swimmers in this area of the pool should look for and will probably stay close to a wall.

Design Considerations: It is best to avoid new swimmers beginning in this area of the pool as it can be both fearful for the new swimmer and dangerous. The deep end is best for designing for swimmers who can swim well on their own. Game- and drill-based products can both be designed for this area of the pool. The designer also needs to consider that the swimmer will not be able to touch the bottom of the pool, therefore making designing products for the lower body easier.

9. Comfort in Water

What it means: Comfort in water refers to the comfortability a swimmer has in the water. This is especially important for newer swimmers as swimming the first few times can be very daunting. This concept also deals with getting a person to want to learn to swim and become a swimmer, which can include miscellaneous toys and games that do not work on a swim skill.

Design Considerations: Designing for comfort in the water will include a lot of devices that help keep a swimmer afloat in the water as well as games. This way the swimmer does not have to

worry about the other aspects of swimming and can just enjoy the pool. This also deals with many pool games in the water as this can encourage someone who might not have any reason to learn to swim to want to go to the pool, to become a better one if they know they get to play with a toy when they go. Designing for comfort in the water may not necessarily make them a stronger swimmer but will encourage them to want to be a better swimmer and teach the swimmer not to panic when they are in a pool or other type of body of water.

10. Breath Control

What it means: Breath control refers to learning how to properly breathe in the water. This includes teaching a person to have their head underwater for periods of time. It is a very important skill to learn for any swimmer at any level and can always use improvement. For newer swimmers, breath control is about teaching them how to blow out their nose, while for more experienced swimmers it is about duration.

Design Considerations: Breath control can be both designed as a game or a drill. There are many existing games like torpedoes and dive rings that already do a good job teaching this skill in a fun way and are used by many swim instructors and coaches. It is difficult but not impossible to teach this skill via dry land or the baby pool but utilizing the other areas of the pool is preferred.

11. Buoyancy in Water

What it means: This refers to a swimmer's ability to float in the water. Focusing on buoyancy looks at targeting two key skills that are associated with the ability to swim for long periods of time on their own: sculling and the eggbeater kick. These skills are vital in bodies of water where a swimmer may not be able to rest for extended periods of time.

Design Considerations: Designing for buoyancy in water should look at the two main forms of swimming to keep someone afloat in the water: sculling and the eggbeater kick, a variation of the

breaststroke kick. These are both explained in further detail below in the guideline numbers 18 and 19. When designing for buoyancy in water, breath control is as not important as properly performing sculling and the eggbeater kick. When doing these two kicks, the swimmers' heads should always stay above the water. It is also preferred that drills and games are designed for deeper ends of the pool so that the swimmer can focus on developing technique rather than using the bottom of the pool for support.

12. Body Mechanics

What it means: Body mechanics refers to the mechanics of the three main strokes that every swimmer should know. Butterfly is not included in this as it is not essential to learn to become a strong swimmer. Body mechanics deals with three strokes: freestyle or otherwise known as frontward crawl, breaststroke, and backstroke.

Design Considerations: When designing for body mechanics, it is important to consider which stroke and which part of the body the product will be targeting. The product can directly target a specific skill and is best done when designing a product to be used for doing swim drills rather than a game. Games are much better for indirectly targeting a skill, which could be just to help strengthen a particular muscle, but also enjoyable enough that a user would want to use the product more generally.

13. Backstroke

What it means: Backstroke is the stroke in which the swimmer faces upward toward the sky. For details on the exact movements, check Figures 9 through 13. With this stroke a swimmer must first be comfortable on their back before they can begin to learn the body movements.

Design Considerations: Designing for back stroke for a new swimmer should look to start at the basics which includes swimmers floating on their back and learning the basic movements. These

movements can be learned both inside and outside the pool, but inside the pool the stroke can only be learned once a swimmer is comfortable on their back. There are many specific movements a swimmer needs to learn as shown in Figures 9 through 13. These include body position, arm movement, flutter kick, etc. These movements can both be targeted via a game or a drill-based product. A drill-based product can target the movements and muscle much more directly and can improve a swimmer much quicker than most games would. A game, though, could be a way to get someone who is still unsure or does not enjoy swimming to be increasingly likely to try or improve at it. For any game-based product, designers should remember that the game will more than likely be played while a person is on their back in the water, which can cause many restrictions to the products that can be designed.

14. Freestyle/Frontward Crawl

What it means: Freestyle is usually the first stroke learned by a new swimmer. This stroke is very basic and very effective. It is also the quickest stroke, so if a swimmer is in trouble and needs to get the wall quickly, they can with this stroke. The freestyle is also known as the frontward crawl as the freestyle in swimming terms technically means that there are very few limitations to what the swimmer can do in the water. It got the name the frontward crawl for the crawling-like motion done in the water.

Design Considerations: Designing for freestyle entails lots of freedom. No matter what stage of ability, swimmers should know and work to improve their freestyle. Freestyle is also good for both creating games or drills. Many pool games involve lots of swimming, which forces a swimmer to use the frontward crawl subconsciously. Using a game-based product may not directly work to improve their stroke but if it forces them to swim around then the product is achieving its goal of improving this swimmer's ability. Drill-based products are also very easy to

design for as a specific technique to swimming that can be targeted. The product can target just one specific area, like the way the arms are supposed to come out of the water, or it could target the full range of movement of the arm. If designing specifically for either the shallow or deep end, designers should consider the length of breaks that the swimmer can have while using the product. More information on the exact body movements of the freestyle or the frontward crawl can be found in Figures 3 through 10.

15. Breaststroke

What it means: Breaststroke is one of the most technical strokes to learn in swimming. It is also known as the most energy consuming strokes as many of the body mechanics used to perform the breaststroke are also associated with being able to float for long periods of time.

Design Considerations: Designing for breaststroke may require much more drill-based products than game-based as it is a very technical stroke. These movements and more information can be found in Figures 14 and 15. Some movements may be easier to teach, like shooting the hands forward in the water because this quick reaching out movement can be easily replicated in a game. Also designing a product for use inside or outside the pool can easily be done for targeting the specific movements of breaststroke but designing outside the water (dryland) or in the lap lane is the best, as these two areas give plenty of room to focus on the technique.

16. Upper Body

What it means: The upper body quite literally refers to any type of product that targets the upper body. This could mean designing for the arms, shoulders, head, or torso. The upper body is a very important aspect of swimming as lots of upper body strength is needed in swimming.

Design Considerations: Designing for the upper body should mainly look at targeting the muscles of the upper body. This can be done easily in any part of the pool and for any level of swimmer. It is also good for creating either game-based or drill-based products.

17. Lower Body

What it means: Similarly, the lower body refers to all activities done in the water that utilize the hip, leg, and foot movements. There are two main kinds of kicking motions associated with the lower body: flutter kick and the breaststroke kick, with the eggbeater kick being a variation of the breaststroke kick. Hip rotation is also important in strokes like freestyle and backstroke as it allows a swimmer to move quicker and expend less energy.

Design Considerations: When designing for the lower body, it should be considered whether the product being created can be used in an area of the pool where the user could stand. Products can still be designed in these areas of the pool but areas of the pool like the deep end or lap lane will force the swimmer to really work the lower body, the goal of the product.

18. Sculling

What it means: Sculling is the action of moving the hands back and forth to stay afloat while in the water. This motion is not the same as breaststroke as there is a side-to-side motion instead of the circular motion used in breaststroke. This is because sculling is intended for staying afloat in a stationary position whereas in the breaststroke the movement is used to propel the swimmer forward.

Design Considerations: Because sculling is a relatively stationary movement, any game-based or drill-based products should look to require very little movement in the pool. It is also suggested to design for either the deep end or lap lane as these areas of the pool force the swimmer to have to tread water.

19. Eggbeater Kick

What it means: The eggbeater kick is a hybrid type of kick of the breaststroke that was popularized by the military and water polo as it is used for treading water for long periods of time. This kick is very important to differentiate from normal breaststroke kicking as it allows the head to stay above the water and prevent the bobbing motion which makes the swimmer expend more energy to keep their head above water.

Design Considerations: Designing for the eggbeater kick could use a similar drill or game as to that designed for the breaststroke kick. The main difference is learning the alternate kick. This could be targeted in a game-based product by making the user have to stay above the water in the deep end to use the product. It is best to design for this skill in the deeper ends of the pool as this is where this skill will mainly be used.

20. Drill

What it means: This is referring to a product whose purpose is to be a drill-based product where the product intentionally targets a particular area of skill or the body. These products will be used as if they are gym equipment to intentionally strengthen a certain ability or muscle.

Design Considerations: These products will closely consider the body mechanics needed to perform the stroke or movement it is targeting. Information on all these movements can be found in 2.7 of the literature review. Many of these products are designed for the purpose of lap lane swim but are not secluded to that area of the pool. Drill-based products can also be good for all levels of swim ability as the goal of this thesis is to improve one's ability around the pool.

21. Game

What it means: A game-based product in this sense is defined as a product that almost disguises the work being done. Turning a simple task like pulling the arms and gamifying it can make

learning a new skill much easier and can be very effective. If the goal is to improve a swimmer's ability but they do not want to use a product that is more drill-based because they find it boring or uninteresting, then turning it into a game is much more likely to be effective in getting them to want to go to the pool. Take for instance a water gun. A water gun may not help someone to become necessarily a stronger swimmer but may make the person want to go to the pool so they can use the water gun. This can make them more comfortable in and around water, which can also lead to this person wanting to be a better swimmer. Another way gamifying learning to swim helps is that many people find swimming very repetitive and using a product that is drill-based is going to be repetitive by nature as it targets a particular area. The game-based product created may not work the targeted area as effectively but could still be slowly working and teaching the skill through the game.

Design Considerations: Designing a game-based product can be a lot trickier than a drill-based game as with a drill-based product the skill or movement is defined and no external factors like disguising the movement is part of it. Game-based products are also good for any level of swimmer as it can make the process much more enjoyable for everyone. A game-based product also is good for most parts of the pool as there is a lot of freedom and space to move around, except in the lap lane. The lap lane can be tricky because the product must be designed almost as a single player game and should not disturb other swimmers unless intended to do so. Another aspect that needs to be considered is defining the objective of the game. A product could be more abstract as seen with products like the torpedo where the game is whatever the user decides it to be, or it could be more direct where there are set rules already in place like water polo. Both accomplish the idea of gamifying learning to swim. The torpedo helps teach breath control by having to dive underwater for extended periods of time and water polo helps teach the eggbeater

kick by requiring the swimmer to stay above the water for extended periods of time. Both examples show that it is possible to gamify learning to swim.

22. Flotation Device

What it means: A flotation device is a device specifically designed to keep a user floating with minimal effort in the water. There are many kinds of flotation devices which include swim floats, inflatables, chairs, lifejackets etc. These products' sole purpose is to keep someone afloat in the water. The goal of these devices is to get someone comfortable in the water as especially for newer swimmers getting into the water can be daunting. This extra sense of comfort could get them into the pool quicker and can also be used in conjunction with other products used for teaching swimming.

Design Considerations: Designing a flotation device is directly designing for comfort in the water. Many people who use these devices tend to be weak swimmers or are looking to relax. These products provide comfort and safety in the water. When designing a flotation device, designers must not restrict the basic movements of swimming or allow the device to become a choking hazard. If designed to support the lower body, like a chair or pool noodle, then the upper body needs to have freedom to easily move around. This is also the case with a flotation device designed to lift the upper body as the user could get stuck. Failing to consider both these concerns could cause more problems than it solves.

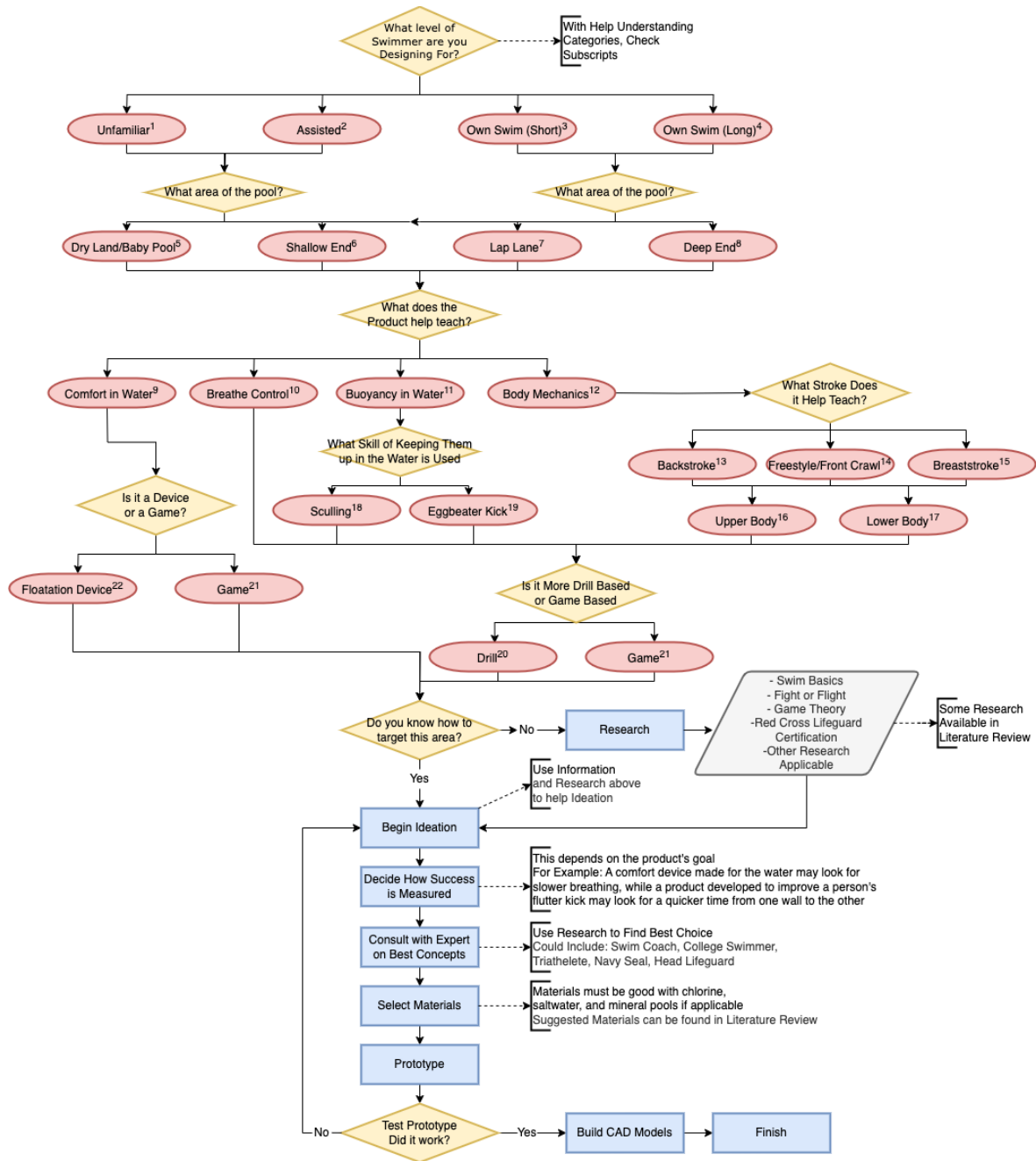


Figure 43: Design Application Flowchart

4.2 Understanding the Application

This thesis is intended to help create new and innovative products in the aquatic industry focused on teaching youth to become better swimmers.

4.2.1 Understanding the Level of Swimmer

When beginning the design process, a designer needs to first identify the level of swimmer they are designing for. This is important as in various stages of swimming development the swimmer will possess a different skill set and different limitations as to what they can do and where they can be in the pool. A child unfamiliar or assisted using a flotation device or trainer must avoid starting out in deeper water where it can be daunting. On the other hand, a swimmer who can swim on their own without any external help has a lot more freedom and is also understood to have learned the basic movements. This means that these swimmers are refining their swimming ability. These swimmers that are strong also do not have the urge to go to the pool and become a better swimmer, which is where the comfort in water comes into play. Just getting in the pool is one of the biggest steps to improving swimming ability.

4.2.2 Understanding the Different Areas of the Pool

Understanding the different areas of the pool a designer is designing can make a significant difference in the products that come out. A product that is designed for dry land gives a lot more freedom and mobility but requires the designer to understand gravity. A product that is designed for the shallow end should utilize the ability to jump off or stand on the bottom of the pool when the product is being used. This can be helpful in products that may require a swimmer to exert lots of energy, meaning that swimmer may need frequent rest. The lap lane is a common place for drill-based products as the swimmer will be swimming in a continuous straight line the whole time. It is possible to develop a game or flotation device intended for the lap lane, but it may be much more difficult due to the constraints put forth by the space between the lane lines. The final area of the pool to understand is also the most dangerous, the deep end. Products intended for the deep end of the pool should be for the stronger swimmers who can swim on their

own as it can be dangerous having someone who is unfamiliar or even assisted in this area of the pool. This is since these newer swimmers may panic, or a trainer could even be pushed underwater by the struggling swimmer leaving the swimmer with no one to help them.

4.2.3 The Four Main Areas of Pool Products

The main goal of this thesis is to create new products for the pool and aquatic industry to improve a swimmer's ability to swim. This is broken down into the four main areas of products seen on the market today. The first area is to address comfort in the water. This is referring to not only having someone comfortable in the water but wanting to get in the water. It is hard to teach someone to swim if that person will not get in the water in the first place. This can be done in two ways. If the person does not trust their swimming ability, using a flotation device could help ease this process and make them feel safe and secure when they are in the water. Another way to get someone comfortable at the pool is to create games or toys for the user to play with. Games and toys help take away the fear of swimming. They can also be a good distraction. Play is an integral part of the learning process, so turning going to the pool into a fun activity instead of a scary one can make all the difference in getting someone new to learn to swim. Designing for comfort in the pool will not necessarily significantly improve a person's ability to swim but may help open them up to the idea of becoming a better swimmer. It is also important to know if the product is successful. This could be done in several ways. Some ways it can be done are by measuring the person's heart rate, breathing patterns, or duration spent in the pool. These are used as intended targets to measure the products' success while helping teach a child to swim.

The next focus of product design in the pool toys and devices category is products designed for teaching breath control. These products need to force the swimmer to put their head underwater to use. Teaching the skills of holding their breath and blowing bubbles can help

prevent panic and even drowning. The most common breathing technique to start with is in conjunction with the frontward crawl as breathing is taught in conjunction with the stroke itself. The breathing technique is often taught before the stroke is taught as many may experience water going up their nose, leaving the swimmer, especially if they are new to swimming, uncomfortable and in pain. Teaching breath control can be done in both a game-based product and a drill-based product. These toys or games usually involve swimming underwater or looking underwater to keep the head in the water. One toy that is commonly used are dive rings as they present a challenge, but to a new swimmer it can be fun and can give them a sense of accomplishment when they successfully retrieve one. A drill-based product could make the swimmer swim under or through an object in the water. Another example is just the use of goggles with whatever is designed. If the swimmer is having to put their head in the water, it is comforting to be able to see underwater too. Other devices could be developed that would make putting their head underwater much more enjoyable and get them to learn breathing techniques. Understanding if the product is successful will not be too difficult as it can easily be seen by the swimmer's ability to hold their breath. A designer could also get creative and find new and innovative ways to test the progress of the breath control of a swimmer.

Buoyancy in the water is an interesting skill to teach and is used in the military because it could save someone's life if they know how to tread water for extended periods of time. Buoyancy in water is a stationary way of swimming, so there are two key skills needed to effectively tread in the water. These skills include sculling and the eggbeater kick. These two skills can be taught via game-based or drill-based products. Buoyancy in the water can be tested to see the success of a product by duration treaded or by measuring the amount of energy it takes the swimmer to float.

The final main area of aquatic products are products intended to teach or strengthen the body mechanics of swimming. This is the backbone of becoming a better swimmer as these skills are needed to swim. It is broken down into three main strokes: freestyle, backstroke, and breaststroke. Butterfly is also a well-known swim stroke but is for more advanced swimmers and is not necessarily a swim stroke that needs to be learned to be a strong swimmer. This area of swimming is essential for a new swimmer to master as it gives them all the tools necessary to swim on their own and be able to do so for extended periods of time. Many devices can help target these strokes and many games can make learning the stroke a lot more enjoyable. Identifying whether the product is successful depends upon what is trying to be accomplished. If the goal is to make the breaststroke kick more powerful, then distance covered could be used as an indicator for success. However, in the case of having the correct form with the arms in freestyle, a device could make a clicking sound to let the swimmer know their arm is in the proper position.

The goal of this flowchart is to help a designer to understand what exactly they are designing for when designing a new product for a swimmer. The main bulk of this thesis is helping the designer understand who the product is intended for and what the product is going to help with. Using this flowchart will give a designer a direction in which to begin the ideation phase of design.

Chapter 5 – Application of Design Guideline

In this chapter multiple products were created to help explain the application of this tool rather than focusing on a single design. This is because there are many different areas of design that can be selected which can greatly change the outcome of the product. One from each of the four main categories was selected to design a unique product for. This was done to help a designer looking to design through any of the paths a better understanding and an example of a product following that path. The design process is the standard design process with the flowchart helping make the decision for who the product is for and what the product's intent is. Explaining through multiple solutions was intended to help understand this approach better.

5.1 The Spin Wheel Kickboard

This chapter will use the flowchart to create new products using the design guidelines. The green bubbles are the selected path taken for each of the products produced. After the selections are made, information is compiled to help aid the design process.

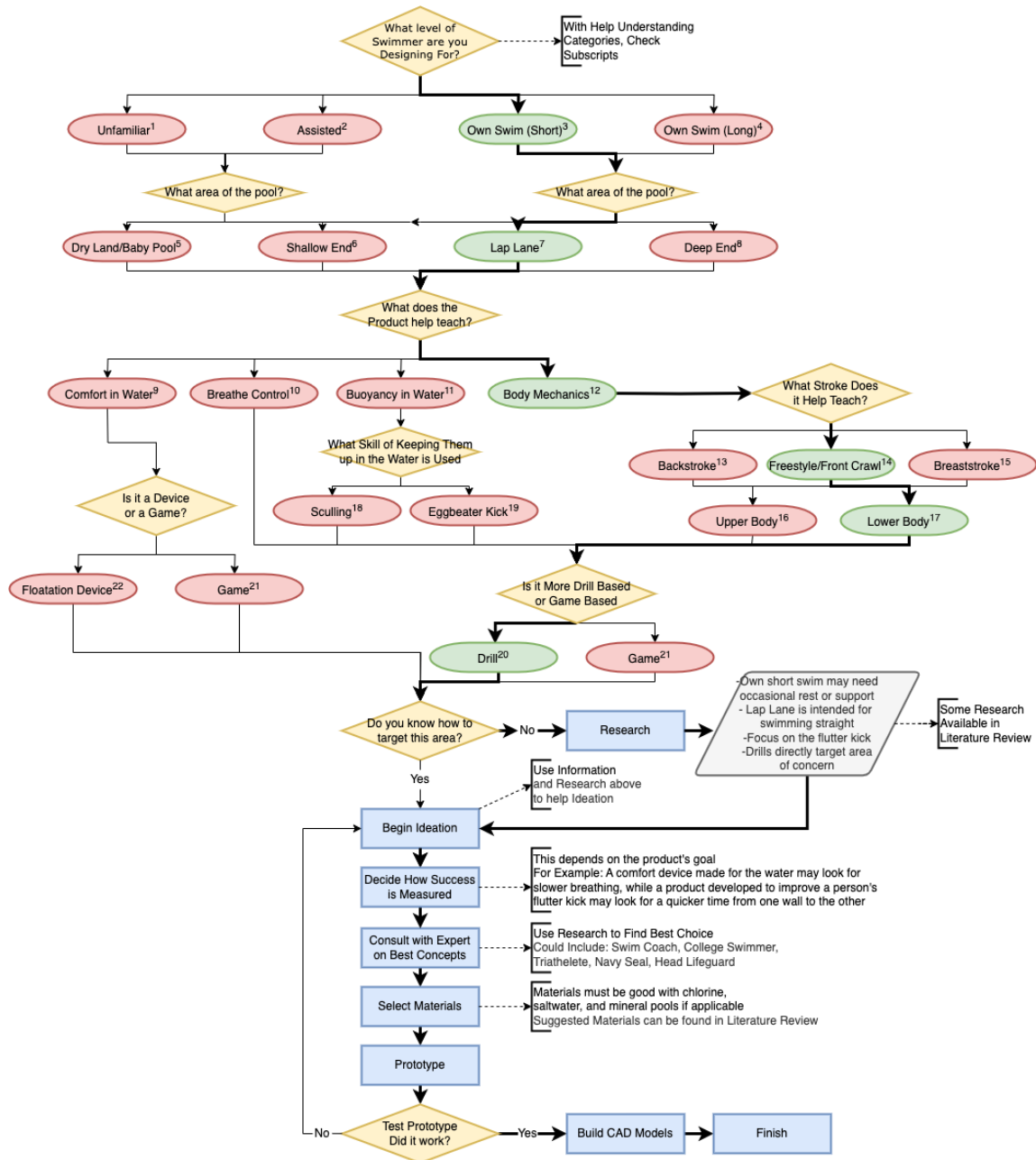


Figure 44: Design Application Flowchart Spin Wheel Kickboard

The prototype product demonstrated in this chapter was designed using the flowchart and then following the typical design phases. This product was designed to help teach someone who can swim on their own, but only for short periods of time. The kickboard floats giving the swimmer extra support so that they may be able to swim on their own for a longer period. Its goal as a product is to work the freestyle lower body, or more specifically the flutter kick. It is designed to be a drill that directly targets and focuses on the lower body.

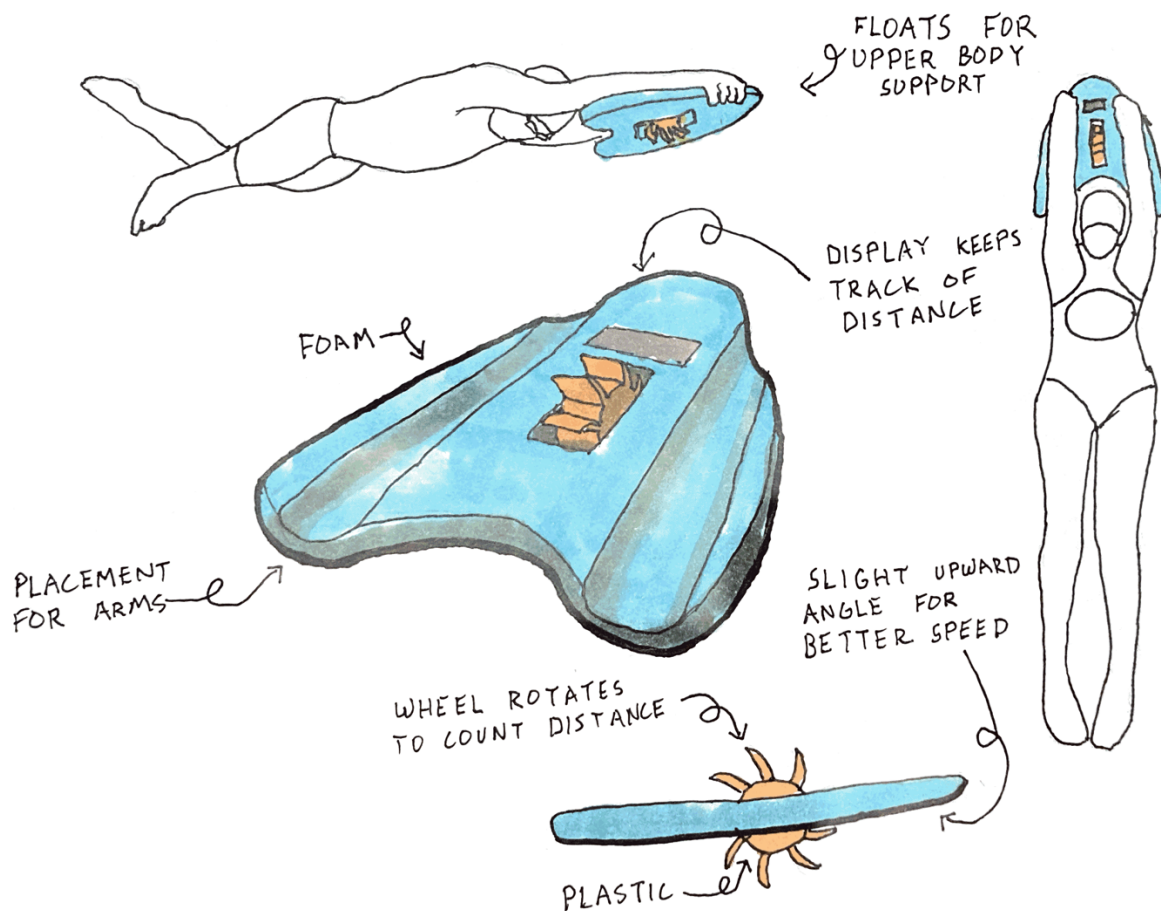


Figure 45: Spin Wheel Kickboard Sketch

In designing this product, current and existing models of devices to help kick better were examined. The design took the traditional kickboard and added a wheel that spins as the user moves through the water. This wheel counts the rotations and shows this number at the top of the

kickboard. This is done so the swimmer may know how hard they are working their kick every time they use the product. The wheel has a unique design like that of a water mill but with a curve design to the end of it. It is designed this way so that the user is not being continuously splashed in the face while using the product, but the design still allows the wheel to spin like normal through the water. The board also gives room to make it easier to grip and understand arm placement on the board. The final model can be found below.

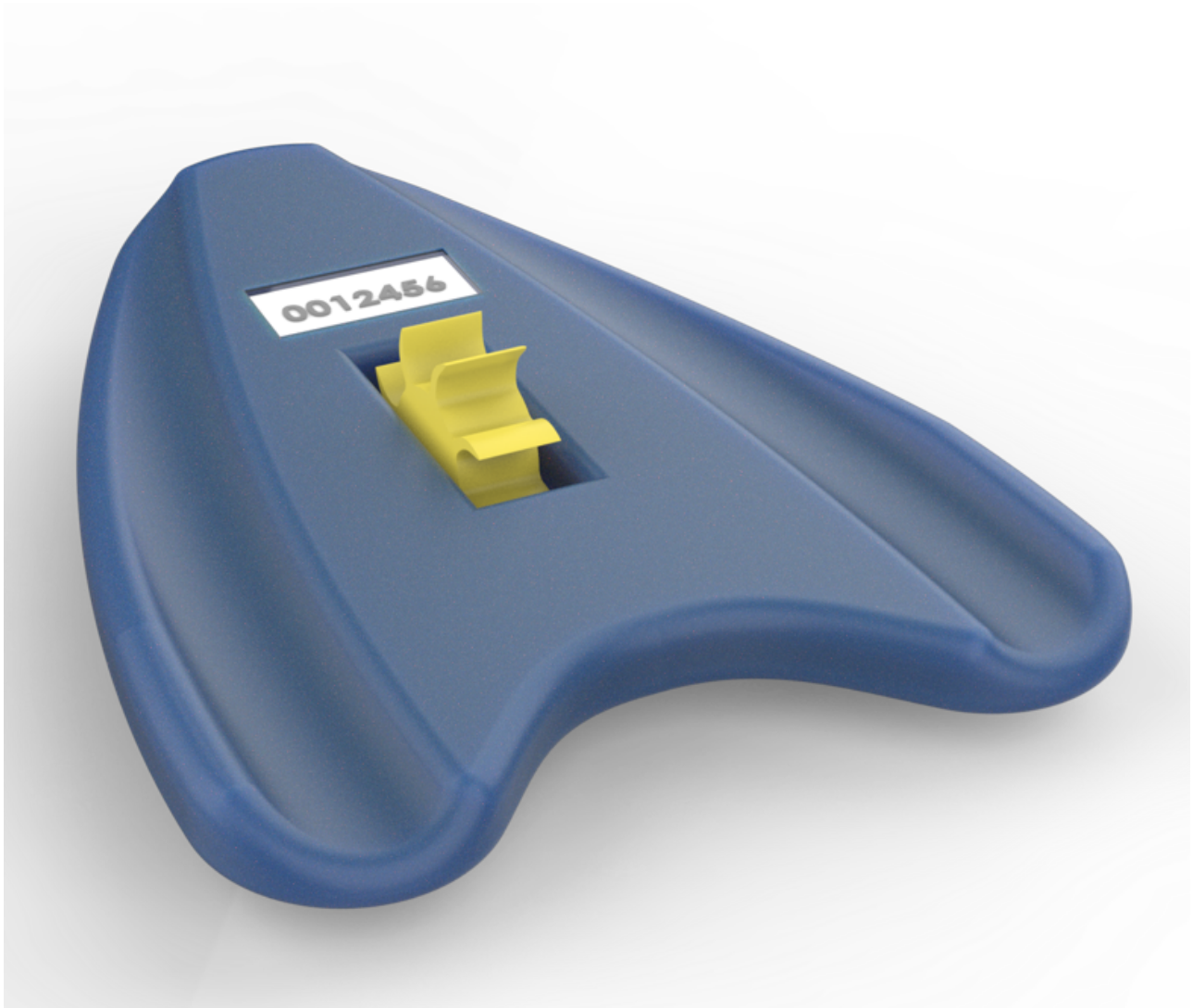


Figure 46: Spin Wheel Kickboard Hero View



Figure 47: Spin Wheel Kickboard Top View

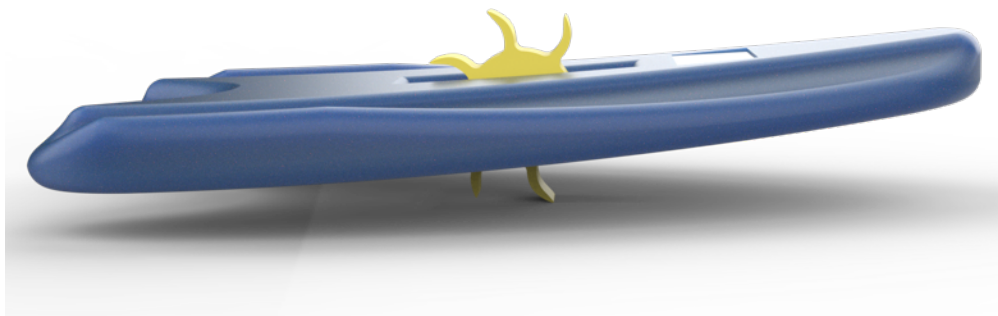


Figure 48: Spin Wheel Kickboard Side View

5.2 The Eggbeater Kick Pads

Figure 49 represents the next example of this thesis. This flowchart seeks to help understand using the different pathways to create a new product than the previous example.

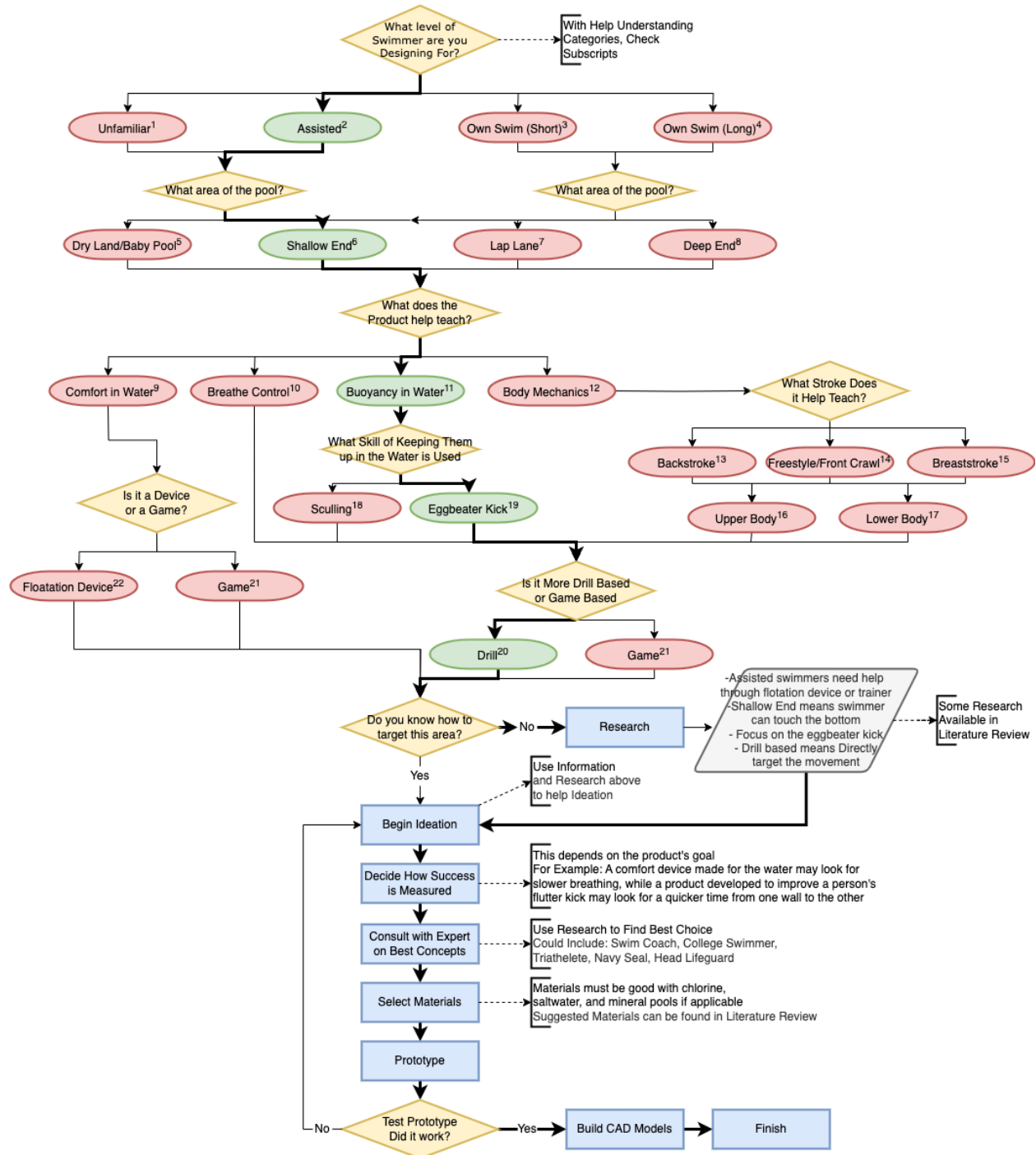


Figure 49: Design Application Flowchart Eggbeater Kick Pads

This second example product was set with the goal to teach the eggbeater kick to a child who is being assisted by either a flotation device or trainer in the shallow end of the pool. By observing the eggbeater kick seen in Figure 49, a designer can see that the kick has an outer push movement before the legs snap down and push the water. The goal of this product is to properly position the foot.

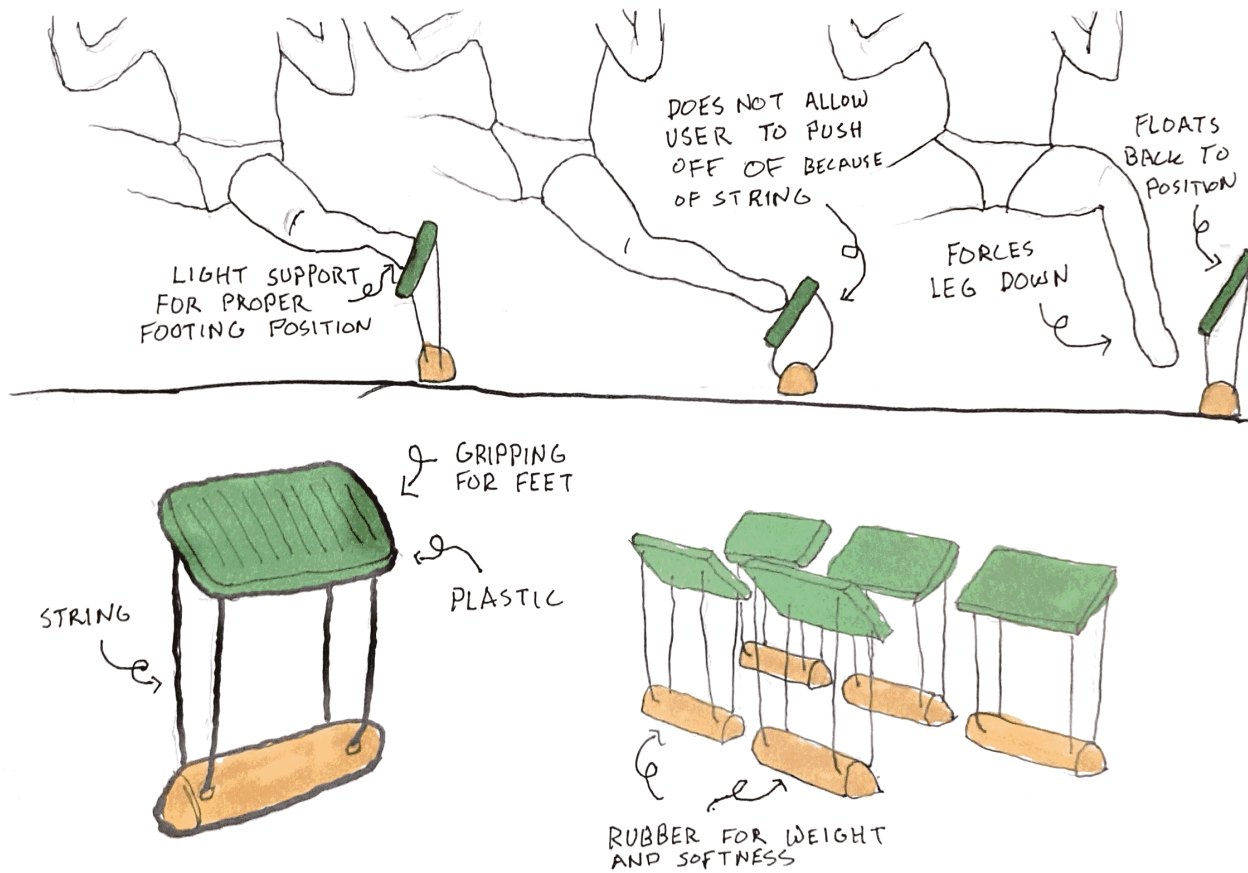


Figure 50: The Eggbeater Kick Pads Sketch

Because this product is being designed for an assisted swimmer, extra support is needed to help the swimmer. Therefore, pads were added. These pads can make learning the kick much easier. The product is held down by a rubber weight that forces the product to sink underwater, while the pad held by strings floats. The pad is not able to reach the surface due to the rubber

weight being heavier. The strings are adjustable as the shallow end can vary in height and the height of the swimmer changing. A trainer is useful in making sure the product is at the proper height and being used correctly. When a child uses the pads, it gives the child enough support to float without getting tired too quickly or, if using a flotation device, gives them the ability to set their feet. Because the goal of the eggbeater kick is for treading water, or stationary swimming, the pads position their feet to push up on the water instead of forward like breaststroke. As the child pushes off the product, the pad would sink forcing the child leg inward and completing the motion of the eggbeater kick. These pads could be laid out close together if the goal is to hit every single pad or just one could be used to focus in on the motion. Below are models of what these pads could look like.



Figure 51: The Eggbeater Kick Pads Rendered

As mentioned above, these pads could be used in a series to both function as a drill-based product but also as a game-based product.

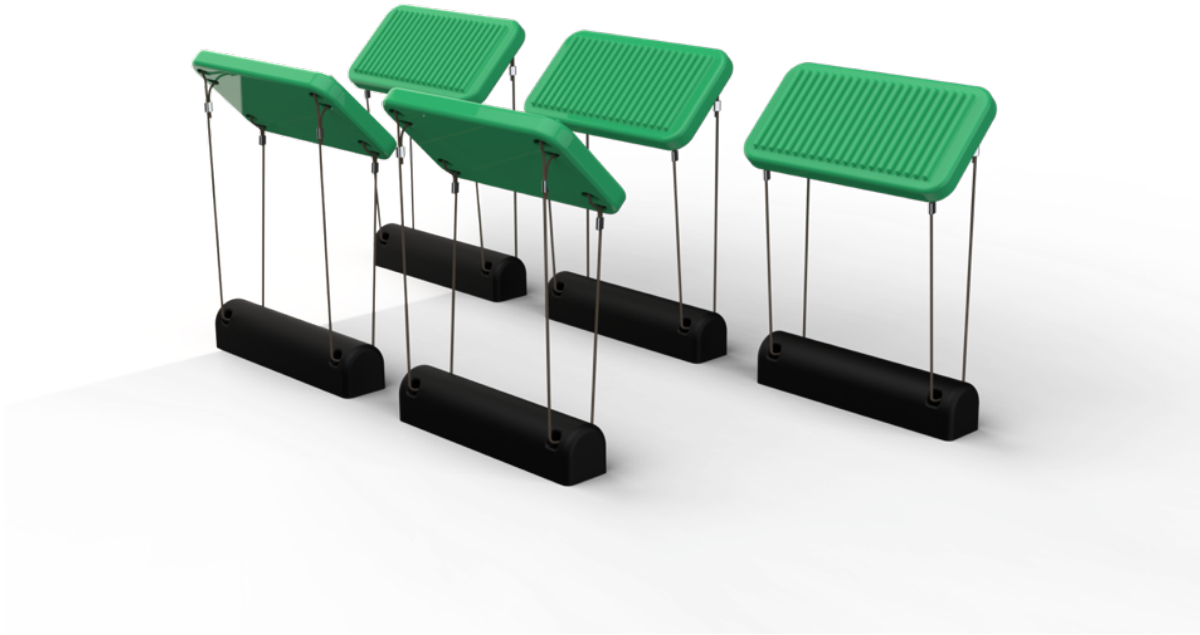


Figure 52: The Eggbeater Kick Pads (Multiple)

5.3 The One-Way Snorkel

This product seeks to help improve breath control in a strong swimmer. Figure 53 represents the design choices made to begin the ideation phase.

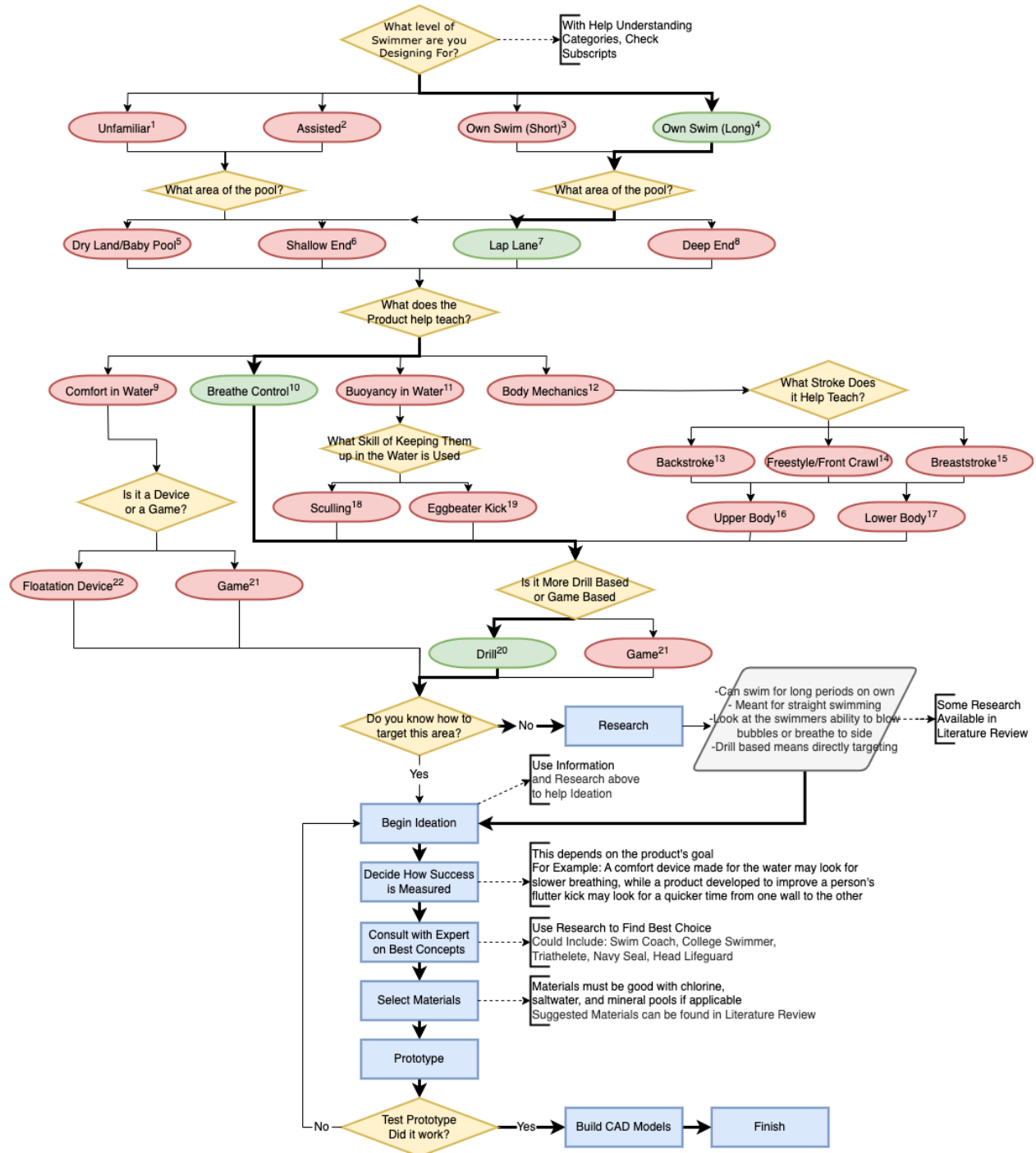


Figure 53: Design Application One Way Snorkel

This product looks to improve breath control in a strong swimmer. This will focus on the two main areas of breath control: blowing bubbles and turning to breathe. The goal of this product will focus on blowing bubbles out the nose through a drill-based product or a product that is intended to directly target what the product is attempting to accomplish.

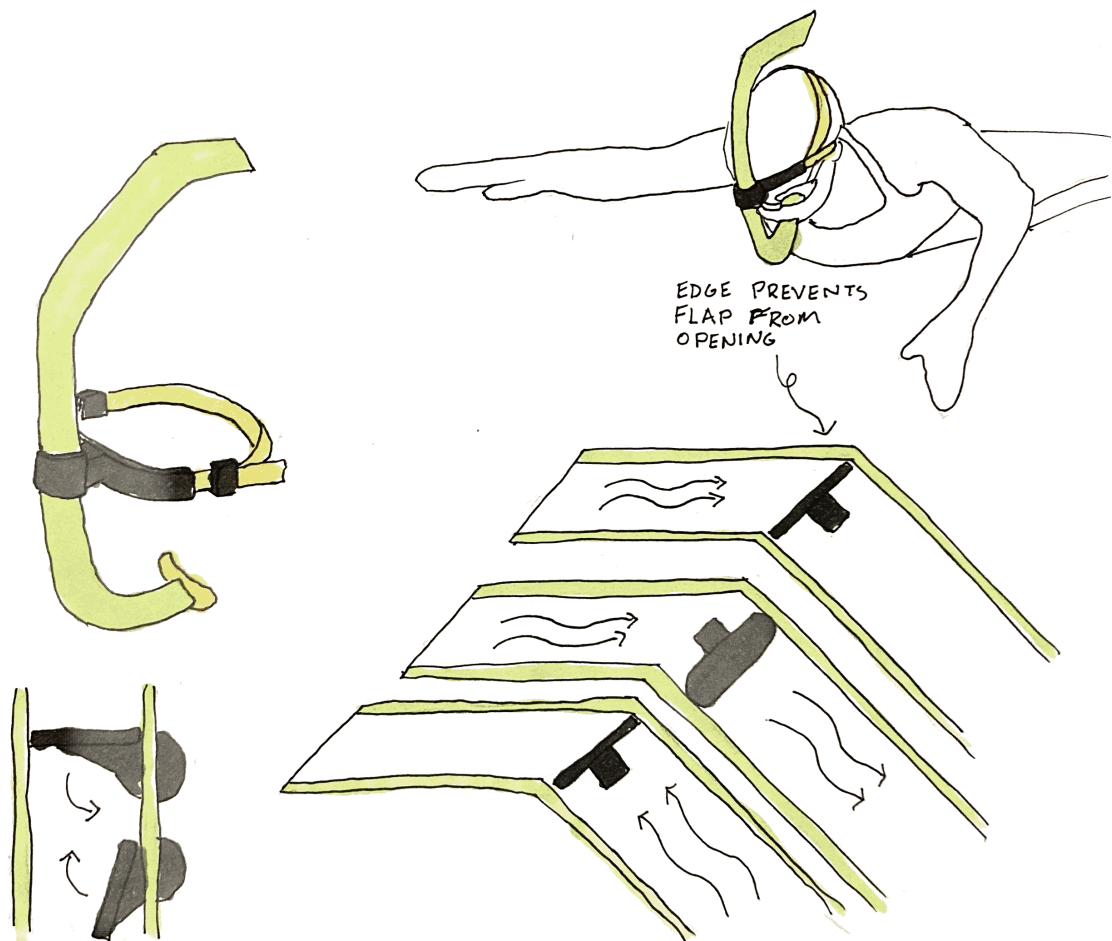


Figure 54: One-Way Snorkel Sketches

As seen in Figure 55, this product is a modification of a snorkel that only allows the swimmer to breathe in, but not out. The flap when breathing in comes down with the pull of air but when the swimmer tries to breathe out through their mouth it closes. This leaves a swimmer with no choice but to breathe out their nose. The product also allows the swimmer to keep their

head in water for extended periods of time allowing the swimmer to get used to the feeling of breathing out through their nose. Figure 5 below, further explains this flap on a rendered model of the product. The bend in the snorkel prevents the flap from opening.

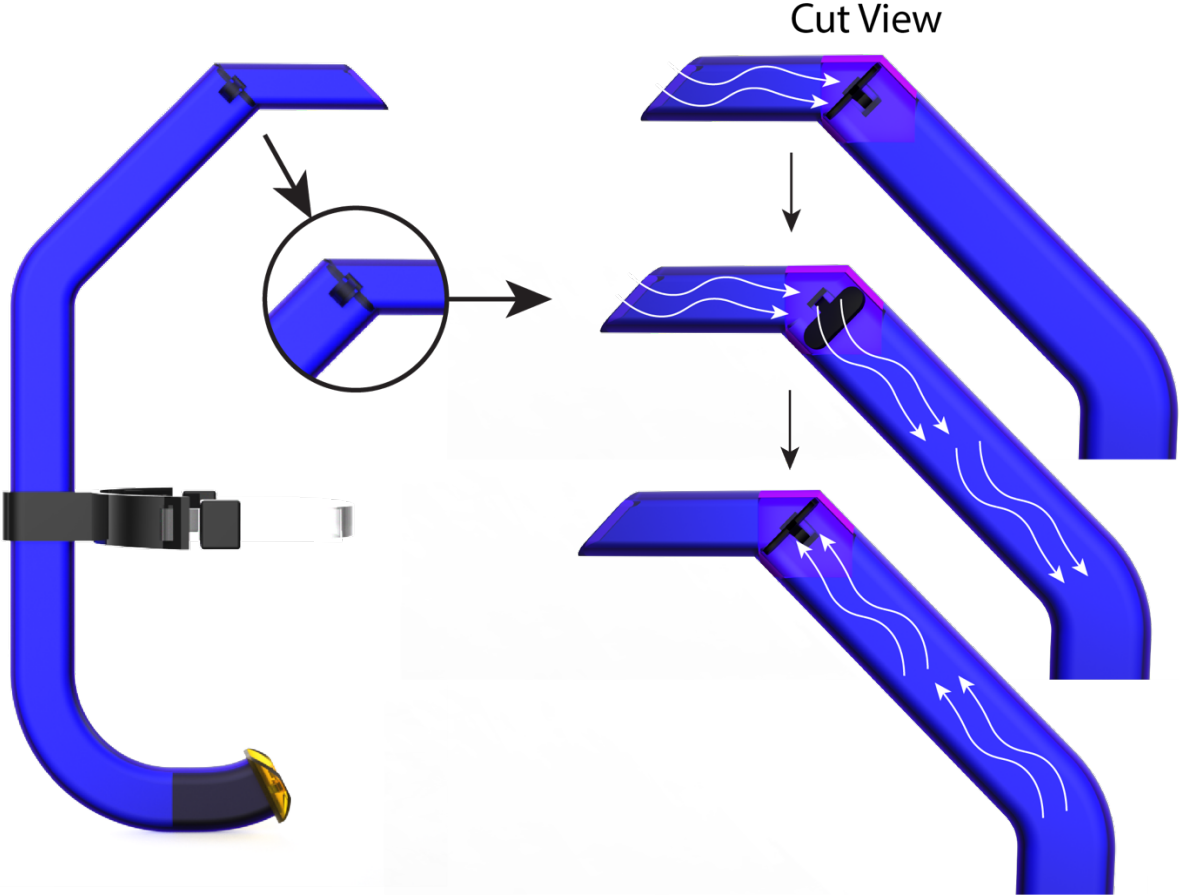


Figure 55: One-Way Snorkel Section View



Figure 56: One-Way Snorkel Hero View

5.4 The Skip Disk Game

This product wants to help with getting a child comfortable in water. Figure 57 below shows the design selections below to help with the ideation phase.

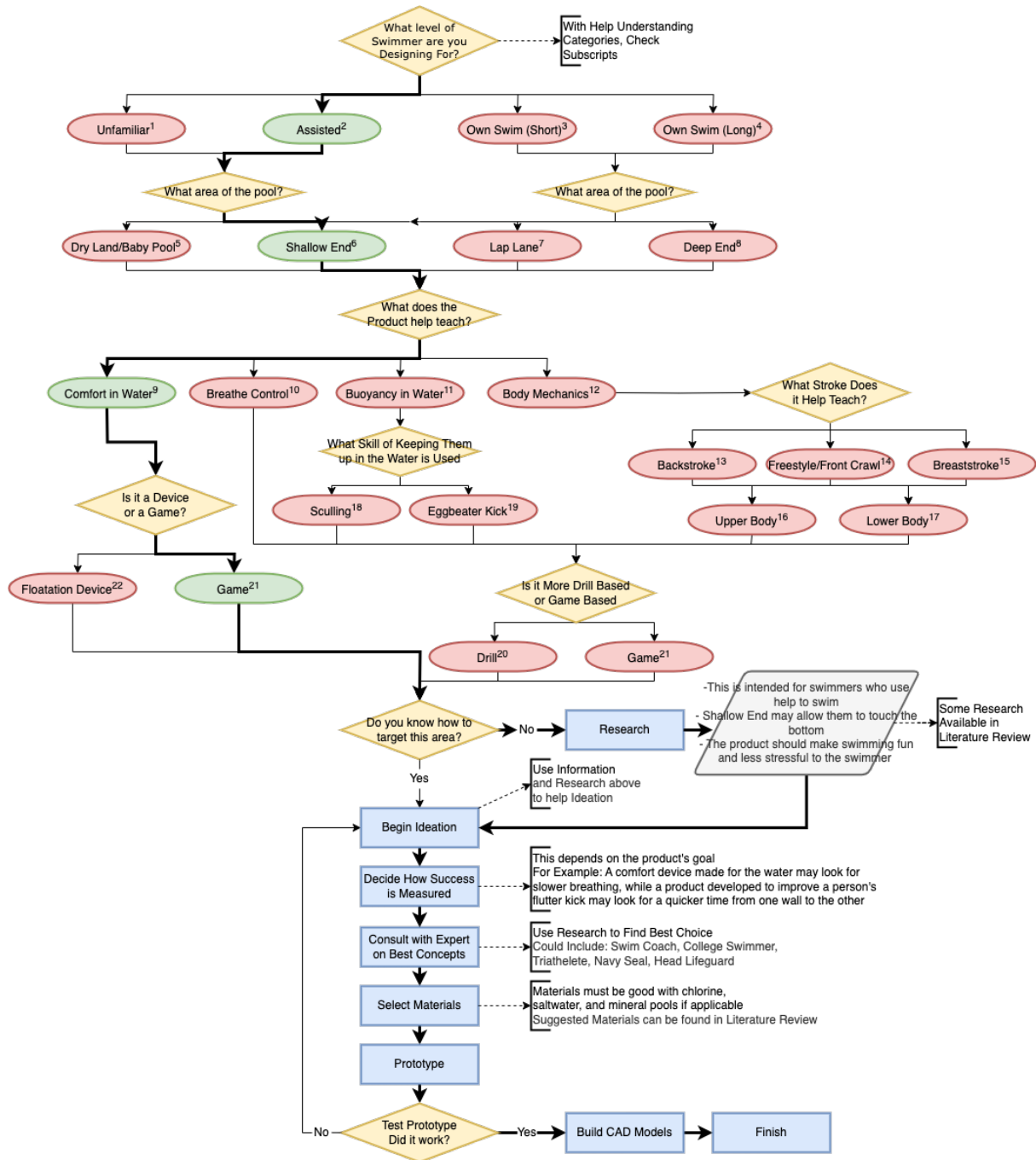


Figure 57: Design Application Skip Disk Game

This product will help comfort an assisted swimmer. This could include a new flotation device for the swimmer, but instead it will look at a product that may make the child more comfortable in the water. The product will be game based to help encourage the new swimmer to go to the pool and get more comfortable with the idea of swimming. The product will also be in the shallow end to make the product less daunting to the new swimmer.

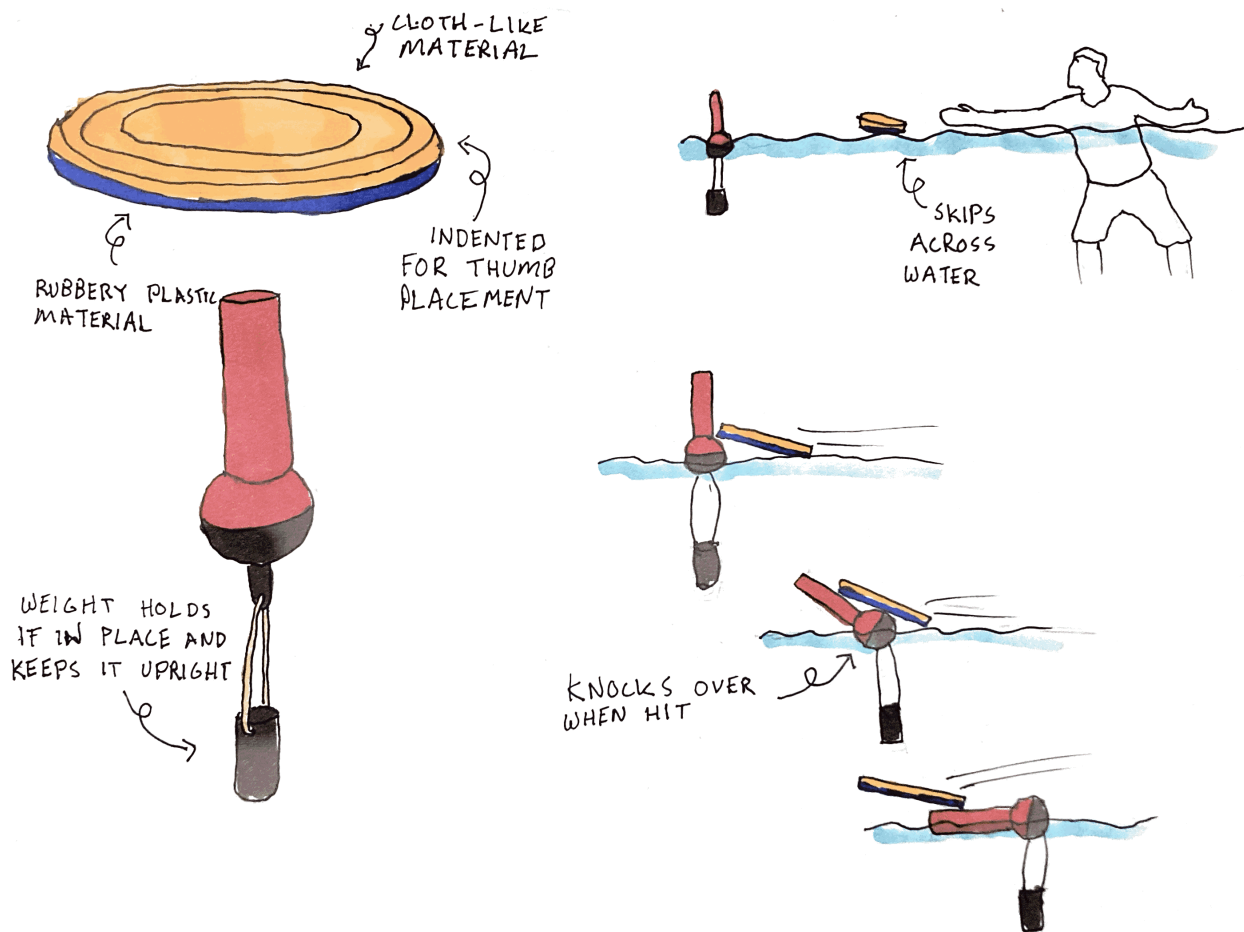


Figure 58: Skip Disk Game Sketches

This product looks to make going to the pool fun. It can be easily played by an assisted swimmer as they will have either a flotation device or trainer nearby to help them play with the device. This device is all above water which can be comforting to a swimmer in this stage of development. This game utilizes a frisbee like disk that skips across the water. This disk is aimed

at three targets that vary in size. These can be put anywhere in the pool as it uses a weight to hold the pins straight up. This makes it easier to aim for and easier to tell when the swimmer has hit one of the targets. This can help take the mind off the water and focus on the game rather than the aspect of swimming as they have a device or person there helping them. Many games can be created from within this product, making it a fun versatile product for a newer swimmer to get comfortable in the water.

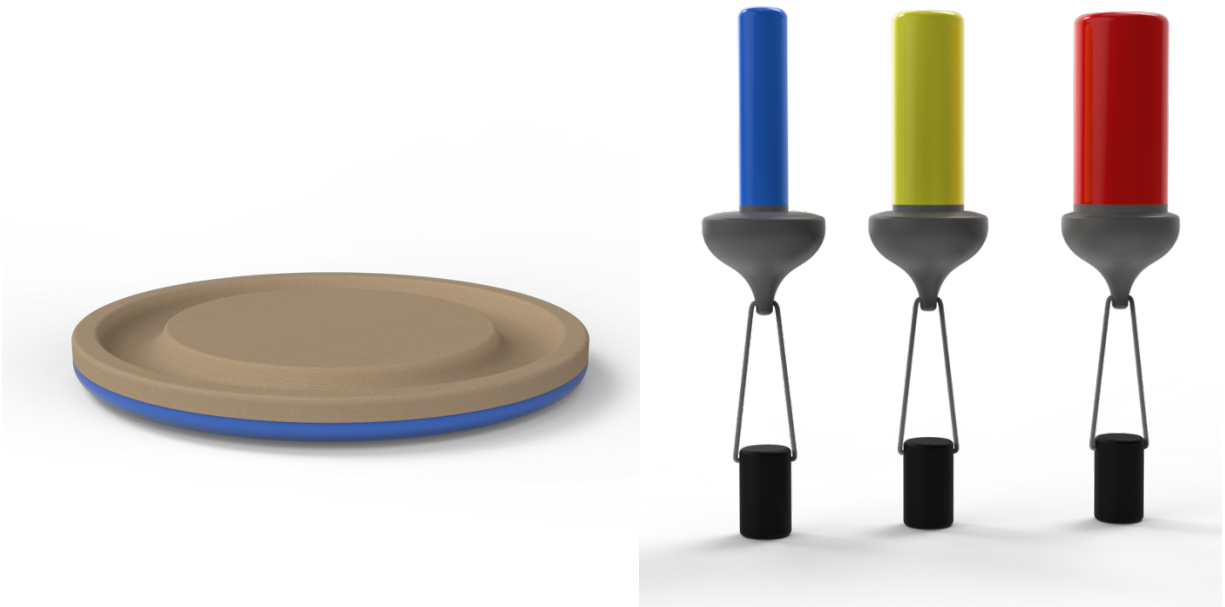


Figure 59: Skip Disk Game Renders

Figure 59 (left) is the skip disk that is saucer like with an indent to place the thumb. Figure 59 (right) are the targets or pins that the swimmer will aim the disk at. They stay floating straight up due to the weight and can come in various sizes and colors.

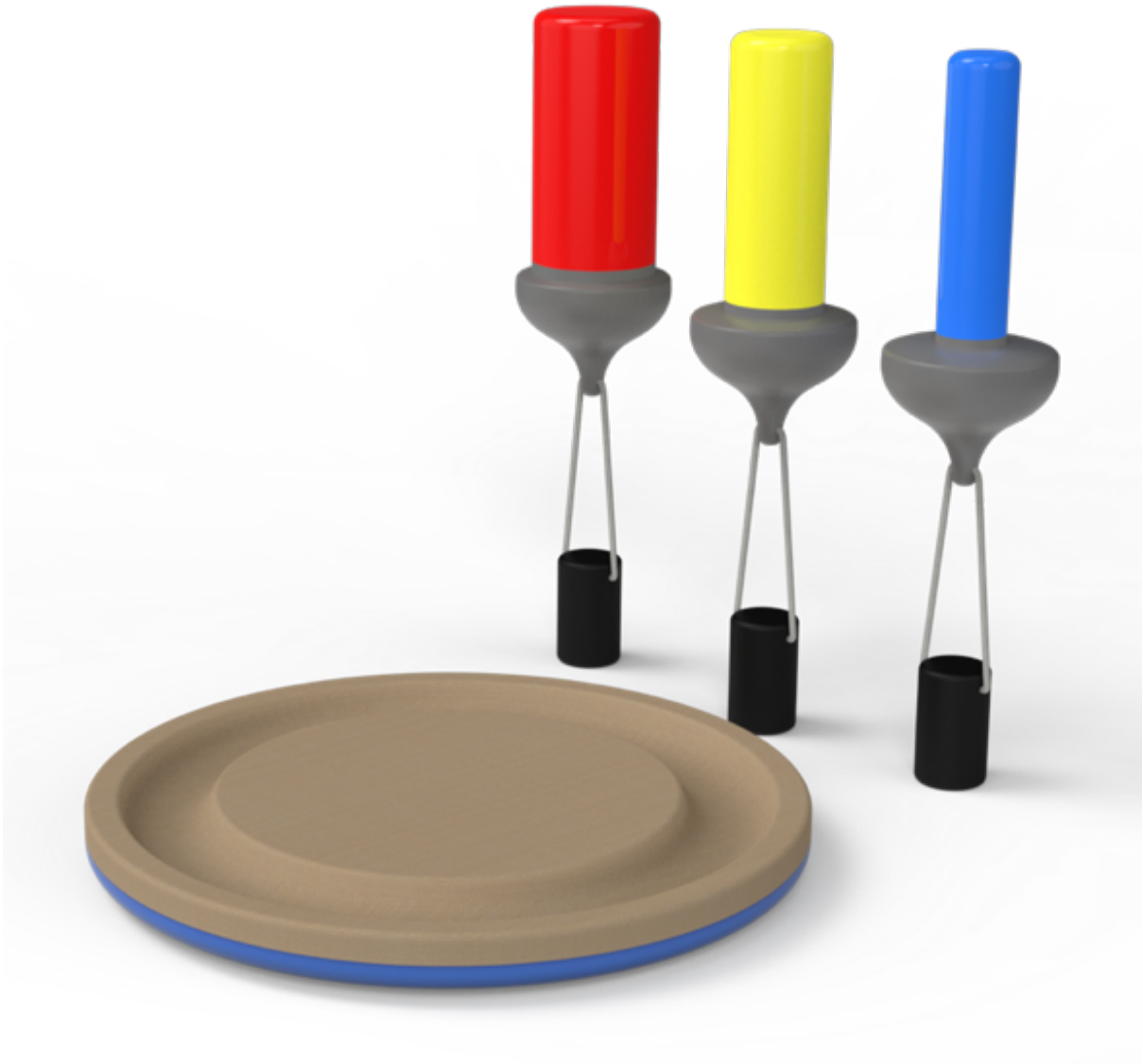


Figure 60: Skip Disk Game Render Hero View

5.5 The Breaststroke Pull Dive Toy

Figure 61 shows the design selections that went into creating the Breaststroke Pull Dive Toy. This helps in designing a product that will work to achieve this goal.

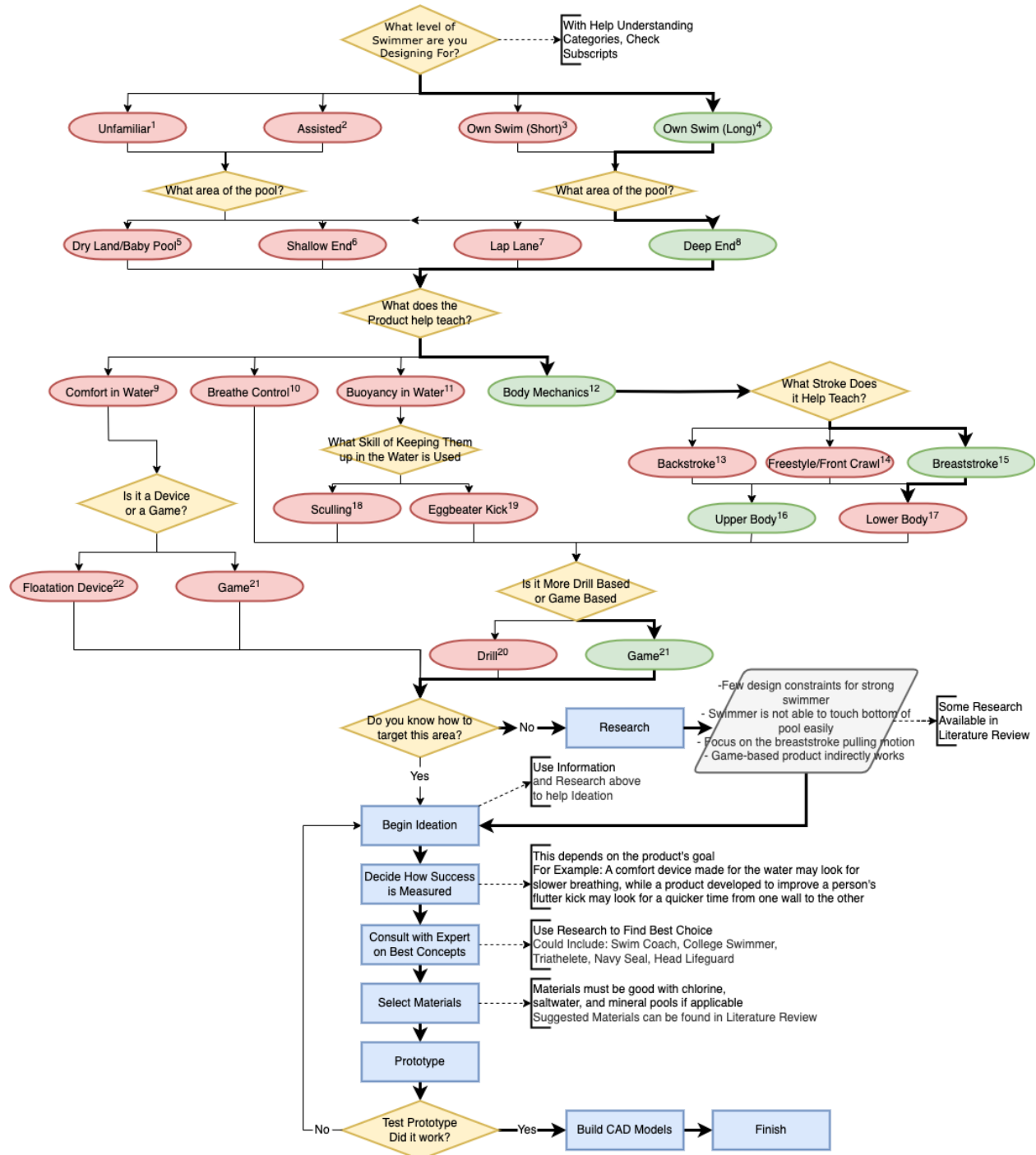


Figure 61: Design Application Breaststroke Pull Dive Toy

This game-based product is intended for a strong swimmer to play with in the deep end of the pool. This means that the swimmer will not be able to touch the bottom without swimming to the bottom. This skill of swimming to the bottom of the pool using the upper body utilizes the breaststroke pull and will be the goal of this product. The breaststroke upper body refers to the pulling motion.

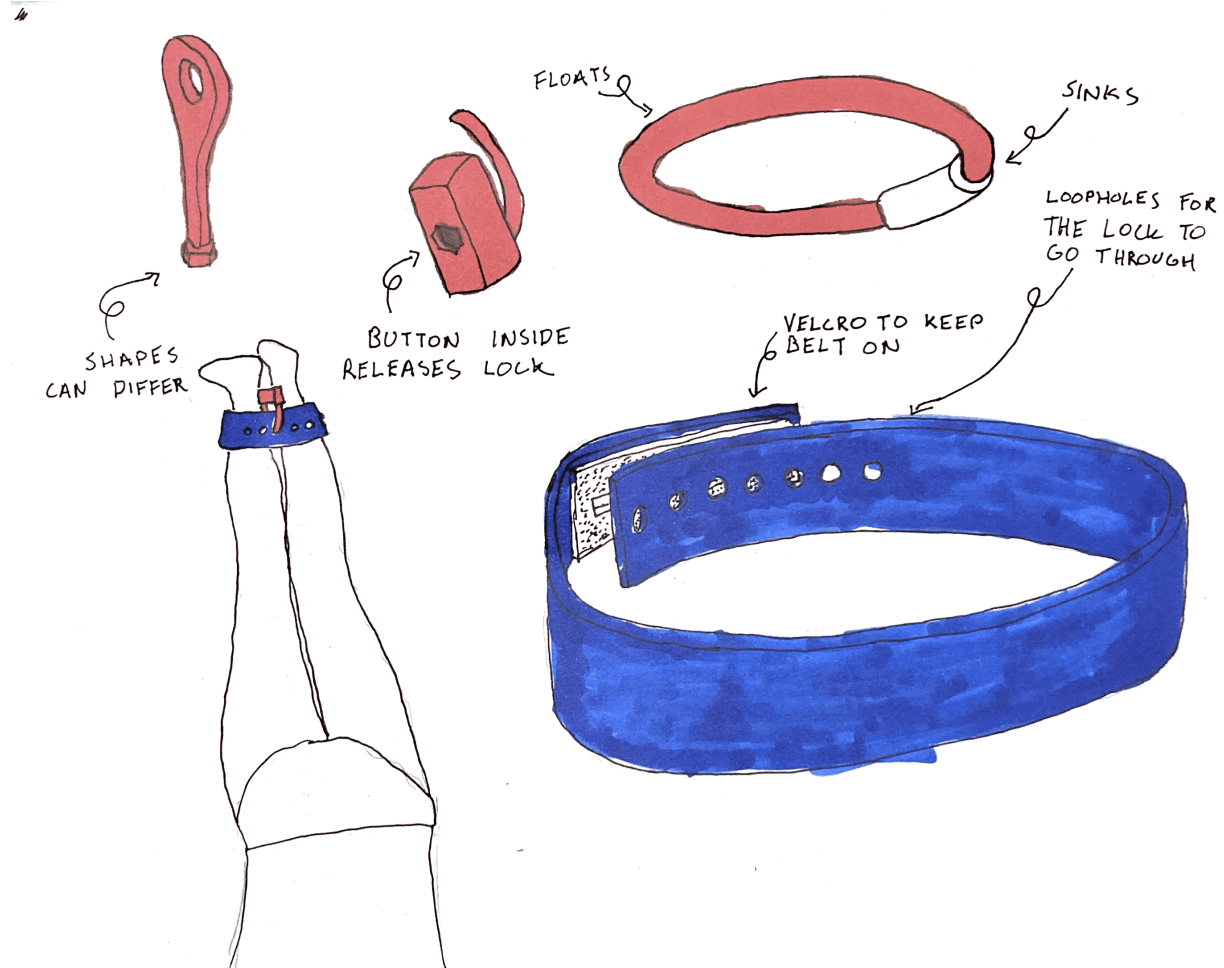


Figure 62: Breaststroke Pull Dive Toy Sketches

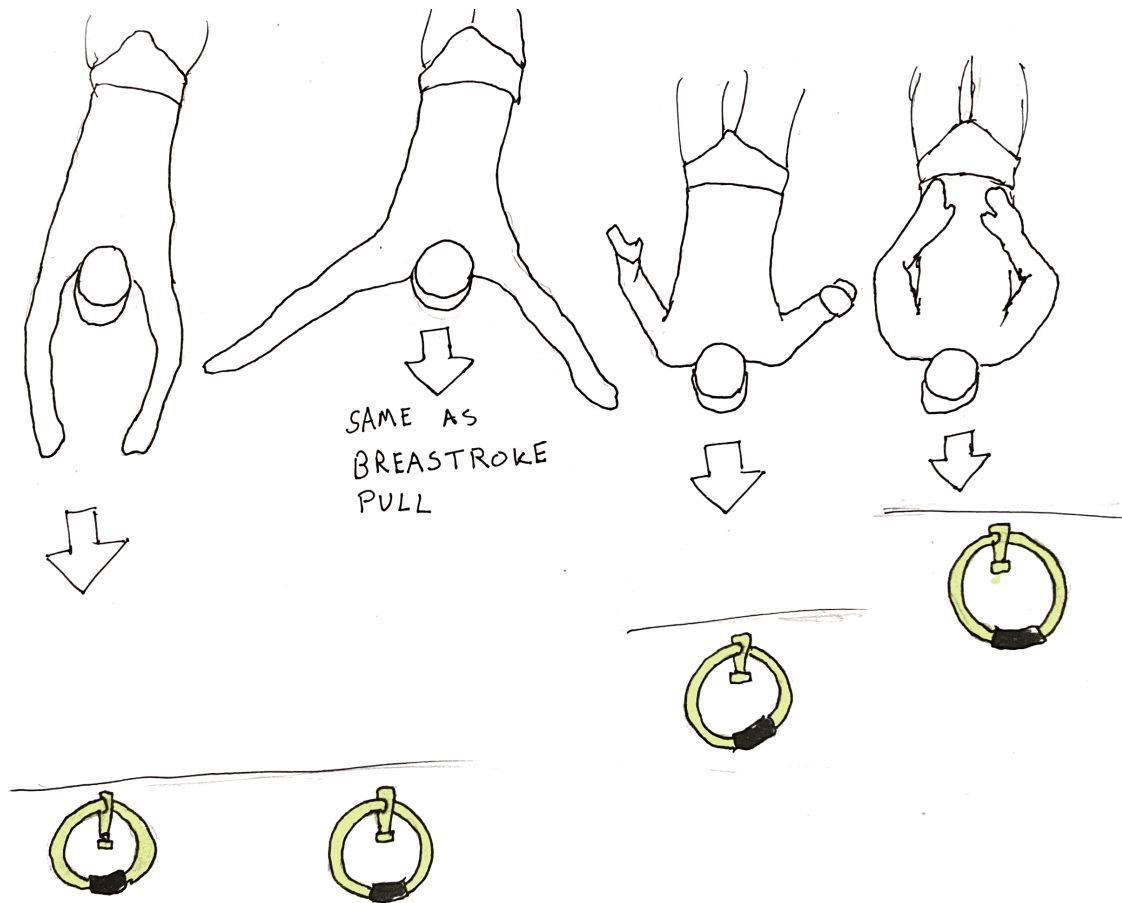


Figure 63: Breaststroke Pull Dive Toy Sketches Downward Motion

This device uses a Velcro belt like structure that is meant to go around the ankles of the swimmer. This prevents the swimmer from being able to use the lower body. Next are the dive rings with a key attached used to unlock the Velcro belt. These can come in all shapes, making a swimmer swim down multiple times to find the right key. This also allows for two people to be wearing the Velcro belt at the same time and race to see who can unlock their belt first.



Figure 64: Breaststroke Pull Dive Toy Render

As seen in Figure 65, the lock goes through the belt loopholes. The holes help to keep the belt from shifting around, making it more difficult to get off.



Figure 65: Breaststroke Pull Dive Toy Render with Key



Figure 66: Breaststroke Pull Dive Toy Render with Multiple Keys & Locks

5.6 The Sculling Board Game

This product looks at a child who has little to no experience of swimming and is attempting to teach them sculling in the water. These design selections can be seen below in Figure 67.

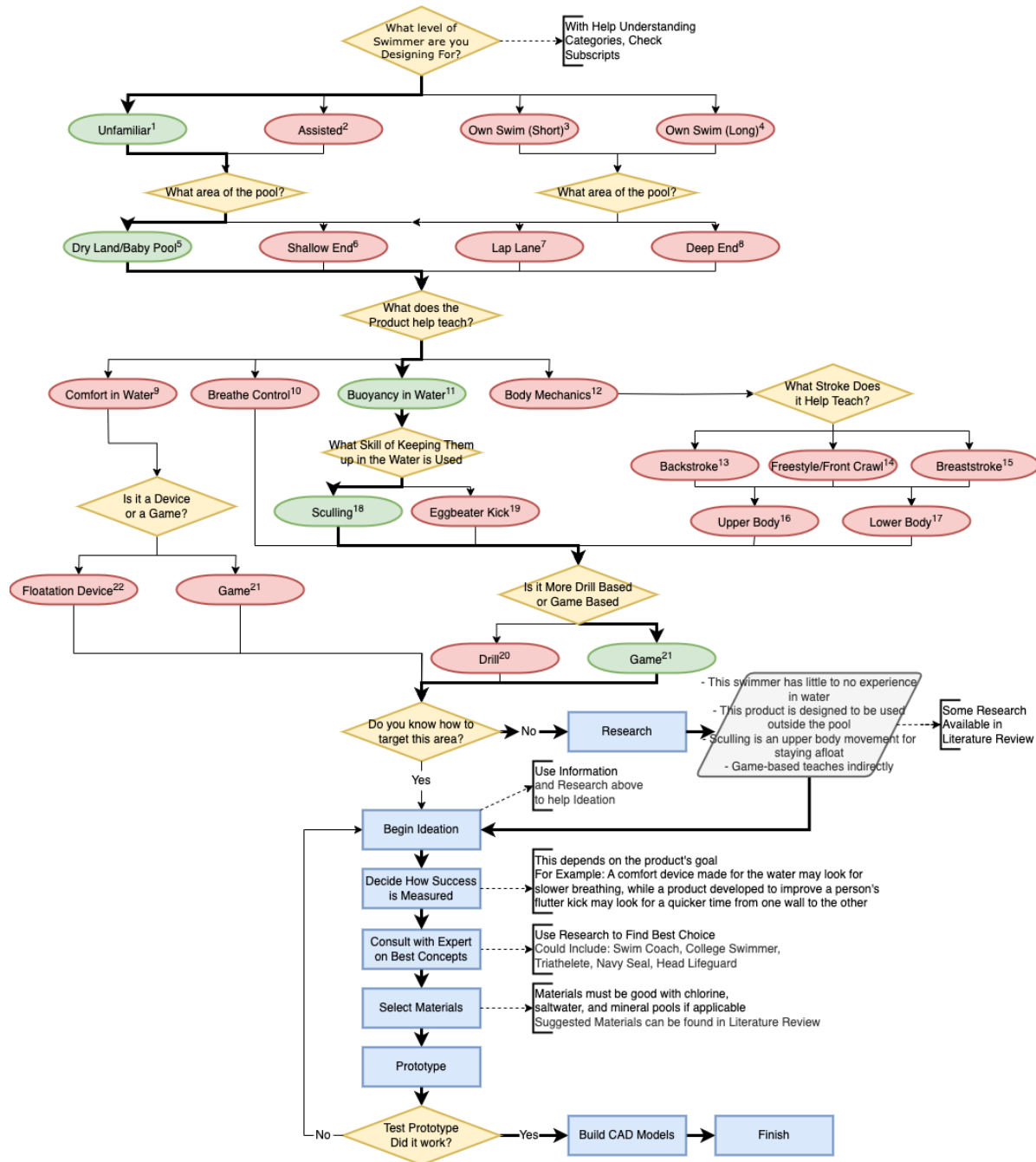


Figure 67: Design Application Sculling Board Game

This product seeks to help a new swimmer who has little to no experience around water learn how to scull. The product will be taught via dryland meaning there is no concern with using the product in water or the safety of the child in water. The product also is game based meaning that the skill is taught through play where the child does not recognize it is learning the skill.

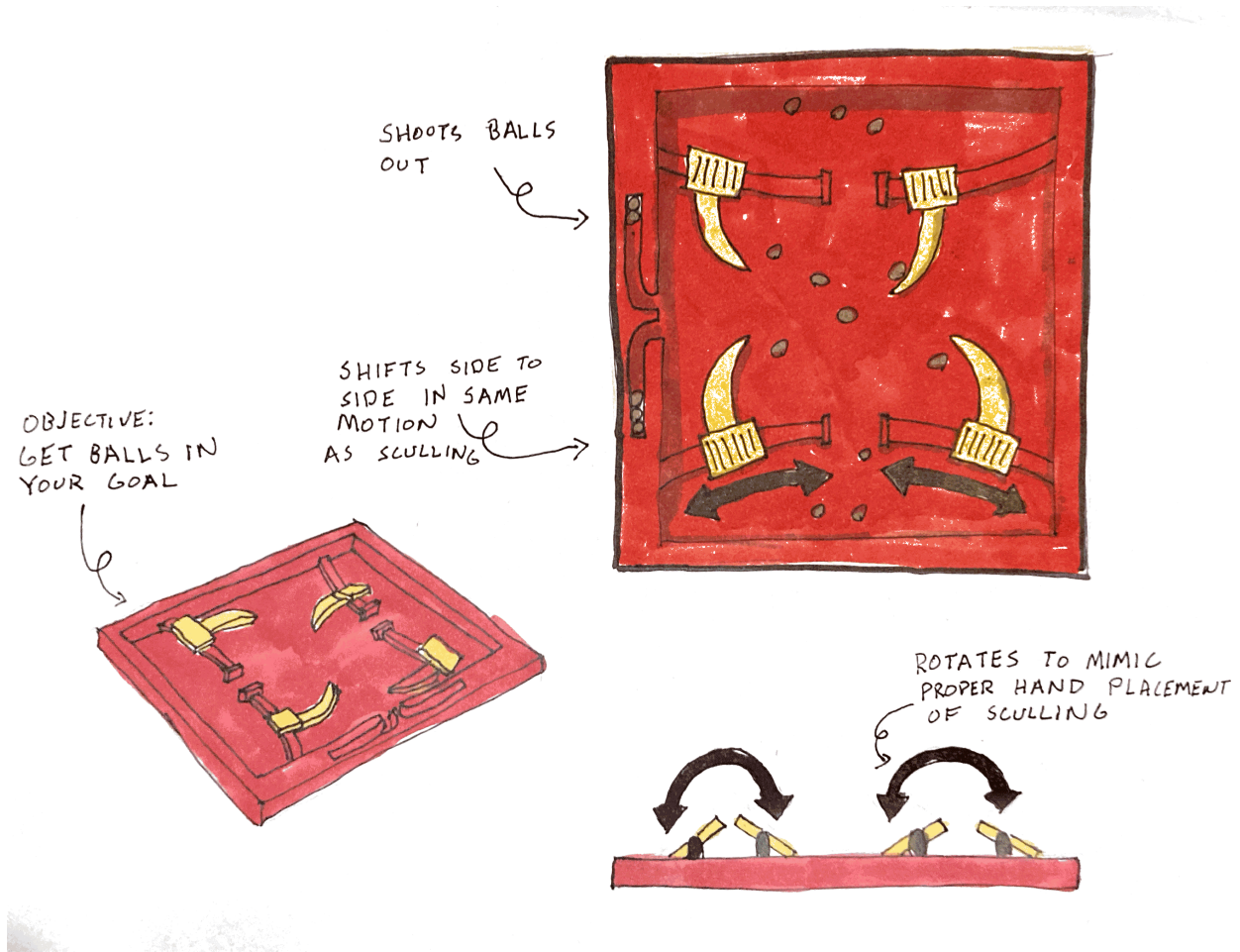


Figure 68: Sculling Board Game Sketches

This product was created by looking at existing board games, more particularly the game Hungry Hippos. By performing the sculling motion, the user moves the yellow pieces back and forth to collect balls into their goal. The goal of the game is to have more balls in your goal than your opponent. Balls are released into the center from the sides like that of a pinball machine. The claw like structures help to collect these balls into the goal. The yellow parts rotate up and

down to make it easier to push these pieces back and forth. This movement is the same as pushing the water back and forth in sculling, making it an excellent product for teaching sculling.



Figure 69: Sculling Board Game Close Up

A button on the side is included to release the balls when the players are ready to start the game.



Figure 70: Sculling Board Game Side View

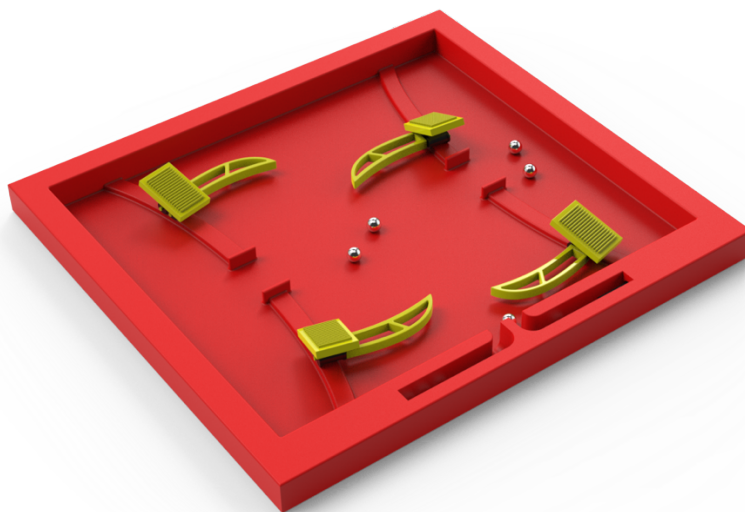


Figure 71: Sculling Board Game Hero View

Chapter 6 – Conclusion

This thesis was written to explore swim products used by children. Its goal was to research children's play and the process of learning to swim. This design tool seeks to help a designer create new products in the aquatic industry aimed at teaching children to become better or stronger swimmers. Popular pool toys and devices were picked out, described, categorized, and analyzed to help form the design tool. The design tool was built to help direct a designer to create a new product with a goal in mind. It evaluated the level of swimmer, area of the pool, and the properties of the product.

Even though two assorted products may be designed for the pool, their purpose can differ greatly in the impacts it has on the child using it. These products ranged from simple flotation devices to game- and drill- based products. This thesis did not look to revolutionize the pool toys and devices industry, but simply help designers to come up and create new and modified products for the aquatic industry. These products could help with a variety of simple skills a child may be struggling to learn. These skills range from just being comfortable in the water to learning to tread water to understanding the body's mechanics and proper breath control.

The products developed from this thesis help to reiterate this idea. Six example products were created to help further understand how this design tool works as well as to show what can be produced. It takes an in-depth investigation into each selection made when designing a new product. These examples can be used as a guide for a designer to help them create new products using this thesis.

Through this thesis it has been learned that many new and innovative products can be designed using the flowchart. Discovering what made a product improve or teach a swimmer a new skill was an exceedingly difficult task to create into a flowchart. There are many ways a

designer can take when designing a product for a child as seen in this thesis. Many existing products on the market could also use improvements and modifications with which this thesis seeks to help. Fully understanding the body movements also needs to be fully understood by the designer as it will help in the design process. Many things were learned about the pool product industry and how designers can help improve this area.

Future Research

This thesis focuses on the research aspect of the design process. New research on integrating the products into use with trainers and parents to get them involved could greatly help the success of the products that come out of this thesis. Future additions to this could be looking into other areas of swimming like entering the water and turning. The use of technology should be further explored as it can be a great tool in products that are created.

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