

**Systematic and Engaging Early Literacy (SEEL) Game
Final Report**

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Needs Analysis

Description of the Problem

Teaching children in preschool and kindergarten early literacy skills will help them become successful readers and writers. There are numerous tablet apps that are designed to teach early literacy skills, but the majority fall short of engaging children in contextualized and interactive learning play. Children lose interest or do not learn skills within a context that makes those skills useful and relevant.

The ideal solution to this problem would be an app available for teachers to use as a supplement to classroom activities, as well as a stand-alone experience for both teachers and parents to expose young learners to early literacy concepts, through activities and practice. The client, SEEL from the McKay School of Education at BYU, has requested the development of two different apps. This proposal targets the first of the requested products.

The client has asked us to create an extension to the existing Hideout app, which exposes and reinforces basic literacy skills (such as phonological awareness, letter-sound association, and word blending) to young children in preschool and kindergarten. The current problem with Hideout is the lack of an assessment or interactive review activities for the learners. This design extension would need to be an interactive and engaging assessment tool that learners can use to practice recognizing target sounds and words in both the classroom and the home.

These are other considerations with the main problem:

- The current Hideout app is expensive to create because each target requires a completely new script. The client would like a few scripts which each cover a number of targets.
- The game/activity must be playful, engaging, and captivating to young children.
- Exposure to targets in the game must be frequent both visually and auditory (and possibly verbally).
- The game/activity will be a review of targets such as sounds, letters, etc.

Description of the Constraints

- Time and scope of design is limited to the fall semester parameters (ends December 2014)
- Must be playable on a specific device or platform (tablet)
- Tasks cannot involve complex gameplay movements, tasks, etc, and should be playable by our learners
- Does not require internet access to play
- Young children have to be able to engage with the game/activity with little input from an adult
- Must utilize targets provided by the client and consider the general sequence in which targets are taught
- The game/activity should be based on the SEEL early literacy model, which is centered around the following 5 principles:
 1. Explore learning through conversation

2. Teach explicitly *what, why, and how*
3. Provide frequent and varied practice opportunities
4. Motivate children with playful practice
5. Make meaningful connections

Learner Analysis

The learners are from a broad base of learners. Mostly, they are pre-kindergarten and kindergarten students, who are native English speakers and educated in the United States, with an access and familiarity with forms of touch-screen technology such as smartphones and tablets. According to Jean Piaget, a respected psychologist in the field of developmental cognition, our learners are in the pre-operational stage, which means their cognitive capabilities have specific limitations and motivations (<http://psychology.about.com/od/piagetstheory/p/preoperational.htm>). The characteristics of learners below are mostly derived from this article, unless indicated otherwise.

The following is a list of attributes of our learners (based on observations as well as the research of Piaget), the learners' motivation, and the learners' needs, as well as the implications for our design based on these attributes:

Attributes of Learner	Design Implication
<p>Demographics</p> <ul style="list-style-type: none"> ● Broad base of learners from all backgrounds ● Pre-kindergarten and kindergarten ● Native English speakers with some sort of exposure to English in the home ● Students in the US ● Access to and familiarity with touch-screen technologies ● Male and female 	<ul style="list-style-type: none"> ● The design must be flexible enough to allow equal interaction with all learners, despite the broad demographics. The design will focus on native English learning to reinforce formal literacy learning in school. The design should be careful to be relatively gender-neutral, or have a balance of both. Also, the design should not depend too much on extensive outside learning.
<p>Characteristics of Learners</p> <ul style="list-style-type: none"> ● Short Attention Span: Learners at this age are often only able to focus on a particular task or activity for limited periods of time. Generally this time frame is five minutes or less. Learners can also be side-tracked or distracted fairly easily ● Not Motivated by Goal Completion: Children in this age range are not 	<ul style="list-style-type: none"> ● The design will need to be grounded in short but intensive exposure or assessment of the target. It cannot require engagement by the learner for an extensive period of time. ● Instead of focusing on an overall goal to achieve, the design should be fun

necessarily goal-motivated. They often will repeat tasks or games they prefer and find fun, rather than attempting to systematically work their way through tasks to ultimately complete an over-arching goal. In fact, it was evident that children are often motivated by what an adult such as a parent or teacher figure instructs them is important.

- **Perceive Time Differently:** Children in this stage view and perceive time very differently than older children, and certainly much different than adults. Due to their shortened attention spans, children are often not able to recognize how much time they have devoted to an activity. For example, they can become engrossed in an activity and not realize that they have devoted a substantial amount of time to it. Conversely, children may *feel* that tasks requiring a short, concentrated amount of time and energy take much longer to complete.
- **Open to Information:** Within this phase of cognitive development, children are often naturally inquisitive and open to new information. However, their cognitive load and working memory have a very limited capacity, and can therefore become easily overloaded if too much information is presented to them at once.
- **Don't Understand Concrete Logic:** According to Piaget, learners at this age are not able to understand concepts of logic, which for them are highly abstract and not as grounded in real-life ideas or their observations.
- **Cannot Mentally Manipulate Information:** Again, thinking in the abstract is difficult for learners,

and engaging enough the learners will be motivated to play enough to ensure they are exposed to the targets. Consequently, an activity of a journey, though more goal-oriented, can be effective if it is entertaining. The learner will be more motivated by the entertainment of the design than by a desire to get to the end.

- The design should be engaging and enjoyable, but also not require long, concentrated amounts of time and energy to complete. Otherwise, the learner will become frustrated or bored with the design.
- The design should only address one target at a time, as to avoid overloading the learner's cognitive load. Though the learning requires intense exposure to the targets, the design will need to be focused on one single target at a time.
- The design should try to utilize the learner's natural curiosity as motivation.
- The design should avoid requiring inductive or deductive reasoning from the learner. The design should be grounded in presentable and interactive ideas.
- The design should allow the learner to work with the targets themselves, rather than introducing abstract ideas.

<p>especially taking in information internally and working with it.</p> <ul style="list-style-type: none"> ● Unable to Take the Point of View of Others: Piaget famously demonstrated this characteristic through an experiment in which children were asked to choose a picture that showed a mountainous scene that they had observed. Most children are able to do this with little difficulty. Following that, children were asked to select a picture showing what <i>someone else</i> would have observed when looking at the mountain from a different viewpoint. Invariably, children almost always chose the scene showing <i>their own</i> view of the mountain scene. ● Adept at Using Symbols: Children are able to see a symbol and equate it to something else. This is evidenced by high volume of pretend playing children do during this age, in which they use certain objects to represent another, like when a child imagines a stick is a sword. Role playing becomes increasingly used by learners of this age. ● Social Awareness: Learners at this age are becoming increasingly social, and find interacting more enjoyable. They want to feel like they are part of an experience. Learners also do not want to be treated “babyish” as they are beginning to mature and differentiate themselves from their younger counterparts (http://alistapart.com/article/kids-4-6-the-muddy-middle). 	<ul style="list-style-type: none"> ● The design should assume that it is being viewed from the child itself. If using an avatar, the child should be able to identify with the avatar and use it through his or her own perspective, as the child will ultimately see the design from their own point of view. This point is vital when designing characters. ● The design can have the learner use simple symbols to interact with the targets. Also, role playing within the design is desirable, as our learners often see this as enjoyable, as they incorporate such playing within their own games. ● The design could incorporate social elements by having the design interact with the learner. The simplest way to incorporate this into the design is to have the instructions speak directly to the learner to immerse him or her in the experience. Involving challenging activities prevents “babying” the learner, which can be demotivating.
<p>Learner Motivation</p> <ul style="list-style-type: none"> ● Eager to impress ● Small, visual game elements engage, 	<ul style="list-style-type: none"> ● Motivation of our learners needs to be taken into consideration in the design.

<p>such as buttons with resulting effects</p> <ul style="list-style-type: none"> ● Enjoys engaging and interactive activities ● Enjoys touch-screen technologies ● Reinforcement is particularly effective at this age ● Motivated (to a degree) by their success 	<p>The design should be accomplishable within the skills and abilities of our learners, otherwise our learners may become frustrated and react negatively to the design. Again, simple rewards are helpful, but motivation will come mostly from engaging interaction with the design.</p>
<p>Setting and Context of Design</p> <ul style="list-style-type: none"> ● At home, in classroom ● Independent practice 	<ul style="list-style-type: none"> ● The design should be able to be used in both the classroom (in conjunction with classroom curriculums and state standards) as well as at home as a way to increase intense exposure to the targets. The design should also allow be usable by the learner without extensive supervision by an adult. This means the design must be clear and easy to use and not depend on a lot of instruction.
<p>Targets According to the SEEL approach, learners will develop skills in the following areas, and help define the targets.</p> <p><i>Pre-Kindergarten:</i></p> <ul style="list-style-type: none"> ● Identify Letters ● Rhyme Words ● Use Alliteration ● Blend and Segment Letters into Words ● Have Print Awareness <p><i>Kindergartner:</i></p> <ul style="list-style-type: none"> ● Identify specific sounds and the letters that make the letters that make them ● Blend and Manipulate Sounds ● Perform basic decoding and phonics ● Identify High Frequency Words ● Perform Spelling and Word Analysis ● Do Shared and Interactive Writing 	<ul style="list-style-type: none"> ● The design needs to integrate these target skills. Other skills may be interesting, but are not necessary to the design.

Current Resource and Training Analysis

Phonological awareness, phonics training, and similar activities are particularly popular for teaching young children to read. The reason for this is that, unlike vocabulary development and comprehension skills, phonological awareness and phonics skills are easily measurable and progress can be easily seen (National Early Literacy Panel, 2008). As a consequence, there are numerous commercial programs and products and many websites on the Internet providing ideas for teaching these skills.

In this analysis we will provide:

- The standards for teaching phonological awareness and phonics in preschool (Utah Standards) and kindergarten (US Standards).
- A description of a popular phonics program (Jolly Phonics)
- A description of the SEEL approach to teaching early literacy skills
- Some of the ideas suggested in the top two hits of a Google Search on *teaching phonological awareness and phonics in preschool and kindergarten*.

Preschool Standards

Although there is no common core for preschool, individual states provide guidance with regards to academic skills. The Utah Common Core suggests that students should be able to do the following at the end of preschool, with regards to foundational reading skills (Utah State Office of Education, 2013):

- With guidance and support, identify and discriminate between sounds (phonemes) in spoken language, such as attention to beginning and ending sounds (phonemes) of words
 - Identify words by syllables, beginning sounds, or individual sounds
 - Recognize initial and final sounds of words
 - With modeling and support, identify individual phonemes (e.g., /d/, /s/, /t/)
- With guidance and support, recognize that words are made up of letters and their sounds
 - Begin to associate names of letters with sounds of the alphabet (e.g., initial sound of own name)
 - Distinguish between letters and words that are the same or different

Utah Common Core suggests the following strategies and activities to master the standards:

- Play simple matching or “go fish” games with letters and objects that start with that sound
- “Feed the bag” all the words that start/end with a specific sound
- Have children sort pictures that begin or end with different sounds
- Choose books that focus on specific sounds
- Begin to find words in a book that have the same letter as the first of a child’s name

Kindergarten Standards

The Common Core suggests that students in kindergarten should be able to do the following at the end of kindergarten with regards to foundational reading skills (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010):

- Demonstrate understanding of spoken words, syllables, and sounds (phonemes)
 - Recognize and produce rhyming words
 - Count, pronounce, blend, and segment syllables in spoken words
 - Blend and segment onsets and rimes of single-syllable spoken words
 - Isolate and pronounce the initial, medial vowel, and final sounds (phonemes) in three-phoneme (consonant-vowel-consonant, or CVC) words (This does not include CVCs ending with /l/, /r/, or /x/)
 - Add or substitute individual sounds (phonemes) in simple, one -syllable words to make new words
- Know and apply grade-level phonics and word analysis skills in decoding words
 - Demonstrate basic knowledge of letter-sound correspondences by producing the primary or most frequent sound for each consonant
 - Associate the long and short sounds with the common spellings (graphemes) for the five major vowels
 - Read common high-frequency words by sight
 - Distinguish between similarly spelled words by identifying the sounds of the letters that differ

A Phonological Awareness and Phonics Program: Jolly Phonics

“A fun and child centered approach to teaching literacy.” (<http://www.usaphonics.com>)

- Uses a synthetic/blended phonics approach (teaching letter-sound associations first and then teaching children to blend these sounds and symbols to pronounce and read whole words)
- Forty-two letter sounds are taught in a particular sequence (see Table 1)
- The sequence enables children to begin blending the letters together early on to read whole words
- A multi-sensory method is used, including:
 - an action for every sound
 - hearing or verbalizing the sound
 - a visualization of the symbol associated with the sound
- Multiple modalities can lead to deeper, longer-lasting learning
- Activities include: songs, stories, actions, and games
- Teaches children the five key skills for reading and writing:
 - learning the letter sounds
 - learning letter formation
 - blending
 - identifying the sounds in words (segmenting)
 - tricky words (high-frequency words that are not spelled phonetically)

1.	s, a, t, i, p, n
2.	c k, e, h, r, m, d
3.	g, o, u, l, f, b
4.	ai, j, oa, ie, ee, or
5.	z, w, ng, v, oo, oo
6.	y, x, ch, sh, th, th
7.	qu, ou, oi, ue, er, ar

Systematic and Engaging Early Literacy (SEEL)

“ Literacy skills are purposefully organized and explicitly taught”
(http://education.byu.edu/seel/what_is_seel.html)

- A systematic and engaging approach to teaching early literacy skills
- Includes developmentally appropriate, meaningful, interactive activities that incorporate high levels of play, multiple exposures to the targets, and explicit instruction
- Activities include singing, dancing, storytelling, creating and acting out plays, art activities, games, and other hands-on interactive activities
- Each activity is centered around a particular target
- Encourages building and practicing literacy skills throughout the day:
 - whole-group instruction
 - small-group instruction
 - individual-instruction
 - transition times, e.g., moving from one activity to another
 - snack times
 - at home (SEEL-at-home activities)
- Activities give students plenty of practice with target sounds, letters, and words
- Activities give students a reason to read and write.
- The scope and sequence of the SEEL curriculum is arranged in Blocks from pre-k through to 1st grade

Although both of these programs are systematic, developmentally appropriate, highly interactive, and use multiple modalities to teach foundational literacy skills, they are highly dependent upon the teacher or another adult. One of the purposes of this game is to provide students with an opportunity for independent practice of the targets.

Phonological Awareness and Phonics Websites

<http://www.education.com/magazine/article/preschool-phonics-phonemic-awareness/>

- Food Fun: While eating a meal, say the names of two foods that start with the same sounds and one that doesn't. For example, tacos, tomatoes, and rice. Ask your child to identify the word that does not sound the same at the beginning.
- Make a Match: Say a simple words, such as "cat". Have your child think of a word (or several words) that start with the same initial sound.
- Seek a Sound: Say a word out loud and have your child go on a hunt for something that starts with the same sound from around the house. To simplify the activity, just give your child the initial sound instead of the word.
- Rhyme Time: Make up rhyming words as you climb the stairs, one word for each step until you get to the top. (The words can be real or nonsense - it makes no difference as long as they rhyme.)
- Fridge Phonics: Use the magnetic letters on your fridge for some wonderful, hands-on phonics activities. Have your child gather a handful of letters and search for items that begin with each.
- I Spy: Use your magnetic letters or letters written on scraps of paper. Draw a letter and then find something that begins with that letter.
- Alphabet Books: There are many wonderful alphabet books in print. These books give your children the opportunity to both see and hear the letters and sounds in the alphabet.

KEY TAKE AWAYS:

- Young children learn phonological awareness and phonics through playful games and activities.
- There is an order in which key skills should be taught to students, though there is a lot of overlap between these. For example, children should be familiar with sounds and have plenty of experience playing with them before they move on to blending and segmenting sounds in words and then doing the same with the graphemes.
- There is no universally agreed upon order for teaching letters and sounds. Different phonics programs teach sounds and letters in different orders. What is agreed upon, however, is the need to teach it systematically in a well-thought out order. Some things to consider include:
 - Begin with simple sounds (continuous sounds that can be stretched out are usually easier to blend, e.g., /m/, /s/, /f/, /r/, /n/, /l/)
 - Begin with commonly encountered sounds before the infrequent sounds (e.g., /a/, /t/, /e/, /i/, /n/, /s/)
 - Introduce vowels early - vowels are needed to make words
 - Separate similar sounds that are easily confused by children (e.g., f, v)

- Introduce a few letters/sounds at a time - allow for practice and review before adding new sounds.
- Phonological awareness and phonics activities can take place throughout the day in different settings.

Competing Product Analysis

While there is no single product that does exactly what we propose to do (essentially extend and expand the client's current product), there are many apps and games that approach the problem from a host of different perspectives. This guide, compiled by Reading Rockets, is one of the most thorough we could find that includes a short summary of the product as well as price (<http://www.readingrockets.org>). More specifically we have investigated these early literacy apps as a part of our analysis.

Fun Brain - by Pearson Education, Inc

For kids ages 2-6 with a focus on the following

- Letter recognition, letter sounds, and early literacy
- Sequence, order, and patterns
- Number recognition and basic counting
- Concepts of quantity and number sets
- Fine motor skills

KEY TAKE AWAY: This app appears to have a more broad scope than what our client wants. It is much more than just literacy, thus for our game we need to continually reflect on the scope of our design and ensure we don't get carried away with the targets and the scope

Sky Fish Phonics

Ages 4-6, emphasis is on reading, phonics, letters, and spelling. Very high reviews and customer feedback.

Sky Fish Phonics includes the following progression of crucial reading activities:

- Letter recognition
- Letter-sound correspondence
- Reading consonant-vowel-consonant (CVC) word groups
- Word building (substituting individual sounds in CVC words to build new words)

KEY TAKE AWAY: While the app appears to do everything it says it can, the big drawback from user feedback we noticed was the user's lack of ability to unlock "new fish" - a procedure that allows the learner to further explore and expand their avatar and rewards system. This sounds like a failing of effective prototyping. Thus for our design it will be important to have users test out the different capabilities and levels to ensure they can access all aspects of the game.

Word Wizard - Talking Movable Alphabet & Spelling Tests for Kids

From the description on the iTunes Store:

- Editor's Choice Award for Excellence in Design - Children's Technology Review
- Winner of a Parents' Choice Award
- Used in US Schools (40K units sold to schools)

Word Wizard is a unique app that lets kids hear the sounds of letters and words using a talking movable alphabet. Featuring advanced text to speech capabilities, the app can pronounce and spell-check an unlimited number of original words and sentences built using a phonics movable alphabet.

Word Wizard also provides spelling practice with a list of more than 1,400 questions and answers, and the best is that you can add your own words to create any spelling quiz, and track the progress of your kids thanks to detailed reports.

KEY TAKE AWAY: This app has successfully utilized audio as a key feature. Perhaps that is something we ought to consider if we want to replicate this success.

The Electronic Company Word BALL! By PBS Kids

From the iTunes description:

- Play through 9 arcade-style game levels, each with two modes of play: Video Mode and Arcade Mode.
- Rack up points for every word and challenge friends to match your high score.
- Includes 10 different types of wordballs, such as Silent E, Transformer H, and Hard and Soft C. Make over 300 different words!
- Features characters and guest celebrities from the popular TV series on PBS KIDS GO!

The Electric Company is a group of friends from a New York neighborhood bound by a love for language and sworn to do the right thing. Each member of The Electric Company has a special ability to produce, control, manipulate, and play with words and letters. The TV series airs on PBS KIDS GO! and is produced by Sesame Workshop. Find the website at <http://pbskids.org/electriccompany>.

KEY TAKE AWAY: This app is connected to a larger system of games, TV shows, and music - which is a strength. However, based on reviews of the app it appears to lack a variety of important instructional elements. Our app needs to be both fun to play with, but also maintain strong instructional principles such as feedback, rigor, variety, and educational content.

In conclusion of the competitor analysis, it is clear there are many options for our target audience and the desired target skills. However, the highly customized games the client desires calls for a unique blend of review materials based on the current app and new games and features that can provide varied practice for learners in a SEEL context.

Design Blueprints

Task Analysis

Phonological awareness and phonics knowledge can be broken down into different components. Teaching phonological awareness gives children the chance to hear and play with the sounds. Teaching phonics introduces the letters, letter names, and letter-sound association. As set out by the SEEL program, these skills can be broken down into the following components:

1. Pre-K Targets

- a. Sorts words that begin with one of 17 phonemes (m, b, t, s, f, p, k, l, r, n, d, h, w, g, z, v, j) from words that do not.
- b. Name and identify all letters.
- c. Identify familiar rhyming words.

2. Kindergarten Targets

- a. Hear and identify 28 phonemes (26 letter sounds and 2 digraphs: sh & ch)
 - i. hear and identify phonemes at the beginning of words (e.g. listen to “bat”).
 - ii. hear and identify phonemes at the end of words (e.g. listen to “cab”).
- b. Associate the phoneme (the sound) with the grapheme (written form of the sound).
- c. Blend onset and rhyme.

Using this as a guide, we have broken the game down into the following six levels or objectives to be used as a guide for creating the review games within the design:

Level 1: Hear words that rhyme

Level 2: Hear words that begin with the same sound

Level 3: Identify individual letters by their letter name

Level 4: Identify words that begin with the same letter (no audio, requiring children to read)

Level 5: Identify words that end with the same rime (no audio, requiring children to read)

Level 6: Identify words that end with the same letter (no audio, requiring children to read)

These levels are useful because they give us specific goals to focus on, whether it be a beginning level that has the learner choose from spoken words those that rhyme with “cat” to identifying written words that start with the letter “B”. One important note, however, is that the content is not being taught in the design itself. Rather the main objective is for the learner to revisit the content delivered in earlier settings, such as the classroom. According to the SEEL program, frequent and intense exposure is key to helping learners more thoroughly develop these early literacy skills. The levels, then, are additionally useful because they allow teachers and parents to synchronize use of the design with current classroom curriculum. For example, if a child in school that day learned about the letter “M,” they can return home and practice Level 3 of the

app and practice identifying the letter “M” from other letters, thereby reviewing classroom material and strengthening their understanding.

We decided to focus our design prototype on Level 2, hearing words that begin with the same sound. Keeping in mind the design implications from our needs analysis, as well as the learner and design constraints, we created a design that encourages repeated learner exposure to practicing identifying words that begin with the same sound.

Below, in the Prototype section of our document, we include a storyboard of our game with our detailed script. We would recommend reviewing that storyboard for the best comprehension of our design, though in this section we detail the design in a written format.

Essentially, our design is a side-scrolling journey. The learner begins by choosing a character associated with a sound, for example, Billy the Bear (audio will prompt, “Choose a character to start”). The different characters with their own sound emphasis allows the learner to become exposed to different sounds to review and also to vary gameplay. So Billy the Bear will interact with /b/ sounds and words.

Then a new screen appears with Billy the Bear walking down a path. The movement of the character is automatic, thereby simplifying gameplay and allowing the learner to focus on the content more than trying to move the character as they wish. The character then approaches an item on the path, such as a banana. The audio prompts the learner by saying: “Does ‘banana’ start with /b/?” and a “yes” and “no” option appears. If the learner hits the “yes” button, the audio replies, “Brilliant! Billy the Bear bites the banana” emphasizing the /b/ sounds within the alliterative sentence. The character would then exaggeratedly perform an action, such as Billy the Bear biting the banana and saying “Nom nom nom!” The silly action, according to our learner analysis, helps serve as motivation for a young learner who may be more motivated by observing cause-and-effect.

Then the audio says, “You get a letter B!” and a letter “B” appears in the top left corner of the screen. The letter-reward serves as extrinsic motivation, and also helps serve as an evaluative tool. We plan to incorporate a way for parents and teachers to access the data about the learner’s performance from the game, mostly by seeing how many letters the learner earned. The letters as a reward also serves to further emphasize the connection between the sound /b/ and the letter “B”.

If the learner, however, chooses the “no” option, then the audio responds, “Oops, not quite. ‘Banana’ does start with /b/. Listen: /b/ /b/ banana.” The character makes a simple, sad expression, but then moves on. A letter-reward is also removed as negative punishment. However, if no letters have been earned at that point, then nothing happens, and the character moves on. We chose to make the reaction to the incorrect choice obvious but mild. We did not want a silly action associated with choosing the wrong answer because then the learner would be tempted to purposefully choose the wrong answer just to see the silly action, and then render our design ineffective.

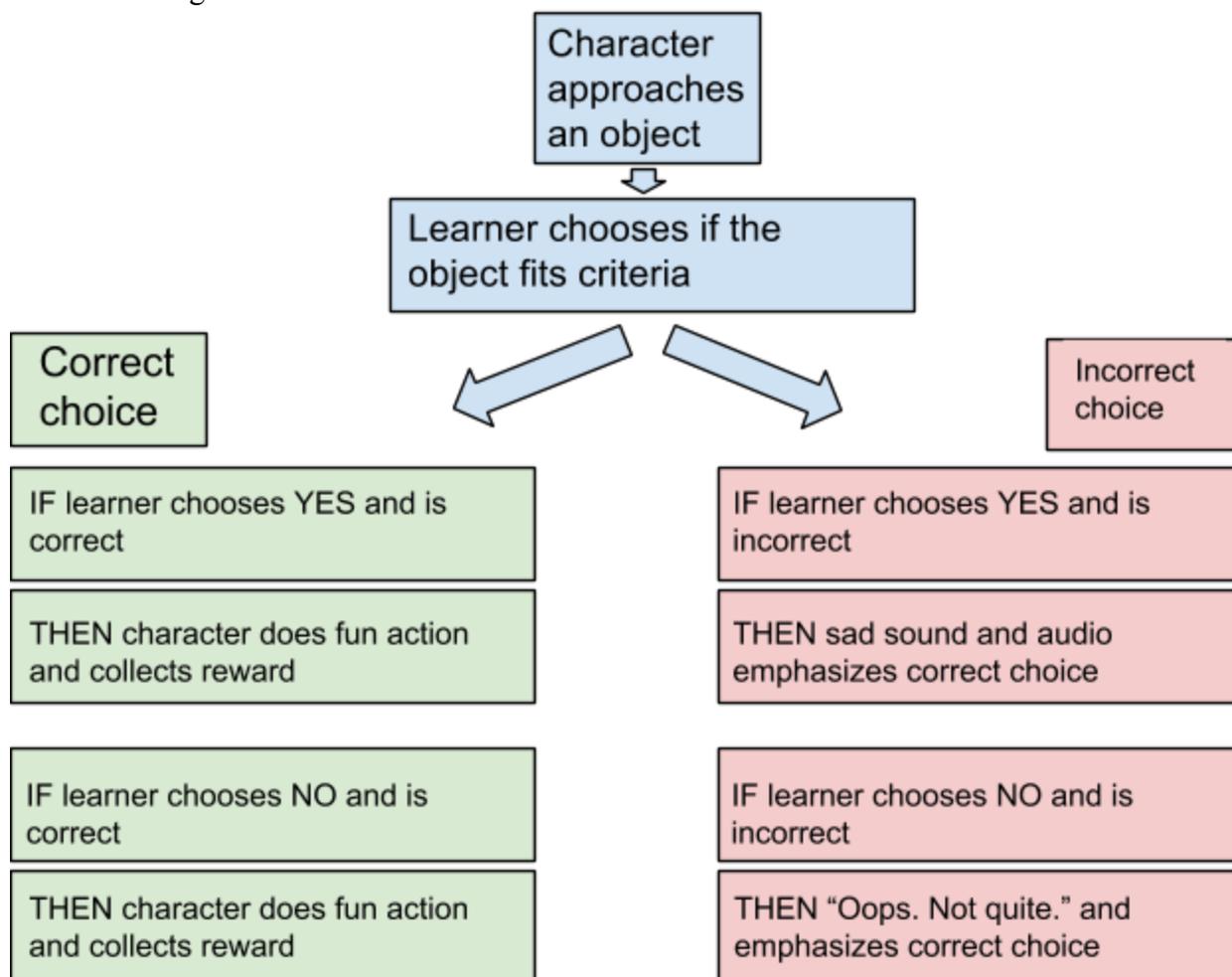
If the character approaches an object that does not begin with the target sound, there is a different sequence of events. For example, “does ‘leaf’ begin with /b/?” If the learner selects the “no”

option, then the character celebrates, and the audio says, “Brilliant! ‘Leaf’ does not begin with /b/. Billy the Bear does not bite the leaf.” A letter-reward is added to the corner with the audio, “You get a letter B!” and the character moves on.

If the learner chooses “yes,” then the character will react mildly and the audio will say, “Not quite. ‘Leaf’ does not begin with /b/. Listen: lllleaf.” emphasizing the sounds. If a letter-reward has been earned, one will be taken away. The subdued reaction is to emphasize the wrong answer in a straightforward manner. The character then moves on.

This process is repeated ten times, with at least three “distractor” objects. After approaching ten different objects, the character stops, and the audio is prompted: “Billy the Bear bites a banana, blanket, ball, box, basket, balloon, and boat!” allowing the learner to yet again hear all of the /b/ sounds. The character then performs the silly action on all of the “b” objects. The audio then suggests, “Let’s count how many letters you earned,” and counts them aloud, letting the learner understand those are all the answers he or she got right. Then the design returns to the start screen and prompts “Choose a character to start.”

Below is an organization chart with the items and actions described above.



Design Model

Gibbons' Design Layers

In beginning our design, we decided to utilize a design model. A design model helps to centralize and create a design around a number of considerations. We chose to use the Gibbons' Design Layers. Gibbons' Design Layers can be broken up into seven components called layers: content, strategy, message, control, representation, media-logic, and data-management. Though broken into different layers, this model allows our design to acknowledge the different "moving" parts, but still integrates into a coherent system. We have detailed each of the specific layers below.

The purpose of our game design is to provide practice and review of early literacy targets for preschool and kindergarten children. Gibbons' Design Layers will be particularly useful in creating and structuring our design because we want to create multiple opportunities for the learners to practice skills without creating additional work for the app developers. The content layer will include several different levels and targets, which causes the representation layer to shift depending on content, but the message, strategy, control, data-management, and media-logic layers will remain constant throughout the design.

Content Layer

The content layer of the design model is mainly concerned with the structure of the content matter, or the organization of tasks. It specifies the structure of the content matter, identifies units into which the subject matter will be divided, and describes how subject-matter will be made available to instructional functions performed by other layers. It should be noted that the technological aspects of the content layers have not been specified, but will be as we progress with our design.

For our design, the content can be summarized as a multi-faceted independent practice of early literacy skills (our literacy targets and skills are specified below). We have divided the content matter into six "levels" or objectives we want to achieve through our design to review and practice early literacy, as detailed above. For our prototype, we chose to focus on Level 2, though each of the levels will have parallel gameplay (side-scrolling journey with audio prompts to allow learners to choose if object matches target). Since our objective for the prototype design was to have the learner practice identifying words that begin with the same sound. In order to do this, learners have to practice distinguishing the difference between initial sounds in words like "bear," "banana," and "leaf." The SEEL program especially emphasizes using frequent and intense exposure, and we incorporate that principle into our design. The main objective of our design is to review rather than teach these literacy skills. Below is a chart of the letter, target sound, character, action, and objects that we used in our prototype and subsequent playtesting:

Letter	Target Sound	Character	Action	Object
B	/b/	Billy the Bear	Bite	Ball Banana Blanket Butterfly Balloon Box Basket
L	/l/	Leo the Lion	Lick	Ladder Ladybug Leaf Lemon Lettuce Lightbulb Lunchbox
P	/p/	Perry the Panda	Poke	Pants Pen Penny Pizza Piano Popcorn Pumpkin

See *Appendix A* for ideas for other targets.

Strategy Layer

The strategy layer specifies the physical organization of the learning space, the social organization of the learners, the roles and responsibilities of the learners, the instructional goals, the allocation of goals to timed event structures, and the strategic patterns of interaction between the learner and instructional experience

Because our design is meant to serve as a review after specific targets have already been taught, it is not face-to-face instruction. Rather, the goal of the design is to help the learner practice and review the targets, not to introduce new content. Because of this, the design will be paced by the learner. Each “activity” of each level of the design will have similar components. It will be a side-scrolling journey in which a character interacts with an object. We will use repetition to encourage practice, as well as positive reinforcement if the learner chooses the right answer and a subdued negative reinforcement if they get it wrong. Our reasoning behind a subdued negative reaction is that if a negative reinforcement reaction is too silly, the learner may enjoy the reaction

and subsequently purposefully choose incorrect answers, thereby rendering the design ineffective for its purpose.

Message Layer

The message layer is the tactical language of message structures through which the instructional experience can communicate content. The main message or objective of this design is to review early literacy targets for pre-kindergarten and kindergarten students by checking their knowledge and allowing them to play while engaging with the design as independent practice. The message remains the same for each level and target, and while the concept being reviewed changes, the message layer itself does not.

Essentially, the learner should come away from the design feeling confident in their ability to distinguish between target sounds and non-target sounds. Like the age-old adage suggests, “Practice makes perfect.” Instead of teaching them concepts, the design will serve as a review, which will ideally recall classroom material taught that day. Our rewards system of letter-rewards and reactions should also be obvious to the learner, in order to differentiate correct and incorrect choices.

Control Layer

The control layer answers the questions” “What will the learner be doing? What control will (s)he have?” This app is in complete control of the learner. That being said, the design does restrict that control of the learner by limiting the actions they can do. In our design, the character moves from object to object automatically, instead of being controlled by the learner through arrows. For example, when Billy the Bear is done biting the banana, he just moves on without an prompting from the learner. However, this limitation allows the learner to focus on the content, rather than becoming absorbed in simply moving from place to place successfully. Without learner action and engagement the design is void of worth or functionality. The main function of the activity is choosing whether or not a sound, word, object, matches the target. In each element of the game the learner will be able to choose which targets to practice, and for how long they would like to practice.

Representation Layer

The representation layer, which focuses on visual and audio, is perhaps one of the only layers that will be shifting constantly throughout the game. All the levels will have similar components: a character correlated with a letter (Leo the Lion for “L”), a target object in which the character interacts with (ladder), an action the character performs on the target object (Leo the Lion licks the ladder), and a reaction (Larry the Lion earns an “L”).

However, in the representation layer, these specific characters, targets, and actions will differ according to the target literacy skill at hand. Learners will both hear and see the representations named above, including distractor targets (e.g. Leo the Lion licks the cactus) and reactions (e.g. Larry the Lion does not get an ”L” because he licked the cactus). A more detailed blueprint of

our basic design is included in the document, which demonstrates the different parts of the representation layer.

Media-Logic Layer

The media-logic layer includes the mechanisms by which representations occur. In our design, this layer is the tablet and the app on which the learners spend all their time with this learning game.

Data-Management Layer

The data-management layer is the layer where data is to be captured, archived, analyzed, interpreted, and reported. Variables such as score, progress through the review, and other data will be captured and shared with the learner. For example, if Larry the Lion licks everything with the “L” then perhaps he grows into a bigger lion for the next level in which students will need to identify words that end in “L”. Additional data will be gathered as to which targets students continually struggled to successfully navigate, and whether remediation or explicit instruction should be recommended.

Game Development: Prototype and Design Narrative

Prototype

In designing this game we went through two prototype stages, the first being simple pictures and the second being paper cut outs. Creating a picture prototype enabled us to discover holes in our game design, identify the format of the game (side scroller), and begin to piece together a larger narrative of the game experience. The second prototype built upon these discoveries and we created a paper prototype that could actually be played. A general storyboard of the game is illustrated below.



Starting out the learner selects a character from a list of options by tapping on the character.

Audio: *“Tap a character to begin”*

If the player taps on the bear, audio: *“Billy the bear likes to bite things that start with /b/, like balloon, bowl, and book.”*



Starting out the character approaches an object. In this case it is a bear approaching a banana.



Audio: *“Does ‘banana start with /b/?”*

The learner is given the audio prompt as to whether “banana” begins with the sound /b/. In this case, the learner selects the correct response of “YES”.



Because the learner selected the correct response, the bear performs an action (bite) on the object in a humorous way. This action acts as a reward for the learner.

Audio: *“Brilliant! Banana starts with /b/. Billy the bear bites the banana.”*

Bear Audio: *“Nom nom nom nom!”*



Additionally, the learner will be rewarded as the character receives a LETTER at the top of the screen. This reward is then a visual token the character keeps for the remainder of the level, unless they get something wrong, they will lose letters.

Audio: *“You get a letter B!”*

Billy the Bear will then jump up and down and cheer.

Lets return to the point at which the learner was presented with the choice of whether banana began with /b/. If the learner *incorrectly* responds “NO” then there is a different sequence of events.



The learner selects the wrong response in the negative.



Because the response was wrong *and* the learner selected the negative choice, then the reward of the B is NOT given.

Audio: *“Oops, not quite. ‘Banana’ does start with the /b/ sound. Listen: /b/, /b/, banana.”*

Proceeding forward, assuming the learner was correct the character approaches a new object and the process starts over once again.



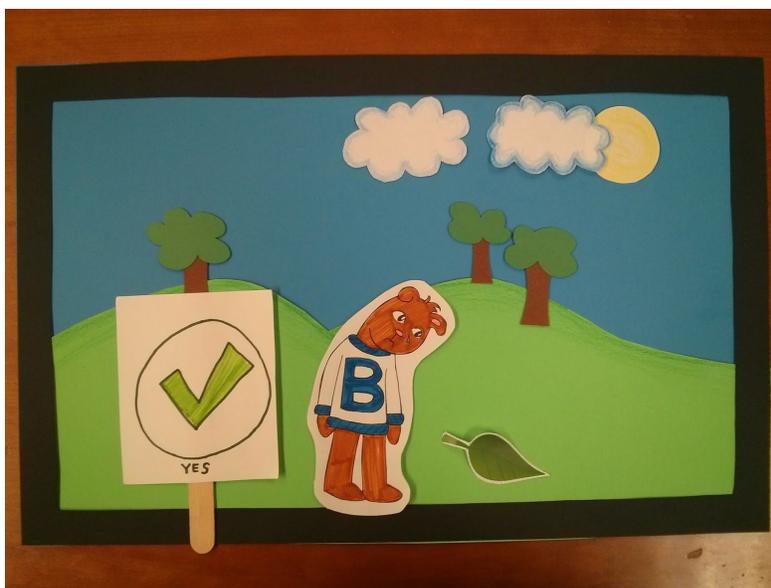
The same sequence of events follow, only now the correct answer is the negative choice “NO”.



Audio: “Does ‘leaf’ start with /b/?”

If the learner chooses the positive choice “YES” but is incorrect, then instead of being rewarded with the funny action of the character on the object, a simple annoying sound is made and the character automatically moves past the object.

Audio: “Wah wah! ‘Leaf’ does not start with /b/. Listen: llllleaf.”



However, if the learner selects *correctly* by choosing the negative answer, then they are rewarded.



“Brilliant! Billy the bear does NOT bite the leaf.”

The character does not perform the funny action on the object, but the character cheers, and moves past the object and discovers the reward item to add to their collection.

Thus the game continues with yet another object.



Once the learner has faced off with 10 objects, the level ends and a short narrator summarizes the “B” objects.

Audio: *“Brilliant! Billy the bear bites: butterflies, blankets, and balls”*



Design Narrative

In creating the design for this early literacy game we use very basic tools to communicate and prototype our design. Initially we used Google Drawings to sketch out the sequence of events in how the characters would interact with the targets. After discussing some of the potential issues with the client, we fleshed out the prototype into a paper game (as described above). At one point we considered using Scratch to do some basic development of the game, but realized that to do so would be unnecessary in order to get the feedback we really needed. Because the game is so basic, we were not as concerned about the feasibility of it being programmed. Of more interest was whether learners would find the characters and rewards rewarding, and there was no need to program a game to discover that.

As mentioned in the “Design Model” section, we anticipate Gibbon’s Design Layers to be particularly helpful in the development of the game. One of our main constraints according to the client was being able to create a game that could be easily replicated by the app developers in order to keep costs low. The design layers, because of their different “moving parts,” served well for us because while allowing us to create a consistent design (the side-scroll journey where a character approaches objects and chooses), the target sounds and objectives can easily be changed depending on the level. While making the paper prototype, we found the design lends itself to being simple to create rapidly without having to make structural or critical changes. However, we acknowledge that the media logic and data-management layers will be different from our paper prototype, so there may be issues we have not yet anticipated in those layers. But in the layers we were able to work with, our execution of the design model helped our design’s effectiveness by showing us how to consider integrating the various moving parts into one coherent design.

Our design process went fairly smooth, largely in part to frequent interim meetings with the client and developmental evaluation over the course of the semester. One difficulty we had was in the beginning stages of the process. The task of simply coming up with the targets and a way to engage learners in a meaningful review activity, while still being fun, felt particularly challenging to members of our team with limited experience in early childhood literacy. Brainstorming with one another, and presenting ideas to the client, helped us overcome this initial barrier and move towards filling out the design in more detail. Ideas for characters and objects to be used for the different target sounds were developed through consultation with the client, including their website and discussion with one another. As mentioned earlier, we did struggle temporarily as to the best way to prototype the design so as to get the feedback needed to refine our game and complete the design process. Programming on Scratch seemed like the logical action to take, but in looking more closely at the code we would need to come up with under the limited time constraint, we realized it was simply not feasible. In asking for ideas and advice from Cory, the class TA, we discovered the viability of making a paper prototype. In hindsight this was clearly the best move, and we were able to get the helpful feedback needed to refine the design for this final report.

A short video of the game being played by a playtester can be viewed at: <http://bit.ly/1uwS5XO>

Evaluation

Playtesting

A paper prototype was created, which included a background screen and three characters for the player to choose from: Billy Bear, Leo Lion, Percy Panda. During play testing the creators of the game moved the objects, narrated, made the sound effects, and asked followed-up questions with the playtester.

Data Collection

Data were collected as play testers engaged with the game. Their reactions while playing the game were observed. They were also asked the following questions upon completion of the game:

1. Was it fun?
2. Did you like the characters?
3. Which characters did you like?
4. How did you earn letters?

Our first playtester was a college-aged female, who was clearly not in the target demographic for our game. Our second playtester was a 5-year-old male. He was a little older and a little more advanced than our target audience. We did, however, receive some useful insight into our game based on their experience and suggestions.

Results

Our first playtester said that she didn't really know what was going on at the beginning and that she needed clear instructions. She also suggested smoother transitions would have been better.

The poor transitions were largely as a result of moving the pieces of the game manually. We feel that once the game is created in a digital format the smooth transitions will be taken care of. But we have also incorporated more explicit directions throughout the course of the game.

Our second playtester seemed genuinely engaged in the game and wanted to play with all of the characters, without any prompting from us. He said that he enjoyed it. His facial expressions showed interest in the actions of the characters. For example, when Leo the Lion licked the ladders he laughed. When we asked him what he had to do to earn the letters, he was not sure, so we played the game again with him, changing the narrative to explicitly state, “You earned an L!” when he got the answer right. When we asked the question the second time, he quickly responded that he got the letters when he got the right answer. As a result, the narrative to our game has changed to include the explicit comment of earning a letter. He said that his favorite character was the bear, though he was not able to explain why. It would be useful for us to test the game on more playtesters to get a broader sense of what type of characters young children tend to prefer.

Project Evaluation Components

Context Evaluation

Our learner and competitor analysis were essentially a form of context evaluation. The goal was to evaluate the need and potential viability of the product our client was requesting. To better understand this we did a surface level analysis of other literacy games, and spent some time thinking through the potential learner demographics of end users for the game. In hindsight, we should have spent more time with kids, parents, and teachers and observed the role of current literacy games in their regular routine. Simply thinking about children playing this game is not sufficient for evaluating the necessary components of a game that will not only be meaningful but also engaging and fun. Perhaps this additional element of analysis and work that is so often lacking in the design process is why there are so many ineffective learning games on the app store.

Developmental Evaluation

As mentioned in the design narrative above, our frequent interactions with the client led to helpful and rapid changes to our design. Continually re-evaluating the nature of the game and how it would work was an integral part of our design process. We constantly took feedback from one another and the client. Playtesting the game was perhaps the most influential and clear form of developmental evaluation. Reflecting on our process, we realize that had we been able to get playtesters that closely fit the demographics of our target end-users interacting with and using elements of the design early on, our design would have significantly more data and direction from which to evaluate and act upon.

Meta Evaluation

In reflecting on the overall evaluation of our design process and product we feel that while we failed to give exhaustive attention to formally evaluating the game in its different stages, we did engage with incremental and developmental aspects of the process in order to keep the scope

limited and focused on both what the client was requesting and what we thought the end-users would enjoy.

In the sections above we've mentioned a few points our evaluation process could be improved. Below these are outlined more clearly:

- Spend more time observing the target audience interacting with digital games in the early stages.
- Playtest the game with a larger number of individuals from the target audience at a variety of stages of the design.
- Create a simple digital prototype of the game to gain greater insight into the experience of players.

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Appendix A: Targets and ideas

Letter/Sound	Character	Action	Reward	Target Objects
A	Angie the Acrobat Adam the Ant Andy the Anteater Astrid the Antelope Allie the Alligator Astronaut	Acrobatics	Apples	Alligator Ant Antelope Anteater Anchor Arrow Apples Astronaut
B	Bat Baboon Bear Boy Ballerina	Bat Bowl Break Bite Bop Bend Bounce	Balloon Bow	Bike Bell Book Ball Baseball Banana Button Basket Ball Bag Basket Boat Bus Bug Box Butterfly
C (Note: when practicing only the sound these words can be combined with the /k/ words.)	Cat Cade Cowboy Clown Caterpillar	Cut Crack Clap Climb Crawl Crush Crunch	Candy Cake Cookie Candy Cane Caramel Cupcake	Car Cap Catfish Cup Cat (soft toy) Coconut Cauldron Cloud Carpet
D	Dragon Daniel Dinosaur Dog	Draw Dance Drag	Dimes Donuts Drinks	Dishes Dirt Door

	Dancer	Drop Dig Dip Drip Drum	Drum Daisy Dollar	Drum Donut Daisy Drink Dollar Dorriotos
E	Emma Ellie Elephant		Eggs	
F	Fish Fran the Frog Fox	Flip Fly Flop Flick Freeze	Feather Fruit Flag	Feather Fruit Fish Fries Fox Flag Footprints Food
G	Goat Girl Greedy Gorilla Goldfish Ghost Grandma	Growl Gobble Grab Glow	Gumdrops	Grapes Gift Gown Garbage Grass Gold Gloves Gum Gumdrops
H	Harry the Hungry Hippo Hen	Hook Hide Hiss Hang Hammer Hug Hit Hop Holler	Hearts Hamburger Hot dog Hat	Hearts Hamburger Hat House Hen Honey Hair
I	Iggy Iguana	Itch		Igloo

				Ink
J	Jellyfish Jester	Jab Jump Jog Jiggle Juggle		Jello Jar Jewel Jellybean Juice Jacket Jeans
K	Kangaroo King K Karate Kid Kitten	Kick Kiss		Key Kite Kitten Kid Kitchen Keyboard Kit
L	Leo Lion Leprechaun Lamb	Lick Leap	Lollipops	Ladders Lunchbox Leaf Lemon Lobster Lettuce Ladybug Light bulb Lips
M	Monty the Monster Misty the Mouse Mark the Moose Magic Monkey	Munch Mix Mop Mess Melt	Marshmallow Muffin	Mail Mirror Mask Moon Motorcycle Macaroni Muffin Macaroni Milk Mushrooms
N	Nelly Nora Ned	Nip	Nuts	Nuts Net Nine

	Nightingale			Nose Nest Nail Noodles
O	Ox Octopus Otter Ostrich			Omelet Ox Otter Ostrich Olives
P	Percy Pirate Polly Princess Pig Panda Panther Parrot Peacock Penguin Porcupine Puppy	Pull Prick Pop Paint Pack Pat Place Pour	Playdough Pigs Pancake Peach Pizza	Pan Pail Paintbrush Paper Pants Parachute Peanut Pear Pencil Penny Pen Pepper Piano Pillow Pineapple Plant Plate Popcorn Pot Potato Pretzel Pumpkin
Q	Queen Quail	Quilt Quit Quack	Queen's crown?	Queen Quail Quilt
R	Robber Rascal Rabbit Rat	Run Rob Rip Roar	Rainbow Red Ribbon Ring	Road Rainbow Rock Ring

	Raccoon Rooster			Ribbon Rose Rug Rat Rooster Raccoon Rabbit
S	Snake Super Snail Skunk Silly Snowman Seal (lion) Spider	Swipe Swat Strike Stomp Spin Slip Slap Hissssss	Stars Stickers Spots	Sandals Sand castle Sandwich Saw Scarf Scissors Seeds Sunglasses Star Sun Spider
T	Tiger	Tear Taste Tap Take Tip Tie	Tootsie Rolls Toffee Toys Treasure	Taco Telephone Teddy bear Train Tomatoes Toast Turkey Tangerine Tent Trampoline Tree Toothpaste
U		Undo Up	Umbrella	Umbrella
V	Vet Victoria	Vote Vet		Vest Van Vacuum Volcano Vegetables Violin Valentine

				Volleyball Vase
W	Whale Witch Wallace the Waiter Walrus Weasel Worm	Whack Whip Wish Waltz Wiggle	Wishes Walnut Wand	Watch Water Waffle Wagon Wall Wand Wardrobe Web Well Wig Wheel
X		X-ray		
Y	Yak	Yell Yelp Yank Yawn	Yellow...	Yo-yo Yarn Yoghurt Yolk
Z	Zelda Zod Zebra Zoe	Zoom Zig zag Zip Zap		Zipper Zoo Zebra Zig zag