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Monster Spells

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MULTIMEDIA/INTERACTIVITY

Multimedia refers to an evolving set of teaching tools that can combine video, sounds, text, and graphics in a computer environment under users control. Interactivity, a function of multimedia, allows the user to manipulate the computer environment with the utilization of physical and mental capabilities. An interactive program is freed from the linear, highly directed flow of printed text. Its comprehensive qualities, varied formats and dynamic linking offers learners individualized access to rich intellectual environments. Such a harmonious environment requires learners to constantly make decisions and evaluate progress, thus forcing the user to apply higher order of thinking skills.

Interactive programs portray familiar actions and objects in many unique ways. The possibility of accessing information in multiple ways can lead to a clearer understanding of the meaning being conveyed. Collaborating the concept of interactive media with education promotes a whole new way of learning. The combining form of computer activities and the existing tools for learning stimulate the curiosity for knowledge. Therefore, computer technology is an important addition to our children's learning experience and processes.

There are five basic types of educational computer software.

Drill and practice programs which reinforce skills: similar to workbooks

Tutorial programs which describe some concept or process and then engage the student in a question and answer dialog

Instructional gains which allow the child to take partial or total control of one side of the action

Simulation programs which provide a model which behaves like some portion of the real world.

Problem solving programs which help the student to learn about some aspect of the real world by writing or using a computer program to solve a problem

Software which allows the child to affect the outcome of a program by taking control over the action, or which allows a child to model behavior, or to solve problems makes use of the unique properties of the computer environment. If the proposition: "the more senses satisfied the easier the belief" is true then interactive media will be an extremely powerful learning tool.

CHILDREN AND LEARNING

Computers can help children understand that animals, people and situations are parts of larger systems that influence one another. The computer is a multifaceted electronic medium. Not only is it interactive but it has the ability to become any and all existing media, including

books and multimedia instruments. This feature will allow users to choose the kinds of media through which they want to receive and communicate ideas. Another facet is the way in which information can be presented from many different perspectives. Computing is building a dynamic model of an idea through simulation that can compare and contrast conflicting theories. In addition, an extensively networked computer will soon become a universally linked information bank. It is possible to design computer programs so learning to communicate with them can become a natural process.

Children seem to be inately gifted learners, acquiring a vast quantity of longknowledge long before they acquire formal education by a process called the Piagetian Theory. The theory describes learning without being taught. Piaget, a noted researcher in child development, thought that children become logical mainly as a result of informal experiences with their environment, rather than as a result of being told things directly. He laid great stress on the idea of intellectual conflict. By that he meant that they tend to acquire new ways of thinking when they find that their existing ways produce conflicting answers. In other words. when they find themselves thinking in two different ways about the same thing. The following is a series of quotes from Seymore Papert, a pioneer in research and development of children's computer interaction. Seymore Papert bases much of his theories on Piaget.

"You can be the gear, you can understand how it turns by projecting yourself into its place and turning with it. It is this double relationship both abstract and sensory - that gives the gear power."[1]

"What the gears cannot do the computer might. The computer is the Proteus of machines. Its essence is it's universality , its power to simulate. Because it can take on a thousand tastes. .... my own attempts over the past decade to turn computers into instruments flexible enough so that many children can create for themselves something like gears were for me"[2]

"The computer presence could contribute to mental processes not only instrumentally but in more essential, conceptual ways, influencing how people think even when they are far removed from physical contact with a computer."[3]

PLAY

During early developmental stages in childhood the primary learning process is exemplified through play and human interaction. Play has traditionally been under valued. Some people feel play only reduces anxiety and tension. Recently, I feel the ideas have changed towards the importance of play and games.

Areas of child development which are affected by play include physical, intellectual, social, personality and emotional development. Play builds self-esteem, problem solving, creativity and the ability to relate to others. Play entices children to discover and deal with their environment. Opportunities for making decisions and choices arise through play. Skills which adults possess are learned

behaviors children have to practice and perfect. Many hours of play are necessary to learn new words, experiment with interactions, test rules, practice skills and solve problems.

Each accomplishment is a step towards a more complex level of being. Piaget, stated that when children discover something for themselves, it will most often remain with them. Children master skills by thinking situations through by themselves. Play offers them this opportunity.

Children need to develop the ability to play alone as well as with playmates. By playing by themselves a child can lengthen their attention span and strengthen the ability to reason for themselves. Playing in a group also enhances their skills and abilities. Small groups of young children tend to repeat experiences continuously and still remain enthusiastic. Repetition is an essential part of learning for the young child. Much of play is done through some sort of game whether it is role playing, pretending, dress-up, activities, creating, board game or electronic media. Most activities are similar to games because both have guidelines or rules to follow that are either implied or standardized.

GAMES

> "A game is an interactional activity played by one or more players, either competitively or collaborative, according to a set of agreed upon rules which define the content of the game and which include criteria for determining the winner"[4]

Above all, games are supposed to be enjoyable. Games have been an important medium for informal learning for many centuries. It is because of their long standing existence and satisfying rewards that educational computer games have been created. Most games serve three general educational purposes:

1. to teach and bring together society's values, attitudes and beliefs,
2. to provide a uninhibited environment for players to experience, organize, share, develop and alter the guidelines for social interaction
3. the development of both motor and conceptual skills. Games are control systems nested in the facets of our culture.

Enjoyment is the chief motivation in learning games, intended to capture the child's attention and increase the likelihood that the child will internalize the message interwoven in the constructs of the game. Computer based learning games range from drill and practice to complex simulations. The computer as a tool with its wonderful interactive capabilities holds tremendous potential. While the computer has many limitations and cannot fulfill many of the traditional goals of non-electronic games, it can provide other ways to present the concepts in existing games therefore strengthening the educational experiences and fulfill our current needs. Intentional educational games can derive strength from formulating out of familiar models, for they help children approach learning from already learned environments. They have that quality the psychologists call

"representativeness". An electronic learning game is more versatile than many traditional games because it can be used by a variety of learners- gifted, handicapped, remedial, adults, toddlers and the bilingual. I can cover any subject matter and be used in a variety of settings such as the classroom and home.

CONCEPTION AND RATIONALE

In researching Interactive Media and its educational implications my curiosity was heightened by the extensive work done at Bank Street College in New York. The college developed a Interactive project called LOGO which assists the child in learning basic math concepts through programming. Seymore Papert's book Mindstorms added to this idea by introducing me to Turtle Geometry, which is a program very similar to LOGO.

Awareness of the current capabilities of the Macintosh computer and seeing the archaic level of graphic representations in the two programs mentioned above. I decided to create a Children's Interactive educational game. After talking with various elementary school faculty, I narrowed my idea to a game dealing with vocabulary and spelling. I wanted to provide children with a stimulating learning tool that utilized the interactive and dynamic color capabilities of the Macintosh computer. Incorporating exploration in the use of motion, as a visual message.

During my research of existing children's games I found many that were difficult to understand, even for an adult. Other games that were enlightening, however, lacked good use of color and design. Color is important because it attracts and entices the attention of the user. Color also adds to the message put forth by the medium. On another level, our society is engulfed by color television and video games. To compete with this existing media, an educational game must keep up with their level of intensity in terms of content, use of color and level of control by users.

I narrowed the ages of my targeted group to be children in elementary school. The primary reason for my interest in this age group is my extensive experience in elementary children's games. I analyzed two existing word games. I reviewed them in terms of specific criteria that I felt appropriate to the task. I developed the criteria based on a combination of my research and my own experience. (refer to pg 44)

The first game I tested was "Word Munchers". The object is to "munch" as many words as you can that contain the target vowel sound. The more correct words you "munch", the more points you earn. If you earn enough points you enter the "Word Munchers", Hall of Fame. The beginning screen is well designed and extremely clear as to what choices the user has available. While the user is deciding, a continual animation of a "troggle (bad guy)" chasing the "muncher" (good guy) is played. The choices on

this screen are Instructions, Practice and Play Munchers.

Instructions were very easy to read but neglected to tell the user that they could click the word they are trying to match and the sound is repeated. I thought this functionality was an important reinforcement and reminder. The second screen of instructions displays all the characters, one good guy and the various troggles. Although I felt these imaginary, genderless creatures to be ludicrous at first, the children easily identify with them and their roles.

The practice mode was an important feature to the program because it allowed the user to practice the game without the pressure of a "troggle" coming to eat their "muncher". This helps slower learners to take their time. The only problem is the user has to complete three screens before they can get the option to actually play the game and there is no navigational tool to return to first screen. This is extremely frustrating for children who learn quicker.

The playing screen design and layout is visually pleasing. The simplicity is appropriate to make the game clear, free of added distraction as you play. The children I tested really liked the time-out function which would pause the game. I found its wording confusing as did the kids. You clicked the button when it says continue to pause and then the button changes to time-out, which can be clicked to continue. This button is awkward but the user can clearly see the game and know whether or not it has been paused.

The screen had the level on the right bottom corner, there were three in all. The score is located to the right of the level. The score is placed in a spot that is easy to check without pausing the game. The playing area is a white rectangle divided into even squares. Each square has a word in it and the user clicks the mouse in the desired square and the "muncher" moves there. A "troggle" may appear and will move in a straight direction across the board changing the words in his path and adding ones in empty boxes.

When playing the game, the user clicks once to move "munchers" and twice to eat a word. Different spaces at different times will be hilighted and these are safe since a troggle can't eat a muncher in there. The player gets four "munchers". They are located on the bottom of the screen and disappear as they get eaten. If the "muncher" eats a correct word, a munching sound is played. If an incorrect word is munched a two note low sound is heard. In addition, the player loses a "muncher" and a message box appears that tells the user the word choice was incorrect, the choices are "hear vowel" or "okay".

As each level is completed an animation is shown in which the good guy gets the bad guy. This scenario is familiar to all children because of the child's understanding of humor and they identify with it, laughing every time. In my point of view, this game is very successful. The users are learning and having fun at the same time being

challenged. The game is a modified version of the popular notion of "the chase." Children thrive on the fear of being caught. It is a natural high. Word munchers also has a point based reward system, similar to video games that satisfies the competitive spirit children possess.

The second game I analyzed and tested was "Word Quest". I had no prior experience with this educational game. I choose the game because of its attractive graphics and description on the cover:

> "Word Quest is a spelling application for use with Hypercard. It helps children to learn spelling by guiding them through the enchanted world of castles, caves and passages in hopes of finding the fire magic words that will rid the kingdom of the spell cast by the evil ice witch."

The opening screen did not have any clear directions as what to do. The children basically had to go by trial and error. None of the children tested understood how to play the game from the instruction. It seems the idea of castles and evil witches kept them interested in trying to play anyway.

Each screen is a part of the kingdom which has invisible buttons all over it. The user can randomly click anywhere and something happens, such as going to another place in the kingdom. These buttons are poorly placed. Not only are they on objects but in the background also. Many of the children were extremely frustrated and some continuously clicked everywhere before hitting a button.

The button placement is not in any way related to where that button will take you or what it will do. If the user

is lucky they will hit a "magic button." A message box appears and a word is spoken and the user types in the word. This is a disaster because the voice recording is very unclear. I like the fact the user has to type in the word. If the word is spelled correctly a non-emotional voice say either "fine" or "great." The voice is not a positive stimulating reward because it makes the user unsure whether they really did the right thing or not. The word choice was also very poor. One child I tested was asked to spell "have" three times. I failed to see a correlation in the words asked to spell and any specific level of educational development. Therefore, the educational aspect is nonexistent and pointless.

The children were extremely disappointed in the poor quality of graphics. They had no logical pattern and were drawn inconsistently. The graphics were black and white and very childlike in nature. Children prefer sophisticated graphics in terms of execution. The only reason children draw simply is because they are still developing their skills. A game such as this one, insults children with these illustrations and it is obvious to me that this company did not research children's preferences. Instead they took for granted that children like graphics which are most representational to their level.

The children were easily lost in the game because there is no sense of logical path. Animations were shown at random. They did not pertain to anything the user did.

All of the children tested quit the game before finishing it. Based upon my knowledge of children's educational needs this particular game shows little comprehension of the requirements to learning that make it an effective learning tool. Analyzing and testing these two existing educational games gave me a good basis to begin implementing my ideas.

I sketched out all of my original ideas and layouts for the spelling game. (refer to pg 49) I eventually, selected the fifth concept, which was a modified version of the popular children's game, Hangman.

DESIGN OBJECTS AND PARAMETERS

Monster Spells is a children's interactive educational game created with Supercard and Macromind Director. The program is a combination of two of the basic types of educational programs, Instructional and Simulation. It is instructional because the game allows the child to take partial control of the environment. The programs animations fall into the Simulation category because they provide a model which portrays some portion of the real world. This game is a spelling learning tool intended for ages 6-9. The words are reinforced through repetition. This is accomplished with the use of several communication forms audio, animation and visual display. The extensive use of colors is intended to invoke curiosity and hold the interest of the user.

The object of the game is to correctly spell the word using the visual clues before the monster closes all of his fingers. Every word has a visual representation that is verbally reinforced when a word is completed. The visual display appears in a short animation and the word is verbally repeated a second time. If the child does not correctly spell the word in the allowed amount of chances, the monster verbally encourages the child to play another game. Monster Spells is divided into levels 1, 2, and 3 which increase in difficulty respectively. Each level contains 12 words with related animations. The game includes a help section and practice game.

DESIGN PROBLEMS

Before designing my game, I was aware of many important design concerns. These concerns are aside from the specific positives and negatives uncovered in the two analyzed spelling games. I feel that it is important to design for children around the educational objectives established by the schools. Children's tools should be built to spark motivation and appeal. Interaction is essential for the learner rather than simply presenting information. Correct responses should be appropriately reinforced. Information presented to a learner should be valid and valuable. Metaphors should be observed and implemented which will assist users in relating new media to other, more familiar ones.

One of the most important factors in any design is layout. Young children exposed to well designed media will eventually not accept anything less. Another concern is the appropriateness of the graphics. Art for children can conform to the audience without mocking the brain. Visual observation tends to be the most convincing evidence. Children never forget, yet they do not always consciously remember. Children, being less capable of translating abstractions into actualities, need visual representation more than adults. Children have a lack of experience and less ability to interpret visual clues. Therefore art for children needs to be clear and concise. Symbolism, illusions and imagery can be used but only from a child's point of view with fairly forward interpretations. In addition, the layout should be precisely thought out to insure consistent navigational applications.

APPLICATION

Monster Spells is a spelling game that can be used in any environment which utilizes a Macintosh computer. However, I was primarily focusing on the school environment. Educational games have many applications. They can help children learn facts and skills that will build on their learning experience in a positive manner.

Players learn what they need to know to play the game. If the game is well designed and contains valuable information, the skill and content can be applied

immediately by actually playing the game. By interacting with the game, the knowledge is likely to be retained for a longer period of time then by other means.

Repetition is an important factor for the user to internalize the content of the game. Games convey the message that learning is a human activity, dependent on human interaction and involving shared understanding rather than adaptation to authority, especially if skill and chance are appropriately mixed.

Game provide opportunity for people with different levels of skills to learn together, in a way which is equal and enjoyable. If used in the classroom, theycan provide opportunities for users to share experience and discoveries.

PROCESS

The early stages of development of my project began with brainstorming words (refer to pg 42) which related to children computers and education. The list was designed to help generate ideas for my thesis. The list assisted me in developing a company , Mind Over Mouse. This imaginary company represents is a corporation that would develop children's interactive educational software. The logo was integrated into an animation that portraysa the company name. The animation was intended to function as the front end of my children's program, Monster Spells.

Beginning research was difficult because my topic does not appear as a subject in the Library. (refer to pg 70)

I then had to use alternative topics to find the related material. One of my advisors suggested that I contact the Bank Street College in New York City. They sent me several technical reports. These documents were very helpful. Not only did they cover the colleges progress with children's programs, but also design concerns and technology and education. The Bibliographies were informative and useful. Several resources in the Wallace Memorial Library assisted me in my research. These included the CD Rom, Microfiche, Microfilm and periodicals. I found some of the material in books, but the information was limited by small sections. The majority of the books and articles were obtained through inter library loans.

Through my research, several ideas emerged. I decided that the interface should be similar to an environment in which the children were familiar. Levels of completion, a reward system and strong navigation became important considerations. I targeted two age groups, 6-9 and 10-12. (refer to pg 71) My initial framework for developing the program was as follows.

Reflect real life events	Reward system
Different levels	Many paths
Concept approach	Nonlinear
Choices produce different events	Map
Warm interaction	Clear navigation
Consistent screen design	Good use of color

I presented these ideas at my first committee meeting, with

my advisors Jim Ver Hague, John Ciampa and Mark Collien. They all felt that I needed to concentrate on a specific area. They also suggested the evaluation and testing of existing children's educational programs against a set of criteria. Other points discussed were graphic assumptions, realism versus non realism, and violence versus nonviolence. In addition, they thought I should look at programs that are extremes in terms of the criteria.

After the meeting , I narrowed my target group to children 6-9 and limited the program's content to spelling. I choose to create my project in Supercard and Macromind Director because of their capability, scripting abilities and color dynamics.

As part of my investigation, I contacted the Board of Education for information on the state requirements for each grade level. I spoke to a man named, Mr. Desoto. During this conversation I learned that there are not any guidelines or criteria for the amount of education a child should have by the end of each grade level. He said certain schools may have their own criteria but its not state wide. Schools are, however, required to teach specific subjects including arithmetic, reading, writing and physical education.

There are two state tests given called the PEP and PET. PEP is given to third grade for reading and math, fifth grade for writing, and sixth grade for social studies. The PET is given to the school to assess that the subjects are being taught.

Mr. Desoto is on a committee that is trying to pass a bill called "The New Compact for Learning". This includes in its proposal setting NY State standards for the criteria for each grade level so there will be consistency state wide. Mr Desoto said that the reason NY State has not set standards prior is due to the exceptional excellence in the NY State school system as compared to the rest of the country. This information led me to wonder how any existing educational software was produced and where it's criteria came from. Due to the lack of information, I had to find an alternative source to obtain the parameters of vocabulary for my targeted age group.

A member of my committee recommended researching learning development theories to help formulate the vocabulary list. Piaget's theory was the most conclusive. In reading more in depth I felt there was great significance in his acquisition of vocabulary but the content did not fit the needs of this specific project. Piaget's age 2-10 was too broad for me to narrow down to my group 6-9. Therefore I was not able to formulate a list of words that children at each age level could be expected to know. I did however, collect information that would latter help in the actual design and functionality of my program.

I then decided to use the word lists found in school reading books. These books are not necessarily nationwide but the Houghton-Mifflin is the most popular book used. The Fyle Elementary school reading teacher put together a

vocabulary list from the back of each book for grades first, second and third which best corresponded with my age group. (refer to pg 50)

After obtaining the word lists, I contacted two sources, Boces Software Library and Apple support Pittsford. I was hoping they would let me look at their Macintosh children's programs. Apple Pittsford said they did not have software on the premises and suggested speaking to Ester Kegan at Boces. Mrs. Kegan told me that they had very few Macintosh programs but over 500 for the Apple II computer. When ordering the few programs they had, the Fyle school librarian let me look at hers. The selection was much bigger than Boces. I spent several hours looking at the programs. I reviewed the following programs: (refer to pg 43)

Bannermania	Word Munchers
Earth Quest	Masters Blasters
Kids Time	The Playroom
The Printshop	The Oregon Trail
The Writing Center	

Exploring this wide range of programs designed for children gave me a good sense of what's out there. I began putting together in my head all of the concepts I felt were strong and weak. These would later be included in a criteria list to evaluate children's programs.

At this point my goals became clearer. I decided the strongest type of program, in addition to classroom

procedure, would be in the form of a game. This game needed to conform to its tool the computer so its success depended on the medium. Word picture association and progression in difficulty would be incorporated into the game's structure. At this time I presented my final thesis statement to my committee:

> I intend to design and develop a children's educa tional game that primarily focuses on spelling and picture association in context for ages 6-9.

I felt that my goal should be designed as a sophisticated and valuable learning tool not a video game. The functionality of the electronic video game is important but there needs to be distinction between "playing for self" and "playing for the mind".

I completed my criteria for analyzing children's computer programs (refer to pg 44) and chose to apply this to the games "Word Munchers" and "Word Quest". Both of these were created to help children with spelling. I felt these two games were extremes in terms of successfulness. (refer to pgs 45-48) Upon completion of analyzing and testing the two games I began my own. I first sketched out ideas and five possible games arose. (refer to pg 49)

> Game 1
>
> This game would show the picture of the word then ask the child to spell it. Every correct letter turns part of the picture into the word. The child scores points for every correctly spelled word. If the child cannot spell the word he/she can push the help button and the wordwill spell itself. In either case after the word is correctly spelled a new screen will appear. At the end of the game they will be asked their name and

their score will be entered into a scoreboard. The game isscored by user receiving 1 point for each correct letter. This does not include the use of the help button.

Game 2
The child looks at the picture and chooses the correct spelling of the word. Each correct choice adds points, while each wrong choice deducts points. The game would have several levels, each one increasingly more difficult.

Game 3
The child is shown nine boxes, with an object drawn on each. On the right side of the screen is a list of words that matches the objects. Each word highlights for a certain amount of time. Within this time the child has to choose the correct corresponding picture. Each game keeps track of time and it is recorded.

Game 4
The game presents the child with 12 words in boxes. The object is to choose all the words that are related. If the child does not know a word they can click on the word to see its visual representation. Each screen is a separate game and there is a number at the bottom of the screen which shows how many words they need to find.

Game 5
The child is shown a covered picture and below are blank spaces for the corresponding word. At the bottom the alphabet is provided. On the right another blank box and below a score box. The child clicks on the letters in the alphabet and correct choices appear in blank spaces. For example if the word is frog then if "f" was chosen it would appear in the first space. Every correct choice reveals a part of the picture. If an incorrect letter is chosen part of a character is added to the right hand box. If the character is completed; the game ends. The score box keeps track of mistakes made. Each screen is a new game.

After careful analyzing, I decided to elaborate on game 5. I conceptualized the structure of the game by designing a flow chart. (refer to pg 51) Many features were added to enhance effectiveness such as levels of difficulty, a help section and a front end control screen. Each level will have a certain number of screens, that each represent one word. As the user completes a level, an animation is played. In addition the words would be randomly picked to assure the game would be different each time played. When I received the vocabulary list, I selected words which could be easily represented graphically. This is so the users can easily identify the picture even if only parts of it are showing. The visual should be used to give the user clues to spell the word. I felt verbs would be hard to identify without the entire picture showing.

In the early stages of actual development, I had intended to use only Macromind to create the game. I ran into problems displaying an entire alphabet on the screen. Macromind only allows 24 objects on the stage at once and there are 26 letters in the alphabet. To correct the situation , I broke the alphabet into segments and an arrow would control the showing of other segments. The screen had to be redesigned. (refer to pg 52) A quit button was added to let the user get out of the game at any point. The functionality was expanded. A message box would appear saying "try again" if a wrong letter was selected. Instead of having

just two animations my committee suggested designing an animation for each word. I thought this would strengthen its educational implications by presenting the word in another form. Repetition enhances the likelihood a child will retain the message. The screen was designed in colors with similar hues to be stimulating but not take away from the visual representations.

I was still concerned about having the alphabet segmented. I felt if the alphabet was not all on the screen at once the user would tend to pick from the first segment first reducing odds. This was an important implication in the success of my game so I moved my game into Supercard in which their are not any limits in the amount of objects displayed. (refer to pg 53) I also replaced the message boxes with a real voice and choose a letter with a "boing" sound for a wrong letter and a "magic" sound for right letter. To continue designing I needed to name my game. After brain storming I came up with a list of possibilities.

Words, Words and More Words

Monster Word

Word Monster

Word Elf

Words and Imagination

Monster Spells

Creative Spells

Word Spells Monster

I tested all the possibilities and Monster Spells was the most

popular. The final Flow chart was created for Monster Spells (refer to pg 54)

I developed an interesting looking creature for the character in the game which I classified as a monster. The monster was originally drawn with big teeth but later was refined to just a smile with its tongue hanging out. (refer to pg 55) This was because of the negative impact the teeth had on children as well as many adults. I dressed the monster in clothes to make its appearance more familiar and friendly.

The game begins with an animated title after which the monster appears jumping and four choices are presented, level 1, level 2, level 3, and a help. (refer to pg 56) The monster jumps up and down until one of the choices is made. The user is informed of this by the voice of the monster which says: "Welcome to Monster Spells, (Ha, ha, ha,ha,ha) choose level 1, 2, or 3, if you are confused click help, if you are done click me to quit.

The voice was first recorded by a male but later changed to a more neutral voice. I did not want t set up the monster as a male and the voice of the words being said as a female. I think this would create a parallel in male/female identity for the user.

If help is chosen the next three screens would explain the game more in depth. (refer to pg 57) Following the explanation of the game is a blank screen with typed descriptions on each part. (refer to pg 58) Linked to this

screen is a practice game that the user just watches. All of the help screens have links back to front screen with the choices.

I further cut down the vocabulary list for Level 1 to twelve words: egg. fly, lunch, kite, pencil, ghost, alphabet, yellow, turtle, duck, juice, stamp. I used the word, egg, as the practice word too. I was concerned at the level of detail needed in drawing the visuals, so the user could easily identify them. I went back to a study I had found early in my research. This study compared photos to drawings and computer images. The study emphasized that children generally do not pay attention to detail and that they first look for prominent shapes to determine objects. (refer to pg 59) With this in mind, I drew the outline of the objects in Adobe Illustrator then screen dumped them into Macromind to add color. I colored the objects in bright vibrant colors to contrast the screen. If the image was too large for game space , I screen dumped the image into Photoshop to resize. In Photoshop I broke up the images into pieces. The number of pieces corresponded with the number of different letters in each word. For example, eggs has three different letters so the picture was broken into three equal pieces.

In creating the actual stack for Level 1, I started with two cards. The first card is blank but hides a field with the list of cards on it. Each level is programmed to open to the blank card and then randomly pick from the rest of the cards to begin. (refer to pg 60) This assures every game will be

different. Each card has an arrow that randomly takes the user to another card for a new game. (refer to pg 61) The stack keeps track of every card shown by a global container and does not go to any card that has been put in the global. I put a script on each card that set the mistake box to 10, clears out letters at the top and hides appropriate objects. (refer to pg 62) The quit button takes the user back to the opening animation and choices so if they did not really want to quit they can choose the level they were on again.

In addition to the sound on the letters, a script was put on each. Wrong letters, when chosen, uncover the next part of the monster. (refer to pg 63) Correct letters in the word were programmed to show part of the object and the matching letter in the word. When the last letter to complete word is chosen the script plays my voice saying the word. (refer to pg 64) Next, the matching animation is played. In designing animations I wanted to portray the object in actual context. Each animation is fairly short and repeats the word a second time. (refer to pg 65) If the word is not spelled before making 7 mistakes the monster says "You've tried with all your might. Next time I know you'll get it right." After completing all twelve screens the user is asked if they want to go to the next level or quit.

After completing level one I tested the game on six children of appropriate age. The results were very positive with a few minor suggestions. (refer to pg 66) Many children wanted some sort of clue or help. To remedy this I

added a field at the top of the screen to keep track of the letters chosen. This field was supposed to have white letters but the program keep defaulting to black so I made the field pink. (refer to pg 67) By trial and error I finally got the field to hold the white property. At this point I changed the monster's mouth to being a smile because some children and adults felt it was too scary. The mistake box was changed so it would never go below zero. This prevented the user from continuing to play after game was over. Clicking correct letters when game was over will play the animation again. The game seemed to be finished in terms of functionality when changes were implemented. I had to continue finishing the next two levels.

After consulting with my committee, I changed the monster from being uncovered to putting down one of his fingers every time an incorrect letter was chosen. This increased the mistake number to ten which I felt would be better for the users. Restrictions were put on the top field so maximum amount of letters it could hold were 10. By presenting the monster uncovered the curiosity is eliminated so the user will not intentionally choose incorrect letters. In addition if the picture is uncovered by correct choices the uncovering becomes a reward. Therefore it could be assumed uncovering the monster is a reward.

The overall screen design was unbalanced, so I colored the background muted pink. The muted pink color enhanced the dynamic effect of the screen. By changing the

background picture color I had to adjust the pictures.

The next few committee meetings were for further refinement and fine tuning. The following changes were implemented.

-lighten the blue color in Level object on screen
-open spell books faster in beginning animation
-give a clue by showing one letter and one part of picture on each card
-redo yellow picture and change house to a lemon
-incorporate monsters face on stamp instead of flower

Game was finally complete and functioned well. The game can only run at normal speed on an Macintosh II fx. I made some additional adjustments but visually everything remained the same. (refer to pg 67) Upon completion of the entire game I retested it. Responses were all positive and no other suggestions were made. Most of the children did not want to stop playing.

EVALUATION AND PROJECTION

Graphics and Illustrations

I evaluated Monster Spells by the criteria list which I formulated and added more indepth explanations when appropriate. (refer to pg 44) There was a significant amount of information on art for children but not specifically on computer generated design. I applied the information acquired to computer design for children and used this to create the graphics for Monster Spells.

Testing Monster Spells proved successful so I feel the

graphics were appropriate for children and more specifically my targeted age group. I decided to draw the objects myself as opposed to using photos primarily to exercise the full medium. This decision was also influenced by the study of Computer Generated pictures and children. This results of this study proved that a child does not view an entire photograph just the foremost image. The rest of the information is not internalized possibly due to their short attention span. The graphics I designed are original but reflect and mimic their real properties.

In terms of the screen design, the layout is consistent and easy to understand, therefore as a whole complements the game. I am still not sure if the readability of the level object on each screen is effective. I think it completes the screen but is not viewed as information important to the users. The placement may not be the most appropriate. The blank spaces in relation to the frame that holds the picture is not always evenly placed. This is due to the different lengths of the words and was unavoidable. From a design point of view, depending on the length of the word, it appears unbalanced.

The monster is also computer generated. It's colors were chosen to portray the monster as possessing human qualities while keeping its total being imaginary. I feel the pictures of the words complement the screen because they have dynamic brilliant colors, while the screen design is more placid. This keeps the users attention on the pictures

while playing the game.

I choose Helvetica for the type to stay within the realm of the age group. Children 6-9 generally are not yet exposed to serif type and are still polishing up their printing skills. Helvetica is the closet font to the children's educational material. Monster Spells exploits the color potential of the computer extensively.

The color creates interest and curiosity providing a comfortable learning environment. I do not believe that color over stimulates children and tends to confuse their perception as I have read. On the contrary the testing of Monster Spells has proved the opposite in this type of application. The design and layout is consistent throughout the program. Only the words and pictures change with each new game. I feel that the graphic representations of the words are clear and informative, otherwise the game would be to difficult too play. The overall design through testing appeared to be aesthetically pleasing to the children as well as many adults. My only graphic assumption was that to design for children you need to follow all the existing design parameters used for adults, to have an effective outcome. I think Monster Spells captures my assumptions and is enjoyable for people other than the targeted age group.

Computer Software

The object of Monster Spells is to present an aspect of learning in a way that takes the material a step beyond

normal classroom presentation. I feel the aim is met because this program utilizes a combination of many different media present in the computer environment. The educational implications of Monster Spells provide additional stimulus to material presented to further assure it is internalized by the user. The computer environment with its interactive interfaces will become an important asset to our educational system.

Through testing and retesting, Monster Spells has proven its effectiveness as a learning tool. Without implementing the game in an actual classroom lesson, I cannot be sure of its future implications on the user. I can only theorize from my research. In the early stages of the game the navigation was limited, through refinement I feel it was extended to its capacity. The game provides ways of getting to any part of the program quickly including at any point being able to quit the game.

Realism verses non-realism is an important issue for Monster Spells. The concepts are realistic, especially in the animations while the graphics are unrealistic. In this specific application the use computer generated pictures helps retain attention of the user while not jeopardizing the fundamental process of learning. Through watching the children's reaction and gestures I was able to assess that the program was especially significant to the targeted age group.

Monster Spells does not take full advantage of the computers abilities for interaction. The game utilizes the

mouse exclusively fro navigation and control. This is important, but the interface is limited because the user can only navigate the game using the mouse. I feel to implement the full capacity of the medium the user should be able to use the keyboard as well.

The program is free of all grammatical and spelling errors. There is one factual error and that is the ghost ani-mation. The ghost is portrayed floating out of a grave-stone but considering there are no known concrete facts believed universally I used my best description. Monster Spells rewards successfully spelling a word with an animation. If the user cannot spell the word the monster asks the user to continue on and try a new word. I feel the reward is effective because it illustrates an accomplishment which the child reacts to positively.

To run Monster Spells any color Macintosh II will work. The Macintosh II fx has enough power to efficiently run the game at a speed comparable to a video game. The format of the material using spelling words is appropriate because it parallels a popular children's game named Hangman. Hangman has been played for generations.

The colors of the graphics and monster have an eye catching quality that children are attracted to. The sound effects are an important facet to my program because they introduce the user to the program, give directions and reinforce the learning content. Monster Spells incorporates many senses. The game stimulates these senses by the use of

visual effects primarily portrayed through the animations.

CONCLUSION

Throughout my work on this project, I learned and was enlightened by the incredible diversity of computers and education. Several issues I found important were as follows. First, I learned about children and education. This is important because the understanding of children assists me on planned future projects. The use of actually programming every step to each part of the game helped me understand the direction of logic needed to implement the program. I find that programing is a much more tangible skill learned. Finally, actual software design issues trained me to filter all the necessary components from the unnecessary components of the software design.

ENDNOTES

1 Seymour Papert, Mindstorms: Children, Computers and Powerful Ideas, (New York: Basic Books, 1980), VIII.

2 Seymour Papert, Mindstorms: Children, Computers and Powerful Ideas, (New York: Basic Books, 1980), VIII.

3 Seymour Papert, Mindstorms: Children, Computers and Powerful Ideas, (New York: Basic Books, 1980), 4.

4 Tom Synder and Jane Palmer, In Search of the Most Amazing Thing: Children, Education and Computers, (Massachutes: Addison-Wesley Pub., 1986), 109.

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APPENDIX

BRAINSTORMING

child
computer
interactive
surprize
interactive
colors
toys
characters
cartoon
outdoor
platground
swing
slide
animals
kitten
dog
cat
tricycle
clown
bicycle
sand castles
school
smile
candy
tears
cookies
books
playmate
PBJ
expressions
emotions
scrape
cut
scrape knees
treehouse
climbing
detective
sports
eagermess
growing
develope
spirit

parents
grandparent
happy
sad
moon
prayer
stars
sun
love
friends
dolls
trucks
curiosity
exploration
fun
water
beach
dressup
jewerly
hats
balloons
zoo
lollipop
chocolate
gumballs
sneakers
jeans
mittens
snow
snowflake
babysitter
arithemetic
reading
teacher
lunch
cafeteria
flowers
nature
rain
horses
TV
jumprope

poems
stories
monsters
religin
questons
answers
why
peopl
strangs
room
bed
morriors
struggle
fights
brat
creative
library
ponytails
baths
buds
time
timeout
ice cream
jingle
mother
popsicle
man
skateboard
neighbor
family
christmas
easter
halloween
holiday
valentine
paperhearts
lace
adorable
swim
beach
cooking
sandbox

teeter
boats
swimming
pool
raft
waterwings
effort
hyper
rubberduck
mud
taste
sweets
little
bunny
girl
boy
willow
movies
cartoons
day
running
parks
rollerskates
fingerpaints
sneakers
baseball
hot dog
applejacks
oatmeal
excitement
cry
curls
barn
need
support
wild
scared
kool-aid
vacation
camping
cubscotts
clubhouse

camping
cub scotts
brownies
pajamas
wheels
slippers
visit
clubs
racing
casual
fishing
doctors
shot
nurse
cowboy
barettes
barbies
bully
bugs
leaves
bows
spaghetti
cheese
chips
snacks
naps
educating
mouse
monitor
interactive
keyboard
programs
CPU
RAM
ROM
microchip
boards
basic
fortran
cobalt
drawing
spreadsheets

scientific
notations
applications
help menu
startup
shutdown
modem
vax
computer
hard drives
chair
joystick
cursor
color
disk
menu
floppy
storage
access
visual
virtual
hand-eye
coordination
active
spell
apple
grammer
teacher
brightness
develope
design
create
mind
environment
calculations
desk
80/40 MB
32 bit

INITIAL REACTIONS

The Writing Center: a simplified Microsoft Word program, used for writing letters and papers, the program is not laid out real well, hard to follow instructions child is better off using an adult word processing program.

Earthquest: no age level specified, the program is a Hypercard stack with many various links, stack intended for educationl use, very complex, easy to get lost, graphics good but crowded, no instructions.

Kids Time: nice idea but poor execution, educational program, screens very empty in design, not very appealing, no age specified, different sections which are seperate excerises, instructions okay but no help section.

The Printshop: extremely hard to use, seems more appropiate for adults than children, writing program.

Bannermania: a very simple delightful banner making program, no age specified but great for children, easy to follow instructions.

Word Munchers: a game focused on vowel sounds, well designed screens and graphics, sound included, fun and challenging, easy instructions.

Math Blasters: only numbers no graphics, not very effective without pictures, easy directions, interesting reward system for correct answers.

The Playroom: very well done young childrens exploration tool, no words, everything is clickable.

The Oregon Trail: decision making is the object, child learns how to plan, object is to get from one point to another, things happen along the way.

CRITERIA FOR PROGRAM ANALYSIS

Computer Software

1. What is the aim of the program?
2. Educational Implications?
3. Effectiveness in purpose?
4. Level of control?
5. Realism vs. non-realism?
6. Violence vs. non-violence?
7. Is the program simple enough to be used by children of the appropriate age?
8. Does the program take advantage of the interactive qualities of software effectively?
9. Is the program free of grammatical, spelling, and factual errors?
10. Does the program avoid making failure more attractive than success?
11. What type of equipment is needed to use the program?
12. Is the format of the material appropriate for the presentation of content?
13. Will the format appeal to children of the age for which the materials are designed?
14. Are the sound effects and visual effects suitable to the program?

Graphics and Illustrations

1. Are the illustrations or graphics appropriate for the audience?
2. Are they understandable for the age level they are being used for?
3. What type are used (photos, line art, college, other)?
4. Are they stereotyped, average, competent but not original or exceptional in some way?
5. How does the illustration or graphic complement the situation?
6. Are they appropriately placed in relation to the other elements which are portrayed?
7. Is there a unity of text and illustration or graphic?
8. What medium is used?
9. Does the color or medium in any way contribute to the situation?
10. Are they consistent throughout the situation?
11. Are the pictures or elements clear, informative, aesthetically pleasing?

Computer Software

1. The aim of the program is to learn letter sounds and match them up with other words. The program is set up as an educational game.
2. Educationally, I feel the program is very strong. The sounds contained in words are important in recognizing other words. These words can appear in spelling reading and almost anywhere.
3. The program works because while the child plays the game, he/she is constantly repeating the sound to match to other words. Through repetition the words and sounds are reinforced therefore retained.
4. The level of control is strong. At anytime the user can see how many men they have left and their score. There is always the option to Quit or Pause the game. The screen also provides the current level. Every option is readily available at any point of the game.
5. The game has imaginary creatures that are very likable. The user controls a muncher and the bad guys are the troggles. The idea of capturing something without being caught by the bad guys is appealing to children.
6. After completing a level, an animation is played. Each animation portrays a chase between the two characters. Kids really get a kick out of this but I feel the animations are unnecessarily violent. There is enough violence around that kids see and educational games should not portray it.
7. The program was intended for ages 6 and up. These age levels are appropiate for the content of the game. I found in testing this game even adults felt it was a challenge.
8. The program is highly interactive, similiar to a video game. The mouse is the tool used to navagate the muncher. The space bar is pressed to eat a word.
9. The program as far as I can tell is free of grammatical, spelling and factual errors.
10. The program makes failure less attrative by using a low sound anddisplaying a message. The message asks if you want to hear the sound again because the word choosen does not match. When a wrong word is choosen you lose a man. The user has no chance of getting another. If a corect word is choosen the muncher eats it and points are added to your score. If your score beats already played games you can enter your name into the word munchers Hall of Fame.
11. The game uses a Macintosh computer and can be played in black and white or color. This is a nice feature.
12. The material is not in any presented in a familiar.
13. The program was designed for ages 6 and up but through research I found the more appropiate age to be 10 and up. The younger kids really struggled with this game and eventually became frustrated enough to quit.
14. The sound effects and visual effects are suitable to the game in most cases. This is not true when you open game. If you do not choose anything the game automatically defaults to the practice game. The practice game is a pain because there is no way to quit until you finish 4 screens.

Graphics and Illustrations

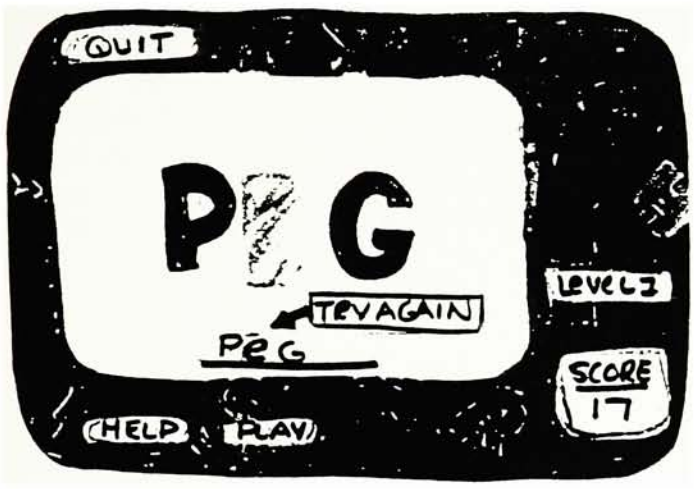
1. I think the characters are very creative fictional beings. They are easy to like.
2. Yes, the graphics are understandable in the games environment.
3. The graphics are computer generated.
4. The characters are definitely original and nicely drawn.
5. The layout and design is aestetically pleasing. The screens are mainly white with black words. This is good for readability. The characters stand out effectively against the rest of the screen.
6. The placement of information is uniform in this game. The amount of men, level and score are placed on the bottom in a row, easy to see while playing the game.
7. The program is very consistent, you know exactly where you are and where you're going. The actual game screen is the same every time you play and at every level. There are no surprises.
8. The color definitely adds to the game but I feel it is still challenging without color. Either version can hold the attention of the user.
9. The graphics are consistent on all the screens. The actual game screen is the same everytime you play and at every level. The beginning screen is easily recognized. It is graphically different but all choices are still available. The "Hall of Fame" screen is designed very differently but this lends to its purpose. If the user does well their score and name gets entered.
10. The pictures and elements are designed very professionally. They look well thought out with children's ideas in mind.
11. I think the designer created these characters with the video game PacMan in mind. A game most children are familiar with. They also assumed that the idea of the chase with, a "good guy" hurting a "bad guy", is appealing to children. These ideas were incorporated into the animations as well as the game's objective. In testing the game, I found the assumputions to be accurate. The overall game is familiar to the user because many of the concepts and parts mimic excisting media material.

Computer Software

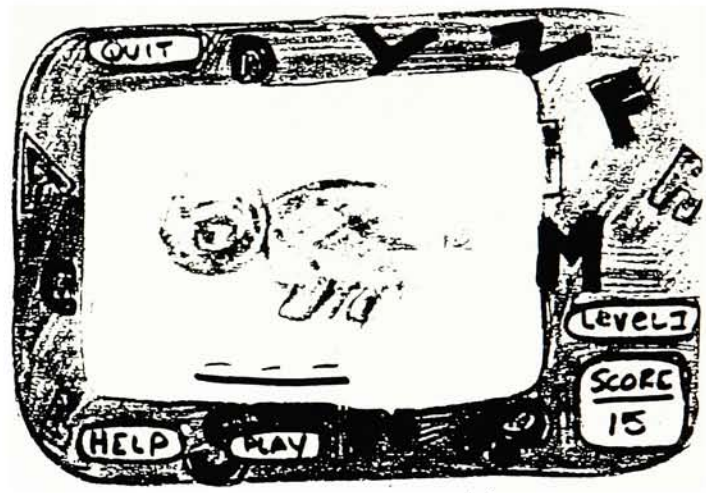
1. The aim of this program is to teach spelling through an adventure in a magic kingdom. This kingdom has many places but user must beware of the wicked witch.
2. Educationally this game is poor. The words that are askedto spell are easier than what the user has to read to play the game. The user is asked to spell the same words again and again even though they were already spelled correctly. The game appears to have many levels all combined into one.
3. I feel because of the above reasons the program is not effective in its purpose.
4. The level of control is poor, eventhough the user is provided a map of the kingdom. There's no indication of where the user has been or where they are going. The user cannot control where they are going because every button goes somewhere that is not necessarily related to the position of the button. For example, a tree button might take you to the castle or a mouse hole button may take you to a kitchen. When the user is asked to spell a word, there is no choice but to spell it or hear it again. Icons for navigation are poorly designed. Even with labels, they are still impossible to figure out. The navigational choices are only available on the first screen. The map of the kingdom has choices but if you go to this card there is no way back to where you came from. This is primarily because there are no labels.
5. The program is a nonrealistic fantasy adventure with elves, castles and witch's. This type of subject matter is appealing to children.
6. Word Quest does not have any violent parts. This is appropiate because the game is an adventure and its for children.
7. The program is to complicated for the targeted age group. The reasons are poor nasvigation, inconsistent levels, unclear directions, complicated icons and the level of the words that are asked to be spelled.
8. The program takes limited advantage of the interactive qualities of hypercard. Buttons are the only form of navigation. Use of key board to type in words is a nice feature. It gives the user a chance to learn the keyboard.
9. The program is free of grammatical, spelling and factual errors but pronunciation is extremely poor.
10. The program attempts to make failure more attractive the success. If a word is spelled wrong the voice says that you missed spelled the word and you can try again later. If a word is correctly spelled a voice says "fine". If it is one of the magic words, a voice says "great". This voice is not very rewarding.
11. The equipment needed is a Macintosh computer either color or black and white.
12. Hypercard is a good program for this type of game.
13. The format of this game would be better if it was executed more professionally. The overall design and presentation is unsuccessful.
14. Sound effects are poorly recorded but definitely relate to the game. The visual effects are very simplistic.

Graphics and Illustrations

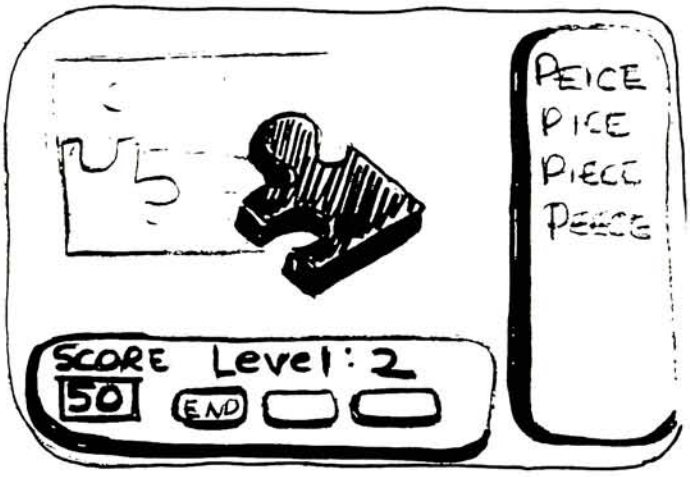
1. The illustrations and graphics are poorly designed. The children, I tested, did not find them appealing because they look like a child drew them.
2. The pictures can easily be identified, if the user knows what a witch, elf and castle are. Most children have been exposed to these subjects before.
3. The artwork was created with the Hypercard tools.
4. The graphics are simple but original in terms of design.
5. The illustrations compliment the program because they relate to the story and the adventure. There are a few objects just thrown in to fillup space. For example, a TV, potted plant andwall hanging these items generally do not exist in this type of story.
6. This question can only be applied to the map and the first screen. Both are designed fairly consistent in terms of relation and space of items.
7. There is unity of the text and the graphic on the first two screens. The text on the others screens is barely recognizable. The type font is not really a good choice because chldren are not familiar with serif type. A san serif type would have been more appropiate for the age group and readability.
8. The program does not utilize color. The graphics do however have graytones. The program can be played on any Macintosh because it is black and white.
9. The graphics are consistent on all the cards because they were abviously drawn by the same person. The first two cards have a different layout.
10. The illustrations are clear but not very informative. The children I tested did not find them pleasing.
11. I feel the designer thought children would prefer simplistic childlike graphics and that they would respond better to them. They developer must have also designed the program to be played by an adult and child because of it's difficulty.



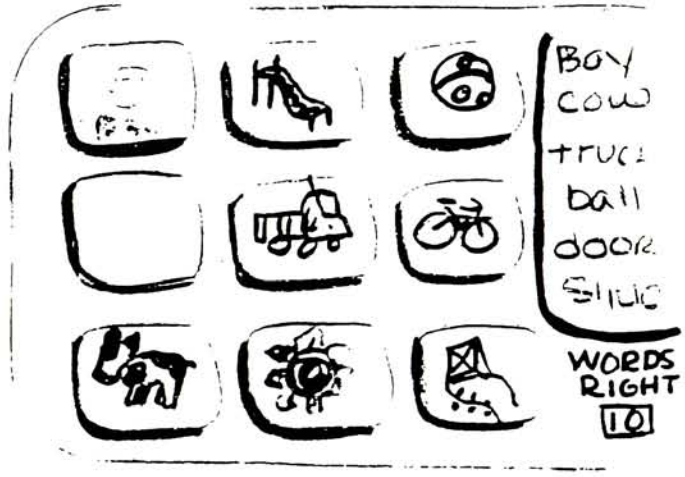
Game 1



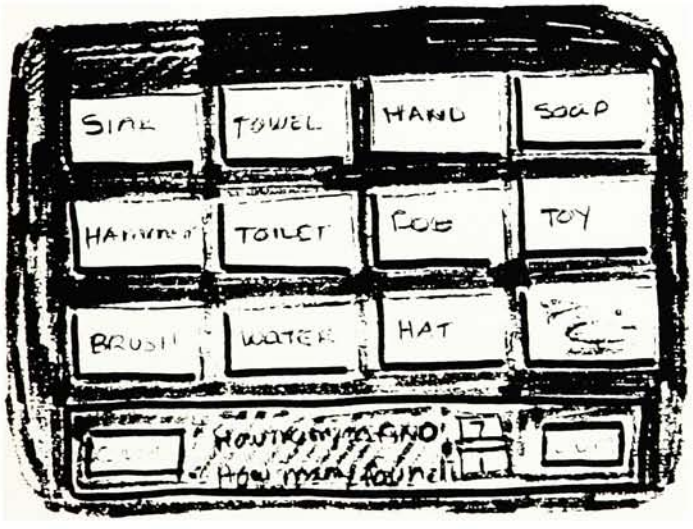
Game 1 - variation



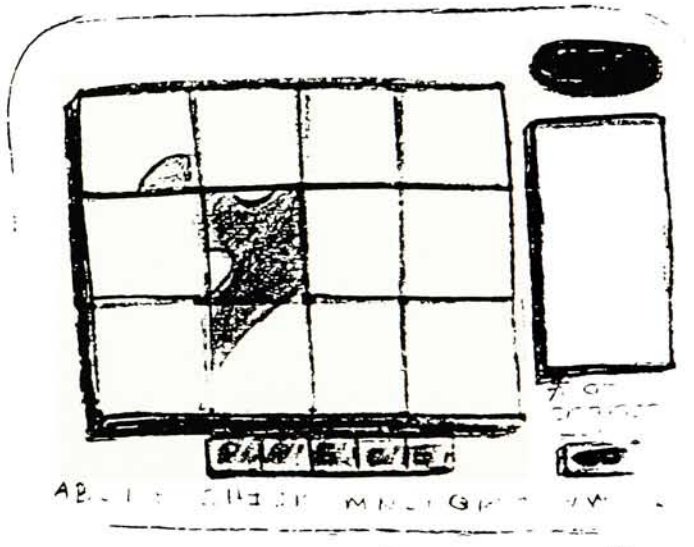
Game 2



Game 3



Game 4



Game 5

Vocabulary

The table labeled *Level B, Bells* contains the 31 new words introduced in *Bells*. The words are listed by page in the order and form in which they first appear. High-frequency words are printed in red. Note, however, that all words introduced at this level are developed to instant recognition.

The table labeled *Cumulative Vocabulary* contains all of the words introduced in Levels A and B. Teachers who wish to devise additional reading exercises will find the cumulative vocabulary list convenient. The words are listed in alphabetical order. Each word introduced in *Bells* is preceded by the number of the page on which it first appears. High-frequency words are printed in red. Note, however, that all words introduced at these levels are developed to instant recognition.

Level B, Bells

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	It
11	
12	
13	get
14	do
15	Bear
16	
17	
18	
19	now
	have
20	Here
	Come
21	in
22	want
23	
24	
25	
26	
27	is
	fun
28	like
	think
29	
30	look
	home
31	did
	What
32	out
33	
34	
35	
36	find
	see
37	cat
38	would
39	
40	the
	good
41	Take
	But
42	
43	Animals
44	too
45	
46	Hat
47	
48	big
49	
50	
51	
52	
53	
54	
55	
56	

Cumulative Vocabulary Levels A-B

	a
43	animal
15	bear
48	big
41	but
	can
37	cat
20	come
31	did
14	do
36	find
27	fun
13	get
	go
40	good
46	hat
19	have
	help
20	here
30	home
	I
21	in
27	is
10	it
28	like
30	look
	not
19	now
32	out
36	see
41	take
40	the
28	think
	to
44	too
22	want
	we
31	what
	will
38	would
	you

Vocabulary

The following table contains the 38 new words introduced in Level C, *Drums*. The words are listed by page in the order and form in which they first appear. High-frequency words are printed in red. Note, however, that all words introduced at this level are developed to instant recognition.

Level C, Drums

1		25	my
2			day
3		26	Fox
4	me	27	need
	Turtle		tail
5	for	28	
	Rabbit	29	
6	this	30	
7		31	
8		32	Surprise
9		33	Mother
10		34	at
11			with
12		35	that
13	work	36	Some
	are		may
14	your	37	tell
15		38	more
16	where	39	
	little	40	
17	and	41	
18	be	42	
	OK	43	
19		44	
20		45	
21		46	Lunch
22	Kite	47	frog
23	Pig		red
	fly	48	
24	make	49	Yes
	friend	50	
51		54	soup
52	No	55	
53		56	

The following table labeled *Cumulative Vocabulary* contains all of the words introduced in Levels A through C. Teachers who wish to devise additional reading exercises will find this cumulative vocabulary list convenient. The words are listed in alphabetical order. Each word introduced in *Drums* is preceded by the number of the page on which it first appears. High-frequency words are printed in red. Note, however, that all words introduced at these levels are developed to instant recognition.

Cumulative Vocabulary Levels A–C

	a		get
17	and		go
	animal		good
13	are		hat
34	at		have
18	be		help
	bear		here
	big		home
	but		I
	can		in
	cat		is
	come		it
25	day	22	kite
	did		like
	do	16	little
	find		look
23	fly	46	lunch
5	for	24	make
26	fox	36	may
24	friend	4	me
47	frog	38	more
	fun	33	mother

25	my
27	need
52	no
	not
	now
18	OK
	out
23	pig
5	rabbit
47	red
	see
36	some
54	soup
32	surprise
27	tail
	take
37	tell
35	that
	the
	think
6	this
	to
	too
4	turtle
	want
	we
	what
16	where
	will
34	with
13	work
	would
49	yes
	you
14	your

Vocabulary

The following table contains the 51 new words introduced in Level D, *Trumpets*. The words are listed by page in the order and form in which they first appear. High-frequency words are printed in red. Note, however, that all words introduced at this level are developed to instant recognition.

Level D, Trumpets

1		28	one
2			all
3	Bed	29	school
4	Father	30	
	book	31	
5		32	Rest
6	on	33	hard
7	thing	34	Try
8	There	35	nice
9			Thank
10		36	play
11		37	sing
12	Pencil	38	They
13	smart		Stop
	show	39	read
14	put	40	
	am	41	
15	best	42	She
16	nose		He
	place	43	Pet
17	jump	44	please
18	don't	45	Why
19			any
20		46	run
21	forget	47	Mrs.
22		48	
23		49	fish
24	Oh	50	
	time	51	
25	bring	52	ROBOT
	tomorrow	53	
26	box	54	
27	Today	55	Mr.
		56	Duck
		57	
		58	much
		59	
		60	
		61	
		62	how
			word
		63	
		64	

The following table contains all of the words introduced in Levels A through D. Teachers who wish to devise additional reading exercises will find this cumulative vocabulary list convenient. The words are listed in alphabetical order. Each word introduced in *Trumpets* is preceded by the number of the page on which it first appears. High-frequency words are printed in red. Note, however, that all words introduced at these levels are developed to instant recognition.

Cumulative Vocabulary Levels A–D

	a		do
28	all	18	don't
14	am	56	duck
	and	4	father
	animal		find
45	any	49	fish
	are		fly
	at		for
	be	21	forget
	bear		fox
3	bed		friend
15	best		frog
	big		fun
4	book		get
26	box		go
25	bring		good
	but	33	hard
	can		hat
	cat		have
	come	42	he
	day		help
	did		here

home
62 how
I
in
is
it
17 jump
kite
like
little
look
lunch
make
may
me
more
mother
55 Mr.
47 Mrs.
58 much
my
need
35 nice
no
16 nose
not
now
24 oh
OK
6 on
28 one
out
12 pencil
43 pet
pig
16 place
36 play
44 please
14 put
rabbit
39 read
red
32 rest
52 robot
46 run
29 school
see
42 she
13 show
37 sing
13 smart
some
soup
38 stop
surprise
tail
take
tell
35 thank
that
the
8 there
38 they
7 thing
think
this
24 time
to
27 today
25 tomorrow
too
34 try
turtle
want
we
what
where
45 why
will
with
62 word
work
would
yes
you
your

Vocabulary
Level E, Parades

In the following table, the number beside each word is the page on which the word first occurs in *Parades*. High-frequency words are printed in red.

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	Dog
	So
14	sleep
	night
15	up
16	
17	when
18	way
19	Hen
20	
21	
22	
23	
24	Idea
25	room
	us
26	let
	story
27	house
	tree
28	Then
	an
29	dad
	ask
30	
31	
32	down
33	our
34	Name
35	
36	Say
	said
37	
38	swim
39	
40	bread
	Who
41	wheat
	plant
42	myself
43	grew
44	cut
	Well
45	pound
46	mill
	flour
47	
48	eat
49	
50	was
	about
51	pictures
52	
53	Bake
54	mix
	dough
55	keep
	Soon
56	
57	Which
	Start
58	walk
	Count
59	
60	orange
61	sandwich
62	juice
63	jar
	went
64	coat
65	
	call
66	
100	silly
67	
101	
68	
102	ran
69	of
103	boys
70	
104	
71	
105	
72	made
106	saw
	kind
	him
73	
107	found
74	
	were
75	
108	hot
76	
109	
77	
110	
78	Sale
111	
	live
112	know
79	his
	many
	sign
113	
80	came
114	Hungry
	paint
115	Once
81	store
	pond
	new
116	breakfast
82	back
	thought
	had
117	table
83	window
	Wait
84	around
118	
85	fence
119	
86	
120	after
87	
	plate
88	
121	
89	Draw
122	supper
90	
123	tablecloth
91	while
124	
92	street
125	
93	these
126	
	other
127	
94	
128	goes
95	two
129	
96	brown
130	Vowels
97	movies
	sounds
	money
	short
98	If
	long
	over
131	each
99	could
	listen

132
133 give
134 Key
lost
135 her
136 by
sat
137 pushed
still
138 gave
139
140
141 kitchen
142 biscuits
roll
143
144
145 fell
146
147 again
148
149 does
150 problem
151
152
153
154
155
156 Miss
157 children
decide
158
159 sick
cards
160 poem
161
162
163
164
165
166 feel
them
167
168
169 Cubs
cute
170 their
171
172
173 three
174 Five
175 dark
176 Four
177 only
Boohoo
178 every
179 crying
180
181 nothing
182
183
184
185
186 Happen
next
187 boat
worms
188 both
189 line
190 teddy bear
191
192 sister
193
194
195 laugh
won't
196
197 stories
ghost
198 Very
199
200 family
201
202 tight
203
204 got
205 scare
scary
206
207
208
209
210
211
212 has
213
214
215
216 or
217
218
219
220

Vocabulary
Level F, Carousels

In the following table, the number beside each word is the page on which the word first occurs in *Carousels*. High-frequency words are printed in red.

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	library
13	brother
14	told
15	last
16	
17	water
	raining
18	
19	Mouse
20	woman
	skates
21	
22	
23	first
24	
25	alphabetical
	order
	alphabet
	letters
26	signs
	row
27	None
28	use
29	Special
30	authors
31	should
32	librarian
	mark
33	Write
34	Mile
	Race
35	Goose
	rocks
36	hop
37	shouted
	finish
38	Owl
	ready
39	win
40	warm
41	slowing
42	
43	
44	hill
	fast
45	
46	
47	
48	
49	knew
	ever
50	sentences
	Map
	before
51	
52	Opposites
53	Sports
	games
	ball
54	report
	important
55	great
	took
56	
57	held
58	bat
59	hit
60	talk
61	
62	
63	
64	felt
65	
66	move
67	away
68	
69	share
70	
71	from
72	Dear
	Love
73	drew
	wrote
74	must
75	
76	tadpoles
77	
78	
79	
80	believe
81	
82	
83	
84	
85	
86	
87	
88	Garden
89	flower
90	just
	prize
91	As
92	right
	mess
93	even
94	
95	
96	
97	
98	
99	colors
100	Meaning
	than
101	Yam
	grow
102	stick
103	part
104	
105	
106	Stamp
107	detective
	dinosaur
108	case
109	note
	sticky
110	lick
	side
111	left
	same
112	
113	leave
114	head
115	smile
116	
117	
118	puddles
119	happy
120	been
121	wet
122	
123	shoe
	off
124	slippers
125	
126	
127	
128	
129	
130	different
	Save
131	
132	Main
	sail
	Most
133	
134	pens
	yellow

135 feeds
136 Pine
Second
Goat
Wind
Man
Fairy
137 sad
sorry
138 better
blow
139 pretty
140 tonight
141 needles
142
143 Hello
144 ate
145 morning
146
147 glass
148
149 break
150 broke
gold
151
152 food
153 wish
154
155
156
157
158
159
160
161
162
163
164
165
166 shy
167 teacher
shake
168
169 umbrella
blue
170 shook
171 grasshopper
holes
172 girls
173
174 woods
175
176
177
178
179
180 hand
front
181 west
182
183
184
185
186
187
188 Monster
cave
189 ugly
190 lovely
191
192
193 People
194 hide
under
195 never
196 deal
197 sure
198 open
199
200
201
202 Describing
203 ground
204 birds
295 squirrel
206 Moles
207
208 fixed
Grandpa
209 Nobody
210 Mom
hold
pulled
211 ears
dirty
212 mind
213 stuffing
214 flat
wrinkled
215 scrubbed
legs
arms
216
217
218
219
220
221 hug
222
223
224 chicken
225 sense
226 also
227
228 Caps
wears
229
230 old
top
231
232
233
234 monkeys
235
236
237 foot
238 angry
threw
239
240
241
242
243
244
245
246
247
248

Vocabulary
Level G, Adventures

The number before each word gives the page on which the word first occurs. Following is a list of words introduced in *Adventures*. High-frequency words are printed in red.

1
2
3
4
5
6
7
8
9
10
11
12
13 job
stared
shirt
14 subtraction
15 bus
seats
16 mumps
captain
baseball
17 airplanes
mine
18 stay
understand
19 change
enough
20 choose
pretend
21
22 terrible
23 kick
24 tin
25 picked
26 vegetables
27 pants
eggs
napkin
28 Dr.
29 fruits
turned
learn
slowly
30 spaghetti
shoelace
rubber
heel
31 evening
32 dump
33 tires
violin
car
34 hope
35 moaned
groaned
36 end
might
37 pairs
below
alike
list
dinner
38 conclusions
figure
elephants
shelf
finally
weeks
39 probably
though
40 fills
seeds
gone
glad
tall
later
instead
41 true
skill
summary
remember
42 farola
lanterns
light
43 owned
closed
parade
dancing
costumes
44 candle
45 expected
wondered
46 arrived
songs
47 smell
fresh
laughter
48 together
join
waved
groups
49 farther
sudden
crowd
50 shoulders
51
52 done
53 feet
mouth
54 suppose
clown
hair
clearer
55 above
huge
56
57 greenhouse
veterinarian
care
zoo
58 computers
programmer
set
directions
59 sells
musical
instrument
hear
music
60 person
61
62 summarizing
causes
else
page
63 ant
cornfield
carrying
sit
winter
such
64 sun
65 cheese
piece
heard
wonderful
66
67
68 fine
69 quite
few
70 path
afraid
71 alone
shine
fall
72
73 sang
74 shall
frightened
asleep
wake
75
76 meant
magic
77
78 until
79 favorite

80
81
82
83
84 balancing
85 wheelchair
crutches
careful
86 blocks
ten
easy
87 tower
88 principal
carnival
89 pay
cheered
90 space
dominoes
between
91 curves
watched
act
92 caught
93
94 click
95 plastic
96 oldest
gather
97 hundred
98
99
100 example
those
102 world
sizes
tiny
103 tallest
giraffe
land
neck
104 weigh
sixty
herds
thousand
105 whale
shark
gentle
small
106 sea
seven
breathe
107 pictograph
108 exactly
109 heavy
black
almost
110 pails
village
stuck
111 edge
112 tide
promise
die
113
114 touched
hurt
115 lifted
throw
116 toward
covered
117 swam
118 able
119
120
121
122 six
bathroom
123 leather
spread
butter
124 stomped
tub
chick
125 hid
126 snow
127 dreamed
128 rope
tie
129 string
~~photograph~~
through
130 faint
131 spent
nine
132
133 earth
city
neighborhood
134 rivers
symbols
135 point
north
south
east
compass
rose
136 answer
park
137 code
138 yard
139 meeting
secret
agents
barked
140
141 paper
message
clue
invisible
142 milk
143
144 followed
across
145 digging
146
147
148
149 mirror
150 club
lots
151 send
152 belong
153
154 written
copy
155 print
156
157 number
158
159 referents
themselves
160 bought
brought
161 several
quickly
162 apartment
163 dollars
164 turnip
doorstep
165
166 cold
gobbled
perhaps
167 potato
168 cabbage
trotting
169
170 sill
171 beautiful
172 hurried
173
174
175 imagine
176 characters
177
178
179
180
181
182 hero
business
183 corner
questions
184 okay
rake
185 brave
fire
engine
trouble
firefighter
186 board
pinned
187 thief
catch
188 danger
189
190 bills
191 empty
192 bunch
193 doctor
194 whom
195 common
syllables
often
already
cross
196 added
197 because
always

199 elves
200 seemed
poorer
201 shop
202 price
203 sir
buy
coins
204 afternoon
205
206 daughter
eight
207
208 rich
slip
209 behind
midnight
lose
210 sewed
glued
211
212
213
214 yesterday
215
216
217 birthday
bicycle
218 cost
ninety
219 roller
spun
guess
paid
220 kid
221 softball
teams
town
tickets
222 rode
223 really
224 umpire
inning
225
226
227
228 travel
transportation
229 near
far
drive
train
230 subway
tunnels
monorail
rail
busy
231 jet
airports
232 helicopter
straight
rocket
astronauts
chance
233 large
sky
234 effect
235 usually
white
worse
236 minutes
237
238 hamster
hunt
nocturnal
239
240 cage
wire
wall
241 fed
cleaned
242 slid
floor
243 fit
244 began
wastebaskets
lettuce
245 pile
leaned
traps
climb
246
247
248 quiet
nocturne
awakened
249 poking
250
251 accident
252
253
254
255
256 solved
match
257
258 pocket
kangaroos
259
260 tears
face
ride
261
262 course
263 bent
manage
bump
264 baby
forest
265 lions
266
267
268
269
270 eyes
apron
tools
271
272 popped
whole
273
274 wife
275
276
277
278
279
280
281
282
283
284
285
286
287
288

Vocabulary
Level H, Discoveries

In the following table, the number before each word gives the page on which the word first occurs in *Discoveries*. High-frequency words are printed in red.

1
2
3
4
5
6
7
8
9
10
11
12
13 visit
sofa
14
15 class
16 spelling
country
raise
17
18
19 against
whispered
20 speak
louder
yet
21 dropped
22 medium
23 tooth
high
24 gathered
25 hi
26
27
28 low
29
30 kittens
purred
31
32 sniffed
fur
stood
wagged
33 enjoy
34 trade
35 stroller
hang
36 sprinkler
offered
37 stairs
ham
38 summer
circling
whistled
39 radish
40 porch
harmonica
41 ambulance
hospital
42 cowboy
43 rust
44 dry
carrot
45
46
47 extra
48 year
life
49 born
stronger
50 skip
young
teenager
career
51 complete
college
prepare
adult
interested
52 retire
develop
hobbies
53 since
during
54 materials
55
56 tape
crayons
lid
57 punch
58
59 twenty-five
party
invite
early
parents
bowling
60 phone
ring
cook
vacation
tamales
61 meat
pots
62 truck
tent
63
64
65 bad
announcement
led
past
66 reached
microphone
camera
lead
67
68 invitation
include
date
mention
69 strips
decorate
lay
center
70
71 active
safe
enemy
raccoon
farmers
mask
72 possum
insects
dead
73 crops
74 full
75 nest
chart
76 plan
77
78
79 cupboards
sighed
80 cousin
81
82 wing
bottom
83
84 hammer
nails
85 stump
voice
86 proudly
present
87 building
fact
88 admired
89 celebrate
delighted
90
91
92
93
94
95 selection
title
96

97
98
99
100 storm
island
101 ferryman
shack
102 dock
seagulls
beach
choppy
103 grabbed
pirates
bury
treasure
clouds
104 blew
sand
105
106 blown
power
107 blankets
hamburgers
tasted
108 tracks
woke
109 packed
dunes
110 washed
111
112 rang
bell
wrong
weather
113
114
115
116 information
organize
related
117 students
tag
118 primary
119 study
cycle
arrow
bits
lakes
120 poster
121 lesson
compare
122 fog
breeze
123 vapor
float
124 drinking
flood
overflowing
area
damage
drifts
125 thunderstorm
lightning
flash
noise
tornado
shape
funnel
spins
roofs
126 forecasters
warn
127 record
128 princess
rule
kingdom
king
queen
129 mountain
130
131 argue
castle
balcony
welcome
132
133 test
134 stream
charge
135 built
dug
136
137 defend
knocked
138 tossed
bag
kept
139 sent
140
141
142
143
144 stones
145
146 bowl
147 canyon
148 star
hole-for-smoke
hogan
sheepskin
stretched
pan
slap
piñon
149 bright
150 kneeling
thin
fingers
gate
151 trail
mesa
152 horns
153 snake
154 graze
155 among
mud
doll
cradleboard
156 deep
logs
bracelets
157
158 weaving
rug
loom
wagon
159 corral
160
161 lap
162
163
164
165
166
167 drove
won
168
169 correct
170 tangled
bramble
bush
171
172 yelling
dress
173 kindhearted
knife
free
robin
disappeared
strawberry
million
174
175 horses
176
177 barns
hitched
bundle
178 sink
sank
179 reins
180
181
182 clods
haystacks
tipped
183
184
185
186
187 tongue
twister
pudding
188 received
189 bean
190
191
192
193
194
195
196 proper
knit
197 plum
198 breath
sip
199 classmates
mayor
rice
moment
200 exciting
201 slumped

202 station
203 high-speed
explained
204 laid
205 nodded
206 glide
sled
ice
207
208
209
210 tramped
strange
silence
inch
211 spot
boots
212 searched
attention
213 conductors
bowed
214 passengers
215 wide
folded
dining
216 shut
217
218 shaggy
219 excused
honor
famous
220 springtime
221 calmly
222
223
224
225
226 context
227
228
229
230
231 mail
hall
232 uncle
trip
suit
233
234 certain
235
236 gurgled
237 picnic
238
239
240 wiped
241
242 giant
tantrums
243 snowflakes
244 roared
whirled
245 fists
bounced
puckered
lips
246 sharply
slurping
temper
247 earthquake
police
chief
248
249 knees
begged
manners
250
251
252 distance
253
254 reason
255
256
257
258 third
259 indeed
260 fair
261 toys
262 merry-go-round
folks
263 eleven
264 starving
bench
265 screwdriver
wrench
266 aim
bolt
strength
hood
rags
267
268 roadtest
repair
269
270 radio
271 middle
272
273 crashed
274 communities
provides
services
departments
urban
rural
275
276
277 theaters
museums
art
history
science
rodeos
278
279
280
281 contents
chose
282 cabin
moccasins
quilt
carve
283
284 dish
spoon
valley
met
285 difficult
286 crafts
sold
287
288 moon
289 backward
290 replied
291
292
293 notice
294
295
296
297 shade
cool
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
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315
316
317
318
319

Vocabulary
Level J, Caravans

In the following table, the number before each word gives the page on which the word first occurs in *Caravans*. High-frequency words are printed in red. Glossary words appear in italic type.

1
2
3
4
5
6
7
8
9
10
11
12 thumb
mysteriously
agency
13 ad
wiggled
14 mystery
15 suspect
flea
market
stolen
identified
positive
identification
proof
twice
shrugged
bodyguards
floppy-looking
startled
embarassing
thirsty
16 yarn
17
18 check
disguise
perfect
19
20 suspicion
officer
21
22 evidence
clothes
prove
thrown
shedding
23 worth
24 hire
tore
25
26 stallion
strayed
surrounded
wild
rescue
27 adventure
settle
drawn
mare
faithfully
sacks
cornmeal
28 quarrel
mustangs
rushed
galloped
sight
29 men
30 stripes
nibble
eagerness
nipped
screamed
loosen
pranced
whinnied
swished
mane
teeth
motion
31
smooth
32
violets
33 coyote
curled
sparkled
nasty
34 tugged
hoofbeats
collar
nuzzled
35 roamed
plains
36 spend
37 wandered
description
38 similar
whose
steer
boldface
type
39 tame
ashamed
behavior
40 meadow
banister
41
42 sculpture
clay
pleasant
expert
sloop
observed
capsize
compose
43
44 blind
45 curtains
burrow
exercises
bending
banging
46 frying
toast
worn
peonies
carnations
marigolds
47 clock
48 o'clock
dollop
jam
cello
35 tunes
sternly
imitating
49 splinters
50 gutter
cheeks
51
52 riverbank
patch
conk-a-ree
53 spice
tea
honkers
flock
geese
54 pours
burns
dots
trunk
apple
television
kiss
55
56 chain
lie
creaking
rustling
57
58 paragraph
59
60 sensory
images
nuts
61

62 clever
63
64 teakettle
65 steeper
howls
66 split
women
serve
son-in-law
trembled
67
68 beaten
single
pancakes
brag
69 salt
rise
iron
skillets
bite
handle
nightgown
bonnet
oven
70 nonsense
71 offstage
sweetly
72 bare
73
74 loaves
shamrocks
ruined
toothache
jaw
75 loaf
squeeze
taught
76 lucky
77 fooled
difference
78
79
80 glossary
ketch
dictionary
81 entry
masts
poles
support
locating
whether
82 guide
appears
improve
83 ***attic***
gosling
wail
gazed
84 skeletons
scientists
bones
85 enormous
continent
extinct
fossils
diary
remains
rotting
crumbling
preserved
discovery
quarry
cliff
steep
86 drilled
blasted
chip
brush
87 draftsperson
position
tissue
88 half-buried
plaster cast
crates
89 frame
metal
fiber
months
90 original
91 hours
92 site
93
94
95
96 ***wisdom***
tale
peasant
greedy
moneylender
hated
loans
interest
rates
98 ***peered***
cottage
cart
accounts
widow
collect
rubles
owe
silver
husband
master's
purse
99 ***plump***
gander
100 ***insist***
worry
ticked
shadows
woolens
heat
stove
slept
wise
101 cereal
cloak
tucked
pie
repeat
especially
thick
company
lonely
wolf
102 narrow
wares
chanted
fowl
brooms
unhook
brass
snapped
103
104 ***recited***
sneered
journey
accept
child's
due
root
105 scornfully
spoke
pink
squeal
106 rays
loaded
107 filtered
chased
skirts
108 ***grain***
riddle
109 debt
110 judge
dust
court
111
112
113 litter
114
115 scratching
thirty
flew
rage
116 wit
relatives
cream
joy
blossom
fortune
117
118 decision
agree
119 fat
delivering
120 categories
121 ***champion***
escape
minnow
net
122
123
124
125
126
127 ashes
mattress
128 aunts
burro

129 swung
forth
frowned
indian
130 dashed
alarmed
rattlesnake
131 ***relief***
132
133 clink
struck
mist
trust
134 ***scold***
135 peeked
136 peel
cornstalks
137 chipmunk
138
139
140
141
142 occasion
143
144 language
goldsmith
145 tailor
146 practiced
147 spilling
148 ***chat***
recess
149 ***current***
scene
150 matter
grumpy
mood
151 ***muffler***
bother
rude
actually
152 complaining
exclaimed
fond
continued
spirits
grouch
pause
153
154 ***tuba***
tambourine

grateful
tiptoed
puffed
tapped
155 ***impressed***
paws
growled
awful
promptly
appreciate
156 snack
honey
157
158
159 ***conversation***
determined
munching
twelve
dozen
160 ***splendid***
161 fever
passed
amusement
162
163 Ferris
grumbled
164 ***discouraged***
165 leaf
yawn
polite
plopped
166
167 ***impossible***
huffing
snore
168 ***hibernate***
169
170
171
172 multiple
173
174
175 shone
marsh
ribbons
weeds
hung
calf
awkwardly
hump

176 ***waded***
beaver
chewed
dam
177 skunks
bugs
splashed
178 creeping
179 whack
branch
crept
attack
leaped
hooves
180
181 calves
butted
protect
stinging
182
183
184
185
186 survey
article
chapter
subject
187 captions
188 chest
camps
grizzly
flecked
189 blending
190
191 ***ripe***
192 dragging
anchoring
193 cob
woodchuck
den
compartments
194
195 ***rodents***
196 twigs
grayish
197 swamps
shoots
feathers
frozen
198 jays

woodpeckers
beaks
migration
monarch
199 ***survive***
divide
sections
200 gift
201 stool
wedding
forward
closet
202
203 pillow
attached
handkerchief
admiringly
204 wrist
206 sleeves
207
208 simply
stroked
209 ***blurted***
responsibility
210 sniffling
211
212 disappointed
213 incomplete
214 stew
advice
royal
quit
recipe
soldiers
215
216 tennis
appetite
banquet
affected
resented
217 ***majesty***
available
218 contest
proclamations
posted
clamoring
219
220 formed
wound

drawbridge
courtyard
throne
interviewing
seventy
shabby
trudging
elbows
bedraggled
grin
palace
221 sort

223 glum
considered
fellow
rare
gasped
ordinary
roast
applesauce
224 ***innocently***
suggestions
sliced
stirred
bubbling
225 pork
226 horrified
beamed
marched
trickled
kill
accusingly
captured
227
228 depended
rid
soak
vinegar
simmer
onions
229 anxious
steaming
chunks
allow
assistant
230
231 gravy-stained
beef
task

lit

233 terrified
234 fanciful
235
236
237
238
239
240 flag
241 state
mission
dormitories
dipper
united
scattered
242 ***salmon***
delicious
243 ***parka***
jacket
mukluks
mittens
white-and-twinkly
fleet
ships
design
holidays
244 ***glaciers***
future
union
245
246 sleigh
melt
mend
season
247 capital
lumber
248 uniforms
baton
twirlers
249 ***official***
250
251 bar
graph
252
253 ***slender***
swoop
double
blur
gleaming

blades
performed
254 chilly
hint
gradually
packages
pasted
255 contained
sweater
rip
256 old-fashioned
hockey
ankles
blunt
257
258 wobbled
unsteady
259 ***impatiently***
260 teased
ripples
cracks
further
firmly
261 swaying
instructed
262
263
264
265 scraping
recognize
scarf
puzzled
knelt
266 relax
267 ***shifted***
neat
entire
whipped
halt
268 skidded
realized
269 lady
briefly
270 ***natural***
271
272 experience
273
274 pajamas
275 giggles
276 comics

277 elf
creatures
278
279 triceratops
tyrannosaurus
trachodon
280 oak
ocean
shore
281 pale
autumn
282 swift-flowing
283 forced
molds
mushrooms
sow bugs
damp
crawled
284 ***bass***
swallowed
factories
285 smashed
terns
286 ***barnacles***
mussels
oysters
287
288 beetles
gnawed
289 rat
scurried
beachcombers
gnarled
polishing
290
291 peaceful
label
details
292
293
294 cattle
295 bred
remarkable
dawn
nudged
296 grunted
ranchers
chuck
bacon
297 shot

boss
plenty
scraps
298 strung
shivered
tumbleweeds
crunched
clumps
299
300 ***plunged***
stumbled
301 boomed
stampede
302 electricity
sparks
brim
303 slicker
saddle
sleet
freeze
worst
304 clang
305
306
307
308 compound
displayed
309 separate
blanks
partner
310 ***opinion***
statement
311
312
313 reptiles
314 rooster
315 university
arrangement
basset hound
parrot
strutting
intelligent
dignified
cocked
uttered
squawking
316 unlatched
immediately
shrill
ceremonial

317 bitter
drank
318 scarcely
disturbing
crowing
groom
319
320 limits
321 carton
smothered
322 murmured
fricassee
323 ***feature***
reviews
urgent
324 mistake
325 custodian
326 creek
telephone
327
328 relieved
fuss
farewell
screeched
329
330 solution
331 phrases
332
333
334 producing
335 ***source***
least
336 machines
337 assigning
editor
video display terminal
338 issue
topic
persuade
339 press
belt
340 routes
341
342
343
344 column
345
346 granted
elder

347
348 huts
seeking
patiently
humble
cane
349 ***radiantly***
350 commanded
reward
vanished
351 ***embraced***
furnishings
servants
bidding
352 carriage
attended
warriors
clod
armor
magnificent
prince
nobles
353 ***dwelt***
robes
velvet
peacocks
pleasure
354 respectfully
snatched
355
356 shelter
weak
dales
wilt
heavens
blazing
357 huddled
fearful
hailstones
blotted
358 fifth
359 fled
budge
nor
torrents
360 ***fragrant***
mossy
silent
361 mercy
emperor's

362 spare
363 ***beseech***
364 wept
pity
entreats
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383

Vocabulary

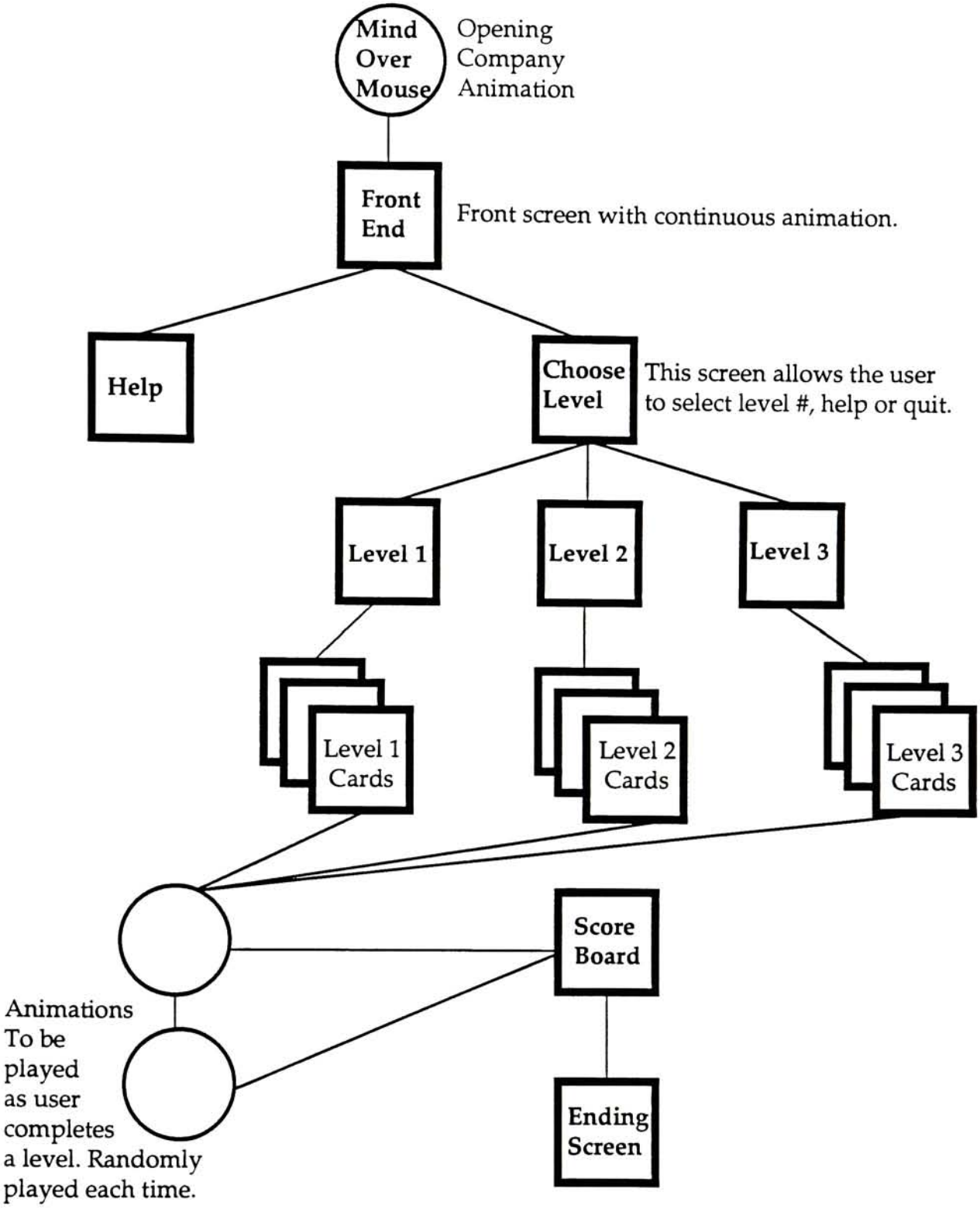
Journeys

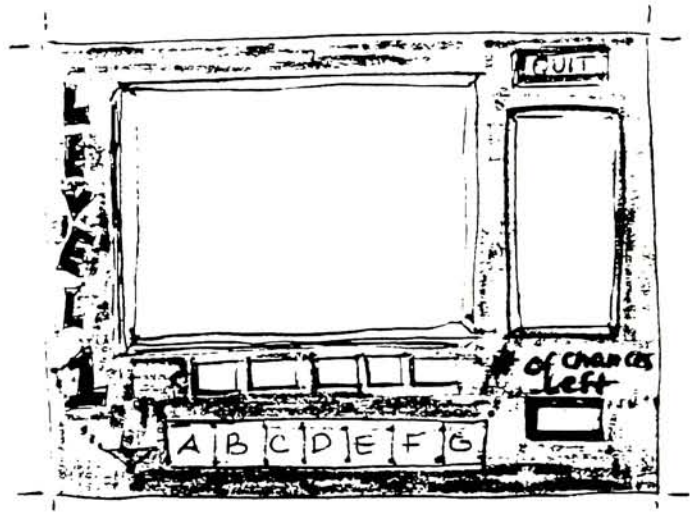
Listed below are the High-Frequency words and Selection words that appear on the Unit Overviews for *Journeys*. Preceding each word is the number of the page on which that word first appears. High-Frequency words are printed in red. Glossary words appear in italic type.

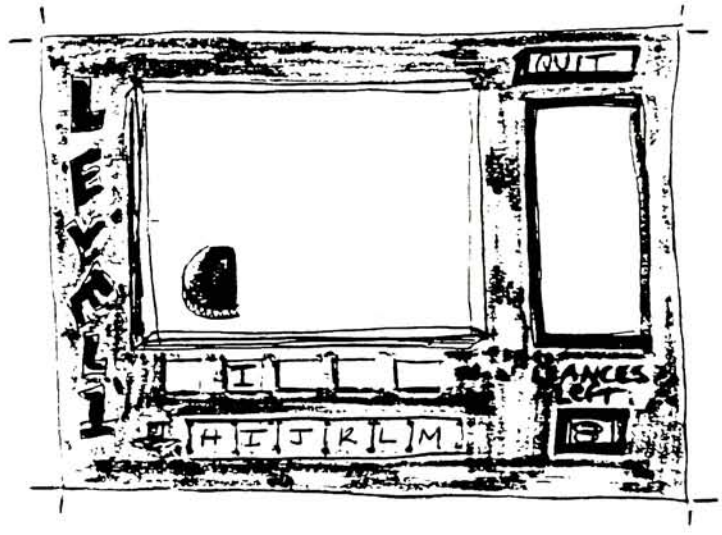
22 aboard
85 accidents
60 ache
23[illegible] acorn
8[illegible] actors
1[illegible] additional
39 address
28[illegible] adds
16[illegible] admire
2[illegible] advance
39 advanced
24[illegible] advised
3[illegible] ages
33 alert
2[illegible] *ambassador*
233 amount
10[illegible] angriness
2[illegible] ants
12[illegible] anxiously
325 appearance
148 appetites
207 apply
63 *arena*
24[illegible] aroma
73 arranged
213 artist
235 ash
122 *astonished*
20[illegible] attempts
336 attendants
87 auditorium
38 *automated*
68 *automatically*
46 automobiles
60 *avoid*
66 ballerina
67 ballet
336 *bamboos*
330 banks
296 bargain
333 *barges*
68 barking
144 *baron*
68 barre
228 basic
330 basin
201 bats
146 battle
183 bay
215 beaches
183 beak
95 beard
338 beauty
176 behaved
35 belts
156 bewildered
129 *bewilderment*
235 birch
203 bird's
229 blacken
97 blame
233 blocking
217 bloomed
259 *bluffs*
80 bodies
85 boiling
332 *border*
344 borrowed
231 boxcars
342 bravely
169 breaks
274 breathless
183 brief
114 brittle
298 browsing
329 bubble
318 *bumpers*
32 burglars
239 burlap
236 burr
218 *bushels*
95 *bustling*
168 buzzer
261 cactus
244 café
54 caked
115 calendar
216 camel
326 camels
36 canceled
237 canoes
331 canyons
361 carelessly
287 carrier
294 cartons
312 casually
218 *catalogs*
102 causes
332 caverns
294 ceiling
320 *celebration*
292 cement
145 chambers
115 chased
244 chatting
165 cherry
106 chin
203 chirp
45 chosen
312 chuckled
156 clamor
165 clap
145 clash
74 classes
308 closest
333 coal
189 coast
189 coconut
300 *coincidence*
32 collie
78 communicate
100 completely
226 completion
189 concerned
359 condensed
168 *conscientious*
215 *conservatory*
60 consonant
148 constant
363 *convenient*
365 *cork*
60 correctly
316 *couch*
115 courage
102 *cozy*
333 create
153 creature
203 crickets
311 cries
260 *crisscrossed*
248 crop
260 cross-legged
32 crossing
361 crossly
100 *crouched*
74 *crumpled*
45 curb
272 curiously
326 curve
185 daily
68 dancers
11 dangers
183 darted
265 *dawdled*
33 deaf
102 *deceiving*
166 definition
35 delivers
331 delta
85 depend
15 *depot*
187 *deserted*
215 *deserts*
165 desk

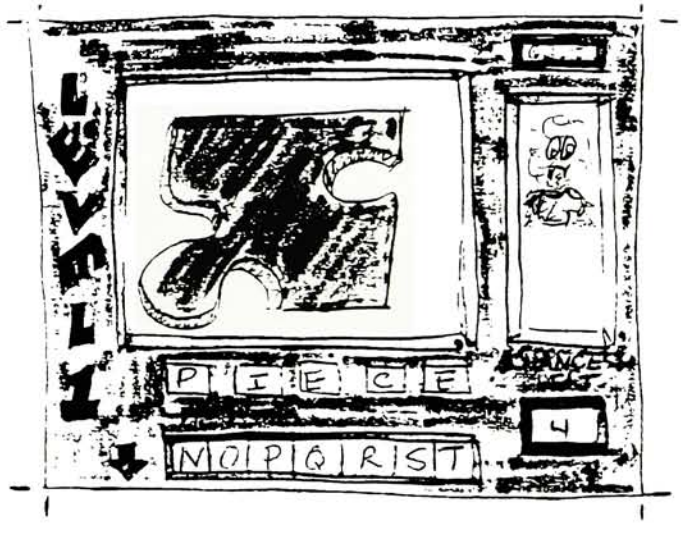
314 layers
204 lays
240 lazy
266 leader
324 leaf
148 ledge
84 lessons
165 licorice
244 lies
332 limestone
356 listening-to
39 ***local***
72 locked
86 lonesome
156 ***loom***
359 lovingly
104 lump
213 lupine
86 magazine
296 magnet
286 mail-order
235 maple
189 ***marine***
190 marked
332 ***marvels***
14 ***mascot***
226 matching
215 melted
329 melts
281 member
248 merriest
338 messengers
158 ***milled***
35 millions
57 minds
85 mirrors
45 mitt
146 ***mock***
215 ***moist***
164 monitor
97 moor
63 ***mosaic***
205 mosquitoes
333 motors
100 mound
153 mounted
243 ***mourned***
358 mouthful
97 mufflers
269 muffling
359 mugs
227 multiple-choice
247 muscles
115 ***musty***
17 mutt
68 ***nagged***
100 narrow
86 national
118 nature
260 necklace
243 neighbor's
244 nephews
148 nervous
101 newly
340 nightingale
172 noisy
68 noon
247 noontime
71 normal
287 novelty
102 numb
74 nurse
189 officers
38 offices
63 ***ogre***
61 oil
358 one's
39 ***optical***
247 orchard
202 ostrich
280 outcome
229 oval
361 ow
84 pad
202 paddle
338 painter
164 palindrome
184 palm
234 ***parachute***
78 parents
54 parted
146 particular
248 parties
24 ***passport***
259 pasture
32 patroling
66 paused
336 peach
203 peeping
26 peered
183 pelican
202 penguins
171 ***penmanship***
79 people's
183 ***perch***
346 perfection
88 performers
311 ***persnickety***
169 person's
342 persuaded
311 ***pest***
274 petals
71 pictured
183 ***pierced***
51 pillowcase
336 pines
182 ***pirate***
45
101 pitifully
328 ***planet***
15 platform
266 playground
185 ***plaza***
68 plié
98 plodded
153 plow
237 pods
359 ***politely***
333 polluted
237 pop
296 popular
57 possible
36 postmark
21 postmaster
183 pouch
308 ***pouted***
280 predict
280 predicted
281 prediction
40 prefer
148 presence
168 principal's
333 ***products***
60 pronunciation
71 ***propped***
66 ***protested***
281 proved
106 ***prowling***
213 ***prows***
86 publishing
289 pump
88 puppet
74 puzzling
44 quitter
146 ***racket***
332 rapid
320 ***raucous***
85 rearview
71 reasoned
39 receive
150 reeds
46 refrigerator
287 refunded
338 refused
37 region
37 regions
364 relations
114 ***relatives***
130 released
344 replaced
295 reply
190 reported
344 ***request***
114 rescued
189 ***research***
146 restless
338 ***restore***
248 results
63 ***rhythmic***
102 ribbon
284 ribs
35 riders
272 rim
235 ***ripen***
248 ripest
259 rippling
336 rising
158 risk
330 riverbed
189 roar
291 ***romped***
326 rough
230 roundhouse
187 ruffled
60 ***ruin***
147 ruined
46 rules
94 safely
126 ***saggy***
247 saplings

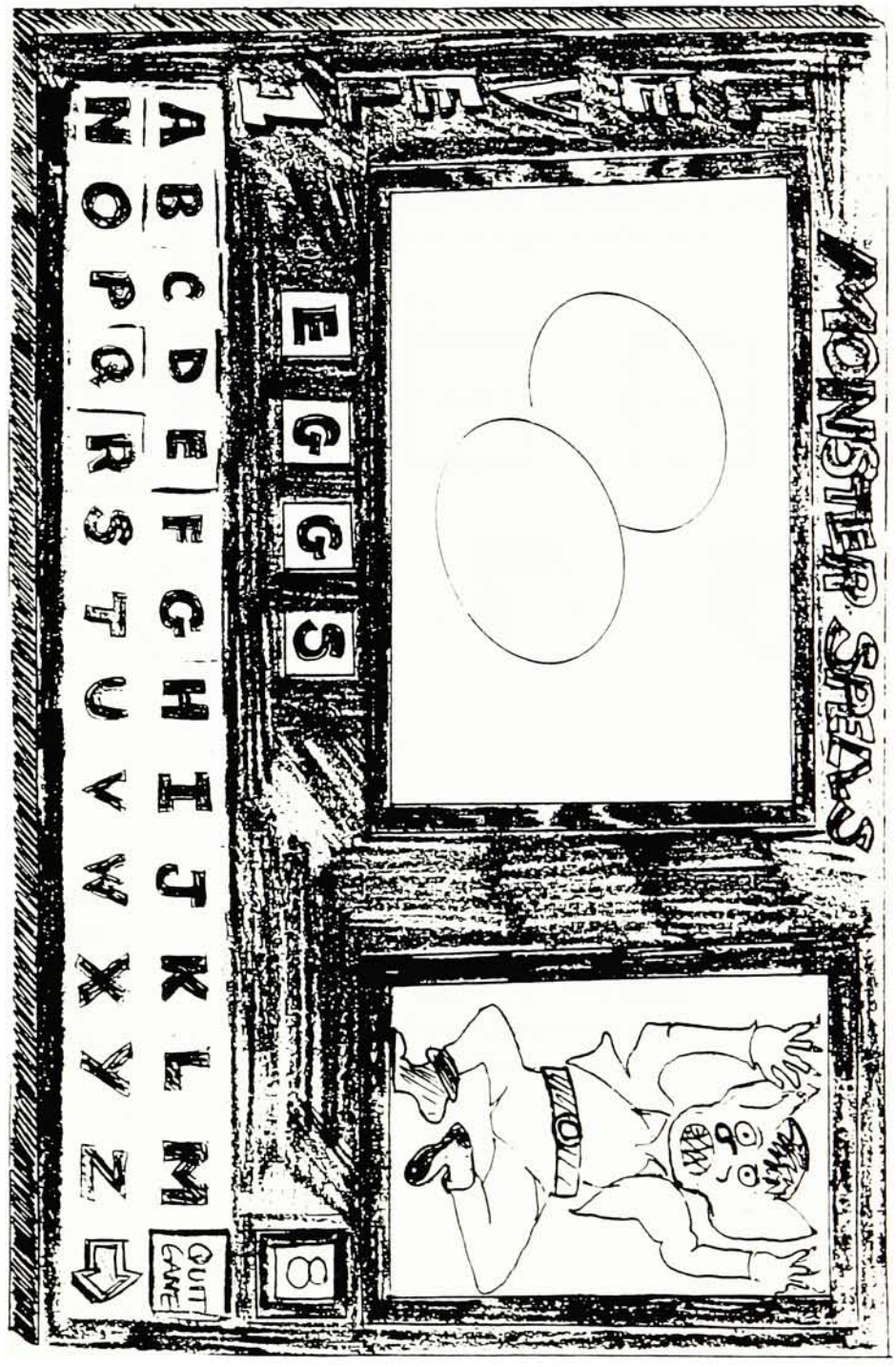
FIRST FLOW CHART



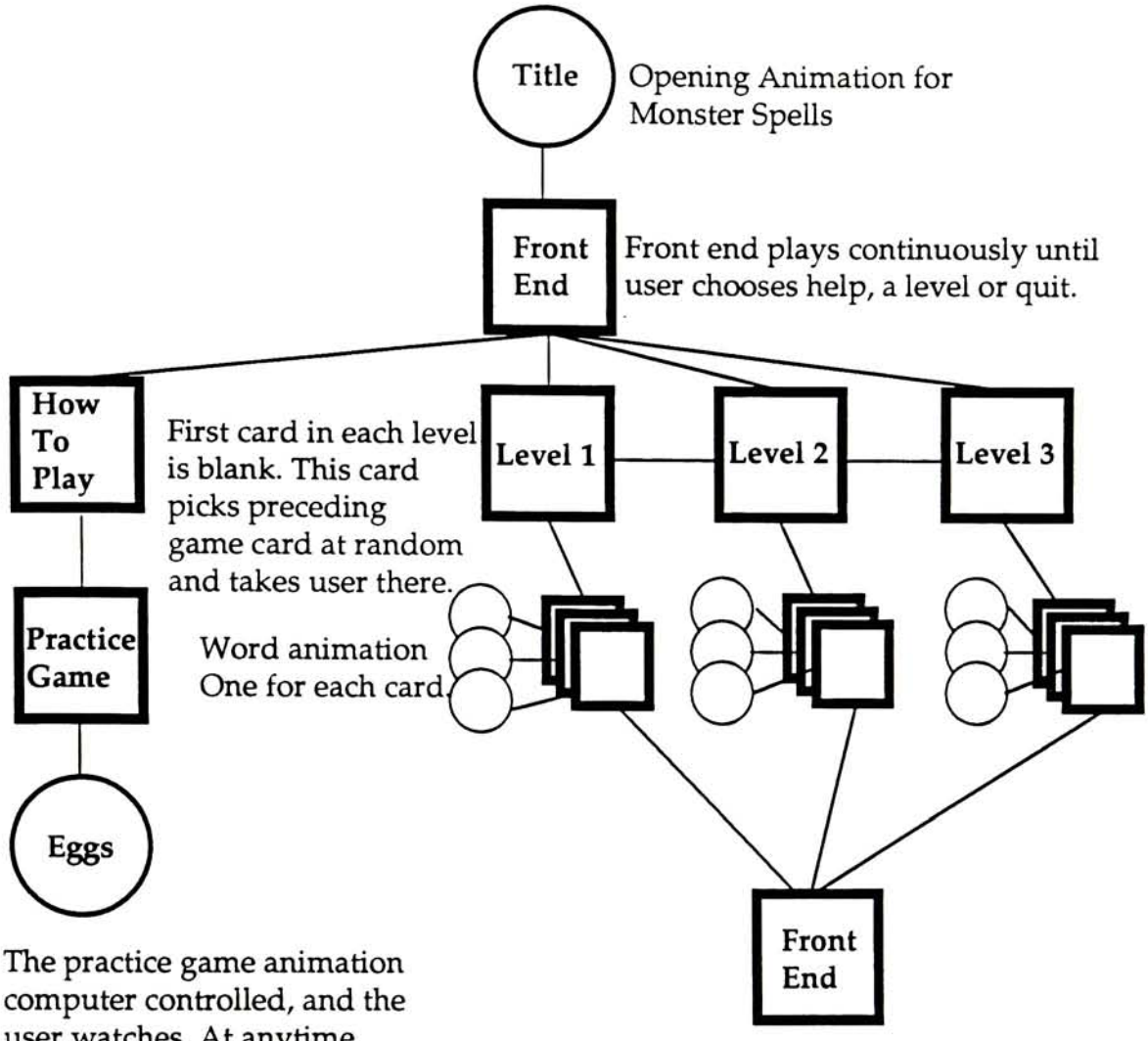

QUIT
LEVEL 1
of CHANCES left
A B C D E F G


QUIT
LEVEL 1
CHANCES LEFT
H I J K L M


LEVEL 1
P I E C E
4
N O P Q R S T


MONSTER SPELLS
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
QUIT GAME

FINAL FLOW CHART



The practice game animation computer controlled, and the user watches. At anytime the user can quit out of help mode and return to the front end screen.

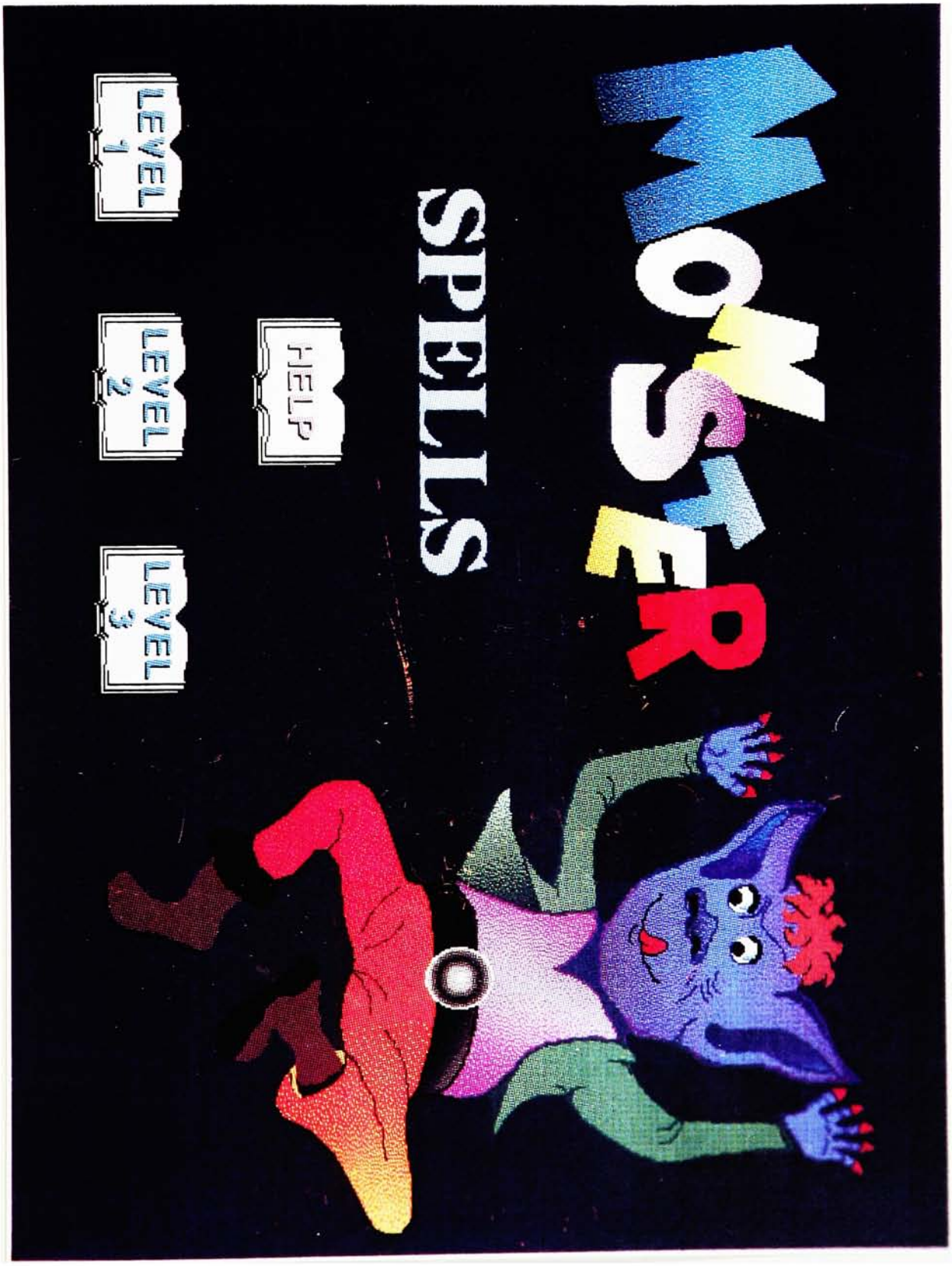
When user ends game they are taken back to front end screen.

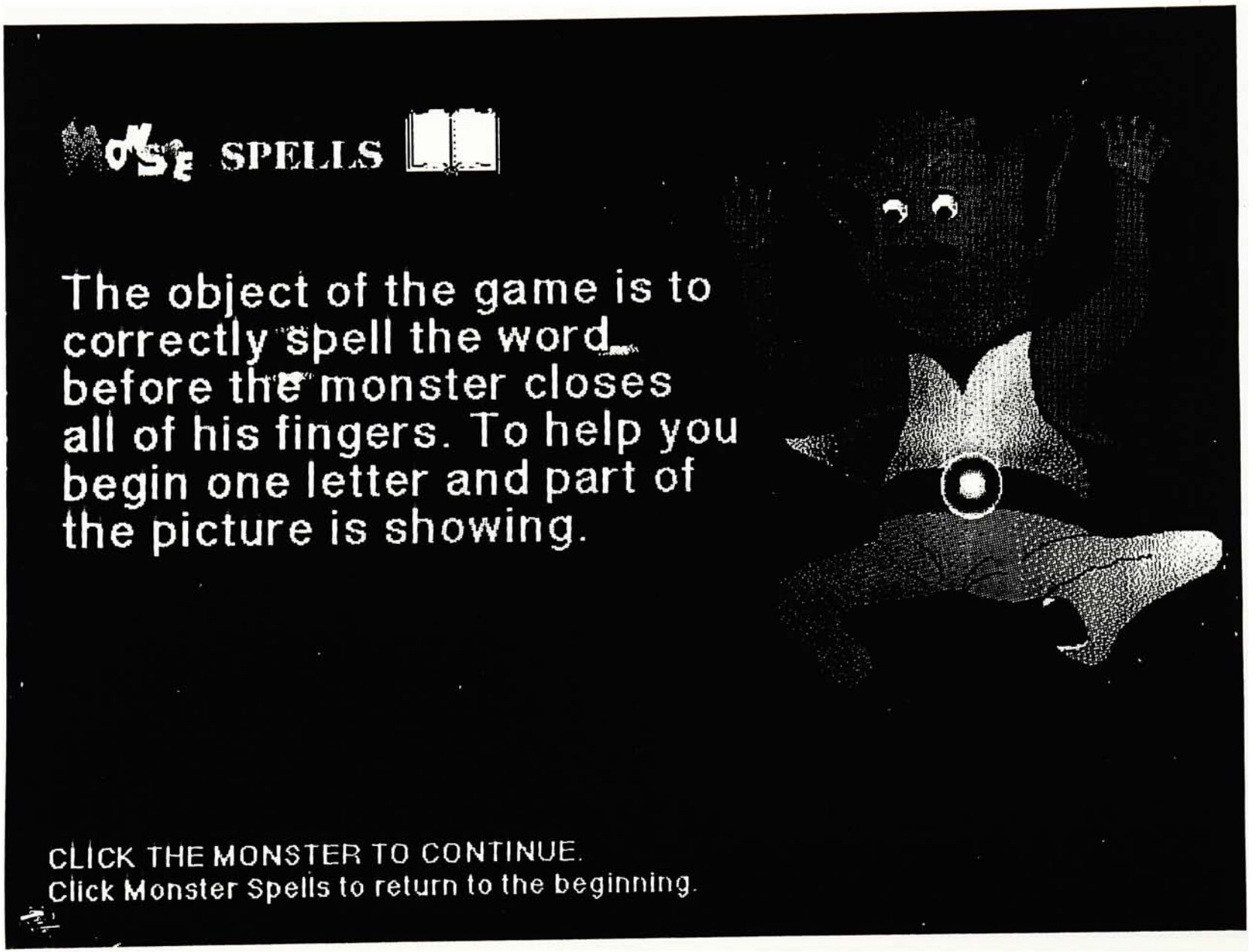
MONSTER SKETCHES

First

Final

FRONT END SCREEN





HELP SCREEN 1

EXPLANATION SCREEN

Future research efforts must be directed toward explaining why teachers who have access to microcomputers fail to make greater use of them.

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Jeffry A. Hurt
Robert F. Kirk

How Do Young Children Interpret Computer-Generated Pictures?

Designers, and subsequently teachers who use educational computer programs, appear to have been making some understandable, but nevertheless pedagogically unsound assumptions about the pictorial representations found in computer programs. The initial assumption is that pictures are, by their very presence, contributing to the instructional value of the program, and that therefore, of necessity and without qualification, they must be incorporated into the program. In many programs, there seems to be a marked lack of verification that the pictures are serving any particular purpose, other than a vague, and probably untested, notion that they provide some motivational function.

The second assumption is that students can and do use the pictures in a program, and that this utilization is consistent with the objectives of the program. Consequently, the use of pictures in computer software continues with little regard for their instructional value or for the relationship between the pictorial and the nonpictorial material contained in the program.

Evidence of this can be found in the lack of emphasis placed on pictures in software evaluation tools that have been constructed recently. Most evaluations either make no reference to pictures or mention them only in context of physical qualities such as color, with no consideration for instructional qualities. However, this lack of consideration for pictures as integral parts of educational soft-

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ware cannot be blamed on those that construct evaluative tools, because there is very little evidence upon which they can base pictorial evaluations. The effects that computer-generated pictures have on learning from educational programs is a relatively unexplored area in program design. A thorough examination of pictures in educational computer programs is necessary to assure that their intended function is being served.

One question that must be thoroughly researched is whether the computer generation of pictures causes interpretation problems for the learner. Although there are identifiable similarities between most pictorial formats, computer-generated pictures have significant attributal distinctions from manually and camera-generated pictures. For example, computer-generated pictures have resolution restrictions not present in other pictures. The means of expressing and using motion can be different. Many computer-generated pictures are simplistic and lack detail and background. These and other physical attributes could have an effect on the ability of the viewer to efficiently and correctly use a picture according to its intended instructional function. Because of this, the possibility exists that interpretation of computer-generated pictures could be significantly different from the interpretation of manually-generated or camera-generated pictures.

The limited research concerning this question suggests that there are few differences in interpretation between computer-generated pictures and pictures generated through other processes. El-Gassar (1984) reports that in college-age students, the change of mode from pictographic to digital image did not affect recognition of the image. Instead, computer-digitized black and white images provided the same information as black and white photographs.

However, the most significant problems with interpretation of any visual image are usually found in younger children. It is generally recognized that children respond to pictures differently from adults and generally obtain less information from them (Travers & Alvarado, 1970). Therefore, the generalizability of El-Gassar's results could not be said to extend to age groups younger than the college-age students in that study. Studies similar to El-Gassar's but dealing with a variety of different ages are needed before general statements about interpretation of computer-generated pictures can be made.

A great deal is known about how young children interpret manually-generated and camera-generated pictures. One important aspect of this body of knowledge is the relationship between the complexity of a picture and a child's ability to interpret it. Another is an understanding of children's preferences in picture type and detail. These two aspects of picture interpretation are important in studying children's interpretation of computer-generated pictures because of the significant variations in complexity that are achievable with them.

Early research on children ages two through ten years demonstrated that the ability to identify details of a picture and to recognize a picture as a whole is developed during this time (Ames, Learned, Metraux, & Walker, 1953). Corresponding to this development is the increasing capability to process complex visual information as well as the ability to incorporate this information into an interpretation of the picture as a whole. In other words, young children have a greater tendency to overlook or disregard details and to isolate objects in a picture, paying exclusive attention to them, at the expense of other objects the picture might depict (Travers & Alvarado, 1970). Undoubtedly, as a result of this development, children also have a tendency to develop a preference for more complexity in pictures as they become more experienced in using them to gain information (French, 1952; Myatt & Carter, 1979). Since ability to interpret complexity correlates with preference for complexity, it is generally assumed that all people, including young children, prefer pictures that are as complex as their development allows them to interpret. Therefore, the most effective pictures will be those that most closely match the optimum interpretation level of the child, while avoiding any perceptual pitfalls that might jeopardize the picture's instructional function.

Higgins (1980) identified one such pitfall by determining that *literalism*, a perceptually dominated interpretation of visuals, was quite common among young children. According to Higgins, children have the tendency to interpret pictures based upon, and limited to, what they see in the pictures. This could have significant bearing on the interpretability of computer-generated pictures, because the digital nature of these types of pictures, coupled with the already discussed distinctions in physical attributes, sometimes makes objects appear quite different from the way they would appear in other

visual forms. Higgins identifies the amount of relevant information contained in a picture as a significant interacter with interpretation and asserts that children have a tendency to accept the content of pictures at face value.

Thus, if the computer-generated picture differs in its display of relevant information, or if it depicts an object differently from a depiction of the same object in a manually-generated or a camera-generated picture, the child might interpret the picture differently. The result could be a distortion of meaning for the picture, and a resultant failure of the picture to achieve its intended function. Success of any picture in achieving its intended instructional function is greatly dependent upon a successful and accurate interpretation of the picture, and it is known that the information a child derives from a picture can be vastly different from that which the picture was designed to impart.

It would therefore appear that a closer look at the pictures that characteristically accompany most computer programs used with young children is greatly needed. Such an examination must initially determine the extent to which the physical attributes of computer-generated pictures affect the interpretability of the pictures used in programs designed for young children. The following study addresses this question of picture interpretability by comparing the recognition of objects contained in computer- and camera-generated pictures as a means of determining whether young children interpret computer-generated pictures in the same way that they interpret pictures in more traditional formats.

METHOD

Subjects

First-grade classes were randomly selected from Alachua and Polk Counties in Florida and Custer County in Oklahoma, resulting in a selection of 155 first-grade students. With each of the classes selected, all students who wanted to participate in the study and who received parental consent were allowed to participate. Thus, the sample represents students working on the first-grade level from a variety of geographical, social, and educational backgrounds, and with a variety of experiences with computers and computer software.

Materials

Four separate black and white photographic representations of phenomenal objects that would be recognizable to first-grade children were produced. Specifically, the photographs show a car, a truck, a rabbit, and a deer. Using a picture scanning technique, a computer-generated replica of each of the photographs was produced. Using a computer drawing program, a computer-generated drawing of each of the objects was also produced. Thus, a total of 12 pictures, involving three different representations of four different objects, were used in the study. The three representations of one of the objects, the rabbit, can be seen in Figures 1, 2, and 3. The distinction between the computer scan and the computer drawing is one between a visual generated on the computer by machine and a visual generated on the computer by hand. Structurally, the distinction is the difference between a high-resolution reproduction (computer scan) and a low-resolution reproduction (drawing program). Both types of representations appear in programs intended for primary aged children and, as can be seen in Figures 1 and 3, the visual distinction can be very noticeable.

Two levels of complexity are addressed by the four representations. The car and the truck are shown with either no background or with featureless, ambiguous background. Thus, these pictures consist of only one important, recognizable object, called in this study the critical object. On the other hand, the representations of the rabbit and the deer show not the critical objects, but also the presence of vegetation in the form of flowers and grass, which in this study is called peripheral objects. Thus, children, when asked what they see in these pictures, have the opportunity to identify not only the critical object, but peripheral objects as well.

In order to eliminate as many variables in interpretability of the pictures as possible, all pictures were developed as black and white slides. This eliminates the possibility of color affecting interpretation of the picture. The slide format allows a visual presentation which replicates a computer screen.

FIGURE 1. Photograph of rabbit.

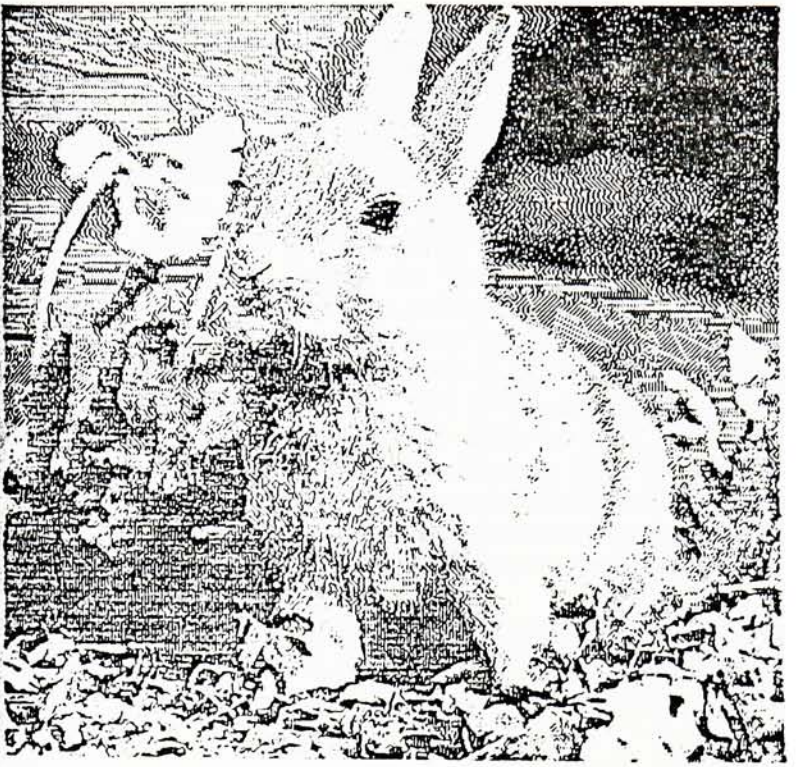

FIGURE 2. Computer scan of rabbit.

Procedure

Each child was individually shown the 12 pictures on an individual slide presentation instrument with a screen similar to that of a computer monitor. The order in which the pictures were shown was randomized in order to eliminate the possibility of the child recognizing objects according to a perceived pattern. Each child was asked the same questions about each of the pictures: (a) What do you see in this picture? and (b), What things in this picture make you say you see a _____? The first question was asked as an assessment of the child's ability to recognize objects in the picture. The subsequent question for each picture was asked regardless of

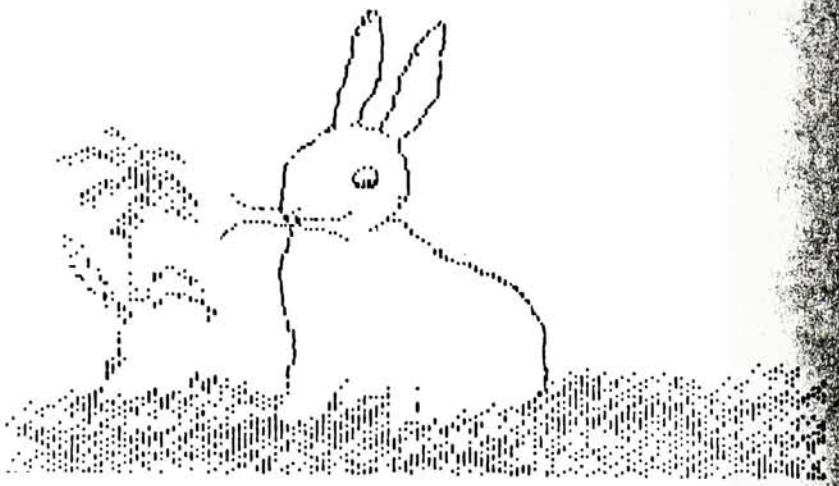

FIGURE 3. Computer drawing of rabbit.

the response to the first question. In other words, if the answer to the first question were "a dog," the second question would be "What things in this picture make you say you see a dog?," regardless of the accuracy of the first response. Children were not corrected or appraised of incorrect answers for any of the questions asked. The questions were asked about each picture while the child was viewing the picture, and each child was given as long as he or she needed to answer each question. Therefore, neither recall of pictures nor speed of information processing was assessed. Children's responses were recorded to allow comparisons to be made.

RESULTS

Recognition levels of the critical objects in the pictures, regardless of format, were very high. Specifically, over 97% of the children correctly identified the truck, the car and the rabbit in all three formats. In the various depictions of the deer, 87% made correct identification with the photograph, 86% with the computer scan,

and 85% with the computer drawing. Thus, it appears that children could identify the objects equally effectively from one format to another. Although the deer was recognized by a smaller percentage of subjects, regardless of format, than any of the other representations, those children who incorrectly identified the deer usually identified it as a visually similar animal, such as a dog or a fox. It does not appear that the complexity of the picture in any format affected recognition. Rather, the visual similarity of the deer to other animals seemed to be the problem.

Distinctions between formats were apparent, however, in recognizing peripheral objects in the pictures of the rabbit and the deer. In the photograph of the rabbit, 14% of the children identified both critical and peripheral objects. In the computer scan, 19% were able to identify both. In the computer drawing, 32% identified both. Thus, more than twice the number of children identified peripheral objects when viewing the low-resolution computer representation than when viewing the photograph. Figure 4 graphically depicts this distinction.

The deer pictures seem to support the results found in the rabbit representations. A total of 20% of the sample identified both critical and peripheral objects when viewing the photograph of the deer,

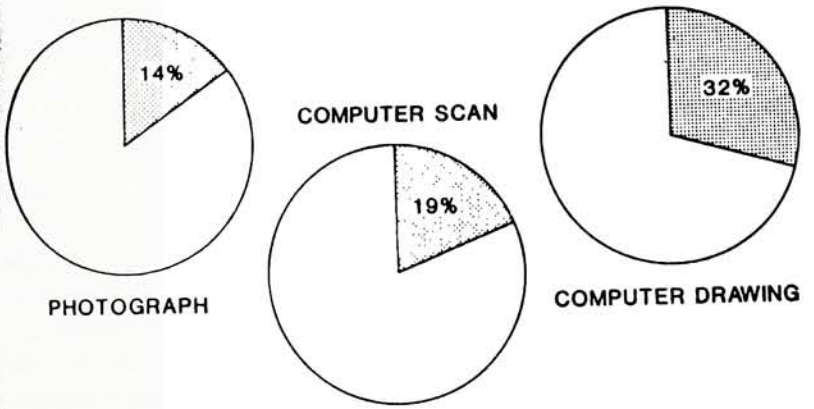

FIGURE 4. Percentage of sample recognizing both critical and peripheral objects in pictures of rabbit.

with 13% for the computer scan and 39% for the computer drawing. Once again, the low-resolution computer reproduction seemed to promote more complete interpretation of the picture. Figure 5 graphically depicts this distinction.

In answering the second question, children indicated that shape was the most important factor in recognizing the car and the truck. Body features, especially facial features such as eyes, ears, nose and whiskers, were the most important factor in recognizing the rabbit and the deer.

DISCUSSION

The high level of recognition of critical objects in all formats indicates that first-grade students have the ability to recognize and interpret the types of pictures that generally appear in computer programs written for their age level. Further, the presence of both critical and peripheral objects did not appear to affect children's ability to recognize critical objects. In other words, limited amounts of complexity in the form of added objects do not appear to detract from the interpretability of pictures. The children appear to draw on

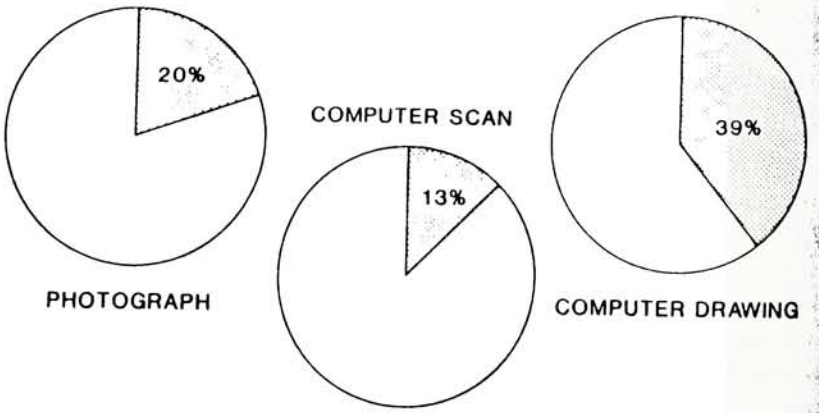

FIGURE 5. Percentage of sample recognizing both critical and peripheral objects in pictures of deer.

past experiences in making these recognitions, and utilize shapes and features of objects as points of recognition.

It also appears that the low-resolution computer drawing, which could be described as the least complex of the three formats, provided a better opportunity to more completely interpret the picture. This conclusion is based upon the observation that peripheral objects were most often identified in the computer drawings. This corresponds with what is known about children's interpretations of pictures in noncomputer formats.

An additional observation made concerning responses to the second question is that children appeared to use mental imagery in identifying the pictures. In the three representations of the rabbit, when asked what it was that made them see a rabbit in the picture, approximately 19% of the total sample said the rabbit had a tail, although none of the rabbit pictures showed the rabbit's tail. Similarly, approximately 16% of the total population indicated that they "saw" a steering wheel in the pictures of the car, even though none of the pictures has a steering wheel visible. Several students also mentioned that the deer had brown fur, even though the pictures were all black and white representations. This suggests that some students were able to construct a mental image of the object or objects in the picture, and actually used that mental image to describe the picture rather than the picture itself. This would appear to contradict Higgins' (1980) statement that children accept the content of pictures at face value and that amount of relevant information in a picture significantly affects interpretation. However, more investigation needs to be done before definitive conclusions can be drawn.

Based upon the results of this study, several conclusions concerning use of pictures in computer programs for primary age children can be made. Initially, it appears that young children use pictures in computer programs in much the same way that they use pictures in other instructional contexts. They seem able to recognize objects in computer-generated pictures as easily as they recognize camera-generated pictures. It also appears that low-resolution pictures of recognizable objects provide the most effective achievement of the

picture's intended instructional function. Pictures with as little unimportant detail and background as possible appear to promote more complete interpretation.

SUMMARY

This paper is a report of a study that was conducted as a means of assessing the ability of first-grade students to interpret and use computer-generated pictures. The study was based upon the need to determine whether the differences in physical attributes between computer-generated and noncomputer-generated pictorial formats have an effect on children's ability to interpret and process the information contained in the pictures.

Results of the study indicate that first-grade students are able to recognize the critical objects in both computer-generated and noncomputer-generated pictures. Children seemed most likely to notice peripheral objects in low-resolution computer drawings.

It was concluded from the study that computer-generated pictures can be interpreted by first-grade students in basically the same way that those students interpret other visual representations. Thus, if computer-generated pictures are effectively incorporated into programs in some specified functional capacity, they can be valuable instructional tools. Further, it was concluded that computer pictures which are low-resolution generations, a process which usually results in the elimination of a great amount of detail, promote more complete interpretation. This conclusion is consistent with research on young children's interactions with visuals in other instructional situations.

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PROJECT SCRIPT

Project Script "Level1"
Tuesday, May 12, 1992 9:48 AM **Page 1**

```
on startUp
    editor

end startUp
on openProject
    global wordlist, cdcount, washere
    put empty into washere
    put 0 into cdcount
    hide menuBar
    lock screen
    play "beautiful"
    go cd "level1"
    put bg field "words" into wordlist
    put random (12) into temp
    put line temp of wordlist into read
    put read after washere
    add 1 to cdcount
    go cd read
    unlock screen
end openProject

on findnew
    global wordlist, washere, read, cdcount
    if cdcount  = 12 then
        answer "You have finished Level1" with "Quit" or "Level 2"
        if it is "Quit" then domenu quit
        if it is "Level 2" then go project "level2"
        exit findnew
    end if
    put random (12) into temp
    put line temp of wordlist into read
    if washere contains read then findnew
end findnew
```

ARROW SCRIPT

Object Script "next arrow" ID = 103
Tuesday, May 12, 1992 9:57 AM Page 1

```
on mouseUp
  global read, washere, cdcount
  findnew
  put read after washere
  lock screen
  put empty into bg field "wordstore"
  go cd read
  add 1 to cdcount
end mouseUp
```

CARD SCRIPT

```
Card Script "eggs" ID = 115
Tuesday, May 12, 1992  9:51 AM                          Page   1

on closeCard
  lock screen
  -- hide cd graphic 1
  hide cd graphic 2
  hide cd graphic 3
  hide cd graphic 4
  -- hide cd graphic 10
  hide cd graphic 11
  hide cd graphic 12
  hide bg graphic 38
  hide bg graphic 39
  hide bg graphic 40
  hide bg graphic 41
  hide bg graphic 42
  hide bg graphic 43
  hide bg graphic 44
  hide bg graphic 45
  hide bg graphic 46
  hide bg graphic 47
  put "10" into bg field "mistake box"
  put empty into bg field "wordstore"
  unlock screen
end closeCard

on openCard
  global win
  put 0 into win
end openCard
```

INCORRECT LETTER SCRIPT

```
Object Script "letterf" ID = 113
Tuesday, May 12, 1992  9:53 AM                          Page   1

on mouseUp
  global read
  play "boing"
  if number of characters of bg field "wordstore" > 10 then
    play "boing"
  else
    put "F" after bg field "wordstore"
  end if
  if character 1 of bg field "mistake box" contains "0" then
    put "0" into bg field "mistake box"
  else
    subtract 1 from bg field "mistake box"
  end if
  if read contains "F" then
    play "beep"
  else
    if bg field "mistake box" contains "9" then
      show bg graphic 38
    end if
    if bg field "mistake box" contains "8" then
      show bg graphic 39
    end if
    if bg field "mistake box" contains "7" then
      show bg graphic 40
    end if
    if bg field "mistake box" contains "6" then
      show bg graphic 41
    end if
    if bg field "mistake box" contains "5" then
      show bg graphic 42
    end if
    if bg field "mistake box" contains "4" then
      show bg graphic 43
    end if
    if bg field "mistake box" contains "3" then
      show bg graphic 44
    end if
    if bg field "mistake box" contains "2" then
      show bg graphic 45
    end if
    if bg field "mistake box" contains "1" then
      show bg graphic 46
    end if
    if bg field "mistake box" contains "0" then
      show bg graphic 47
    end if
  end if
  --  if bg field "mistake box" contains "1" then
  --    playMovie read
  --  end if
  if bg field "mistake box" contains "0" then
    play "lose"
  end if
```

CORRECT LETTER SCRIPT

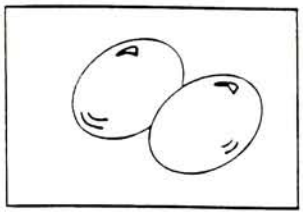
```
Object Script "lettere" ID = 137
Tuesday, May 12, 1992  9:53 AM                          Page    1

on mouseUp
  global win
  play "magic"
  lock screen
  show cd graphic 1
  show cd graphic 10

  unlock screen
  if the visible of cd graphic 10 is true and the visible of cd graphic 11 is true¬
    and the visible of cd graphic 12 is true then
    put 1 into win
  end if
  if win = 1 then
    play "eggs"
    playMovie "egg"
  end if

end mouseUp
```

ANIMATIONS

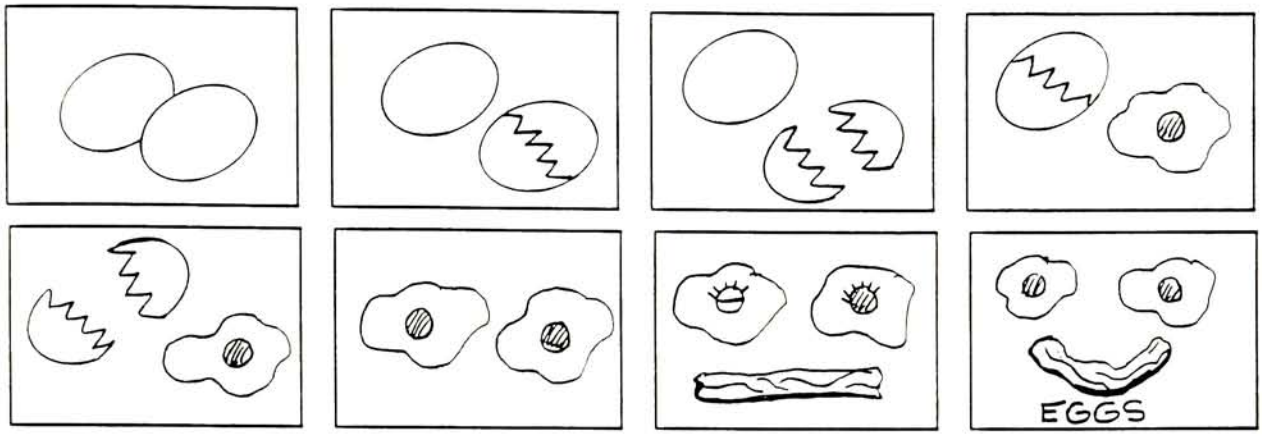
Level 1
eggs
fly
lunch
kite
pencil
ghost
alphabet
yellow
turtle
duck
juice
stamp

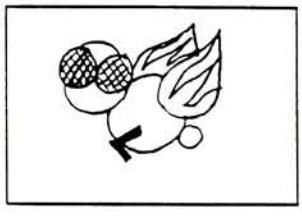
Level 2
strawberry
queen
dump
whale
eyes
arrow
crayons
city
hammer
treasure
mask
birthday

Level 3
television
bones
shamrocks
feathers
coconut
mosaic
continent
telephone
flag
bubble
desk
signals

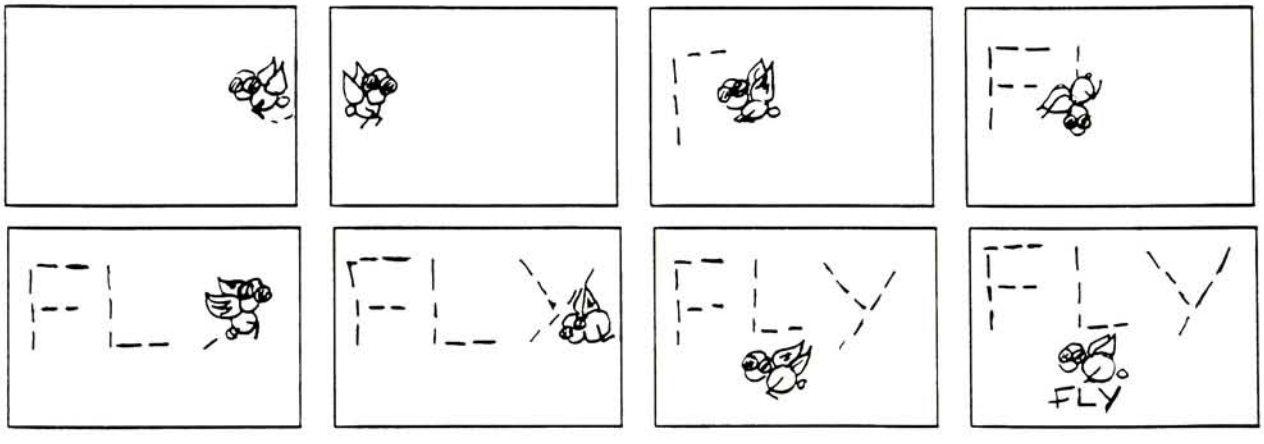


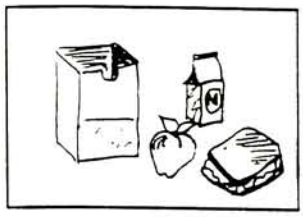
eggs



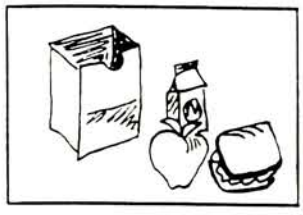
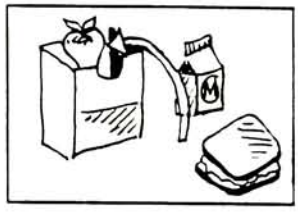
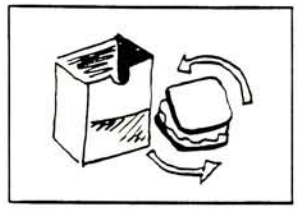
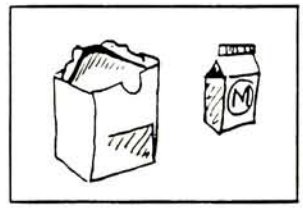
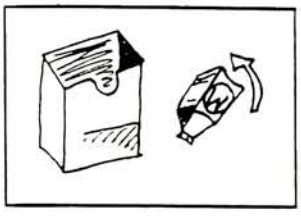
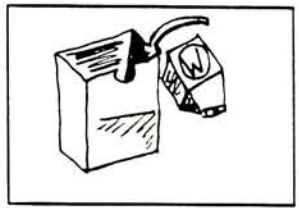
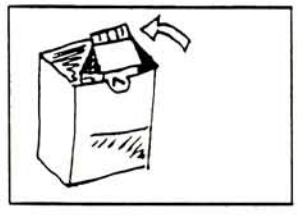
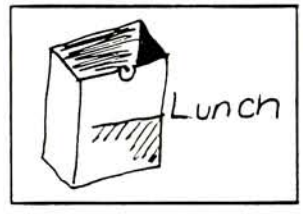


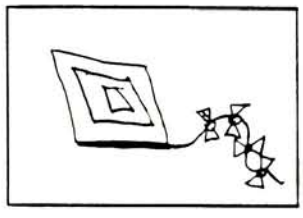
fly





Lunch



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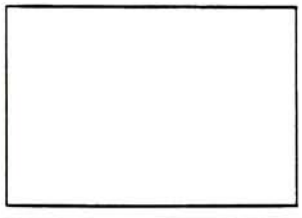

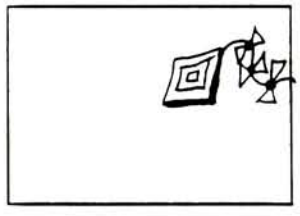
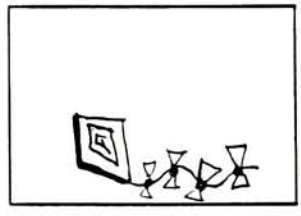
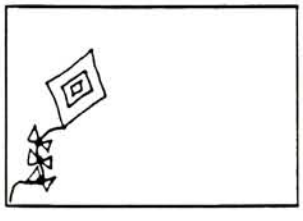
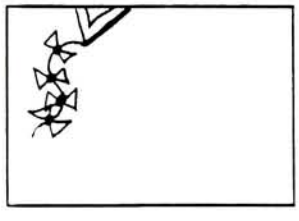
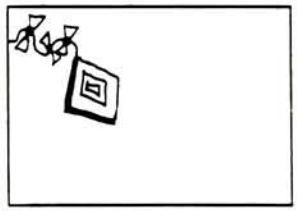
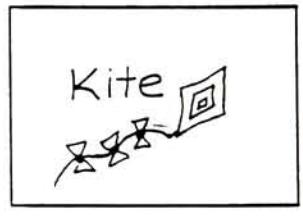

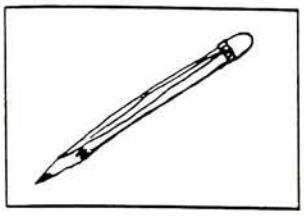

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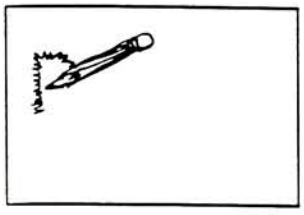

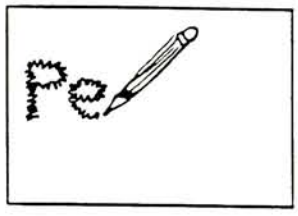

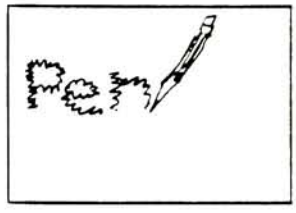

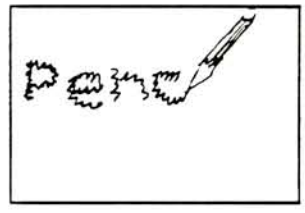

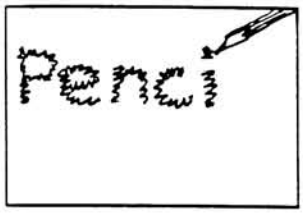

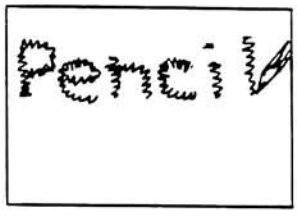

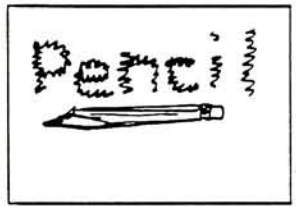

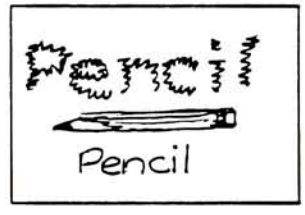

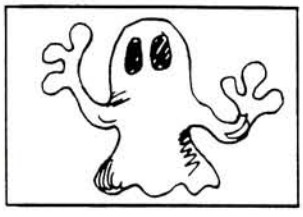

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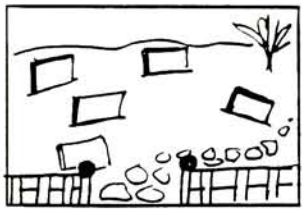

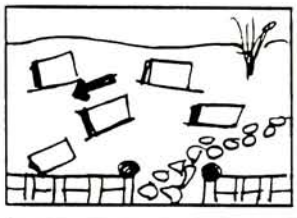

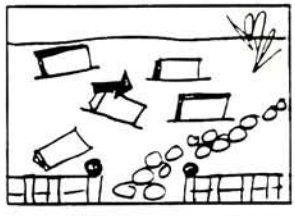

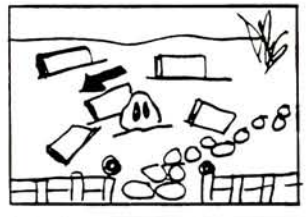

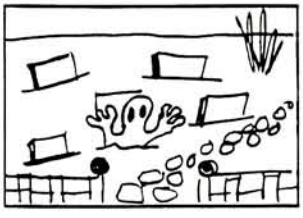

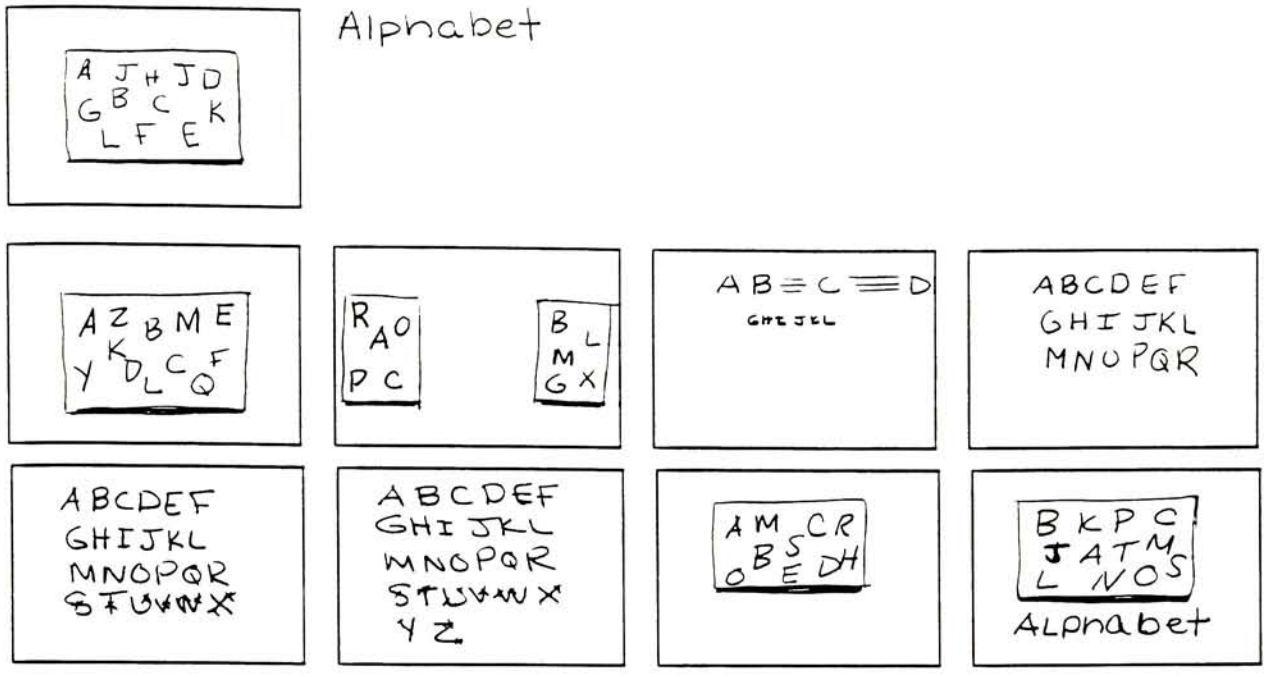
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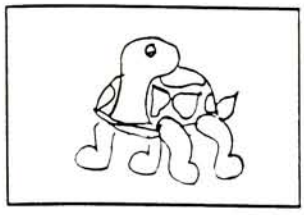
Alphabet
Yellow
Yellow



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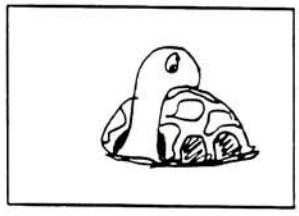
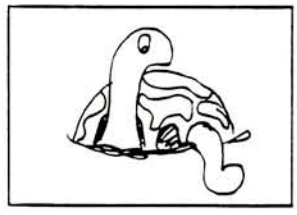
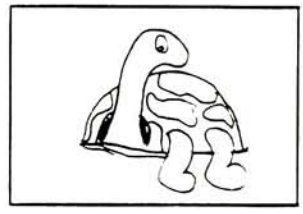
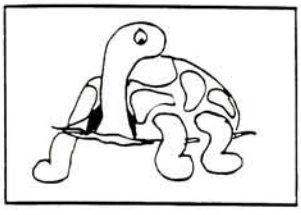
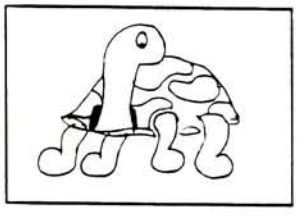
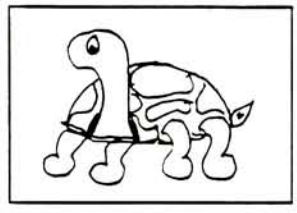
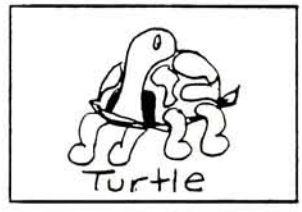

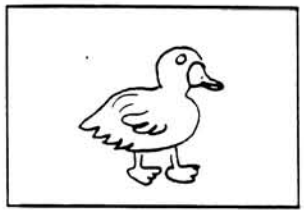

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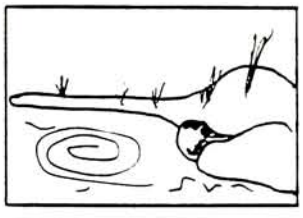
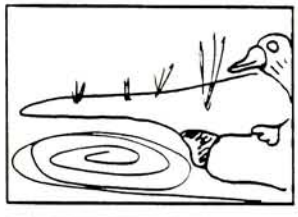
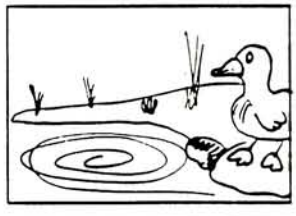
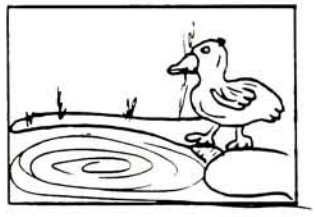
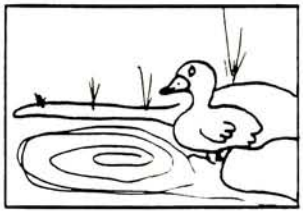
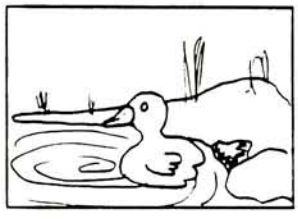
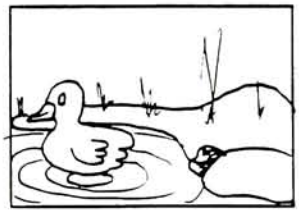
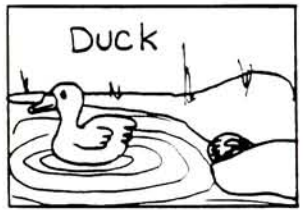

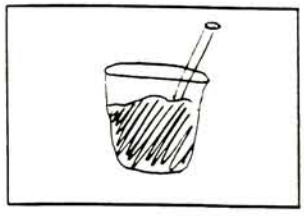

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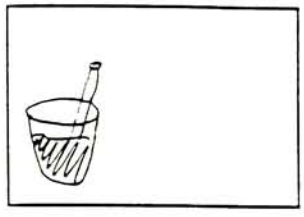

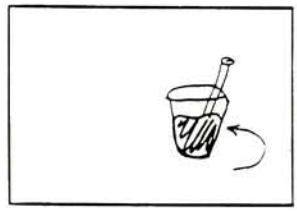

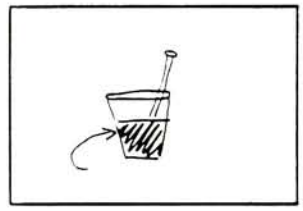

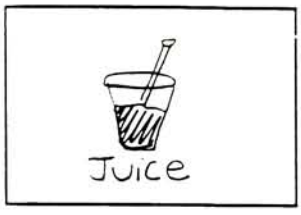

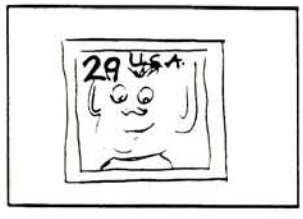

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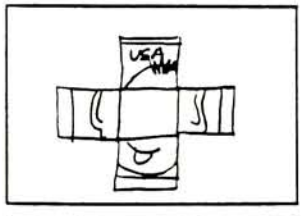

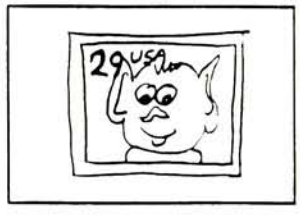

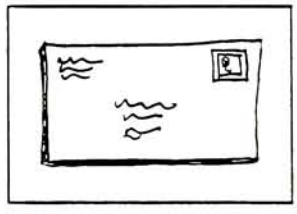

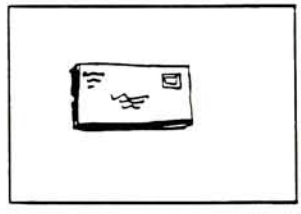

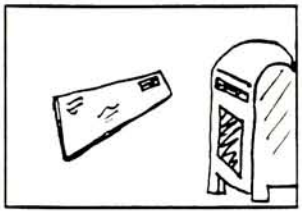

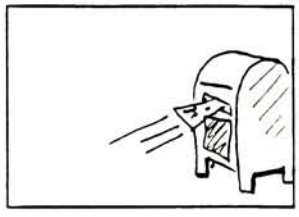

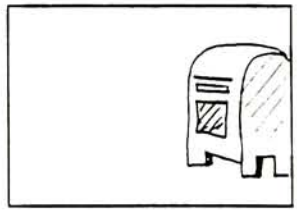

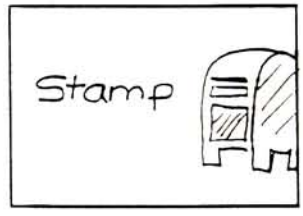

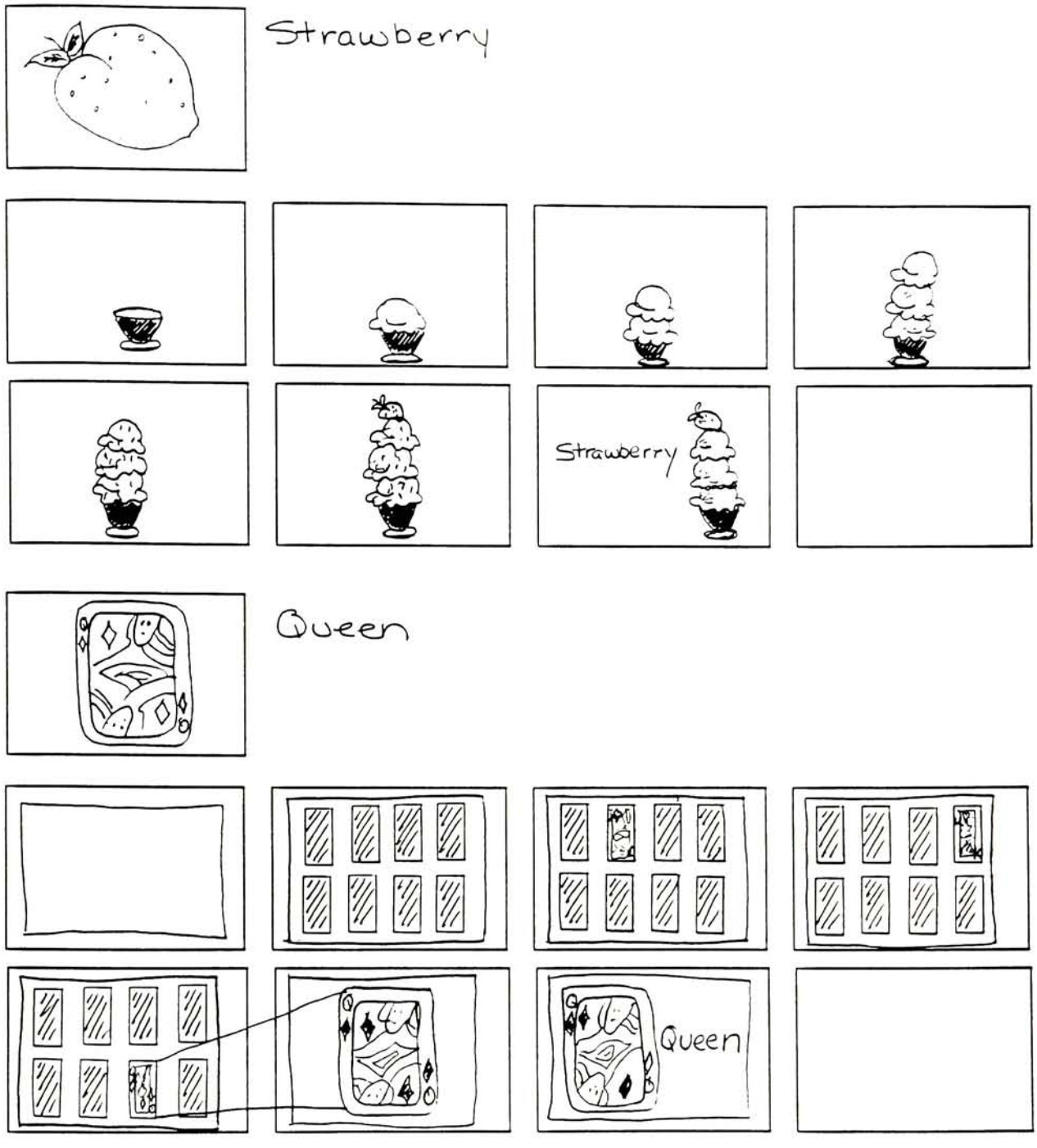
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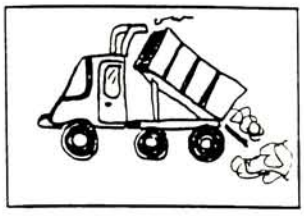
Strawberry
Queen
Queen



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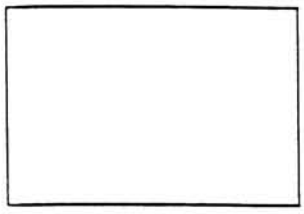
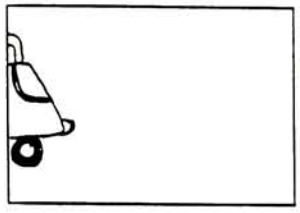
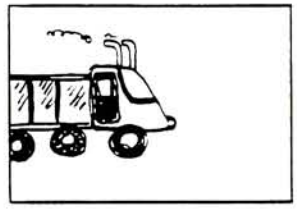
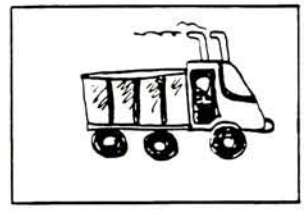
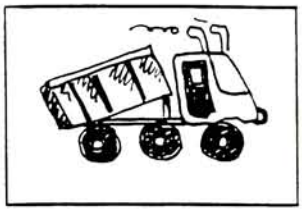
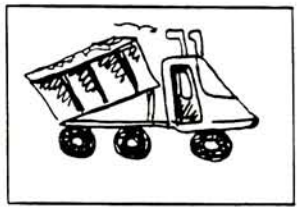
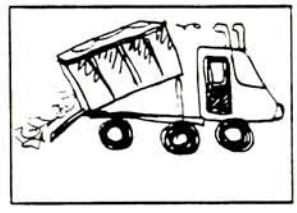
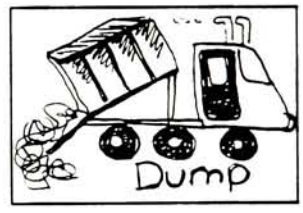

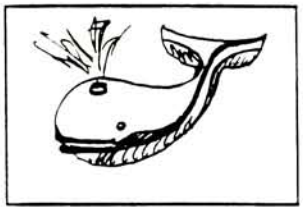

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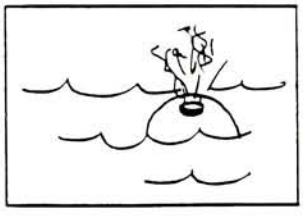
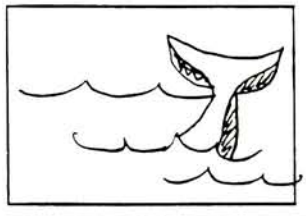
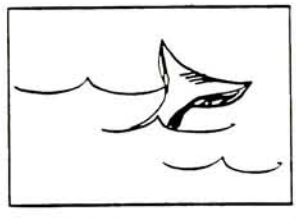
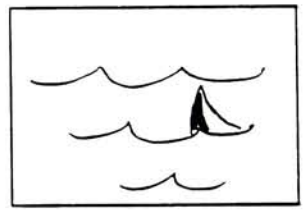
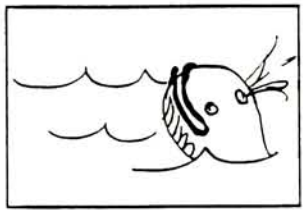
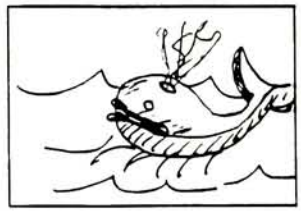
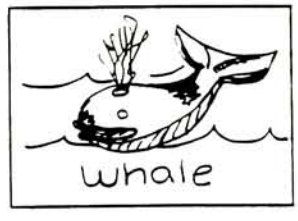

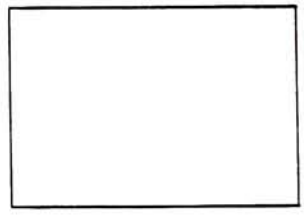

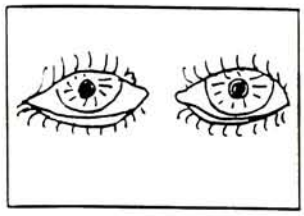

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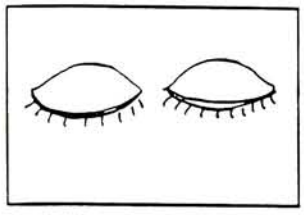

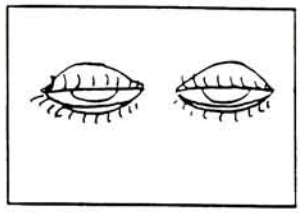

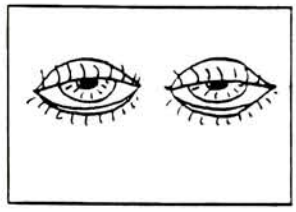

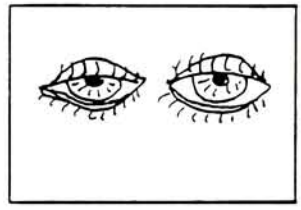

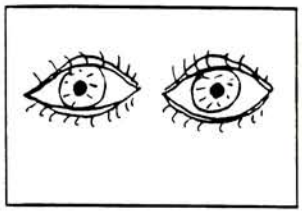

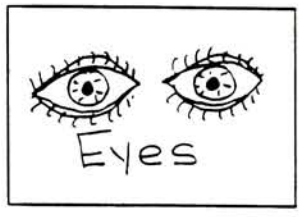

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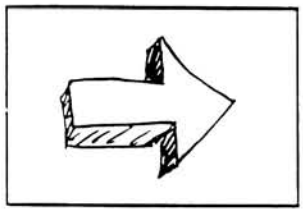

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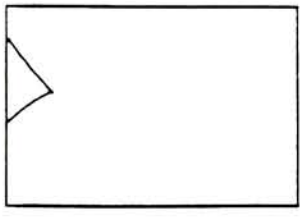

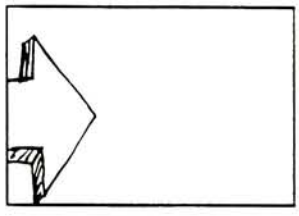

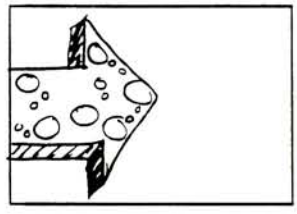

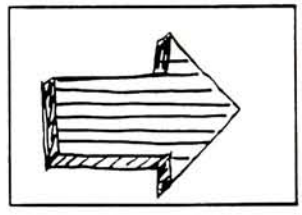

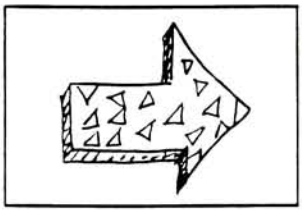

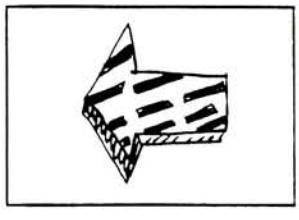

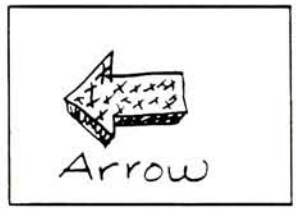

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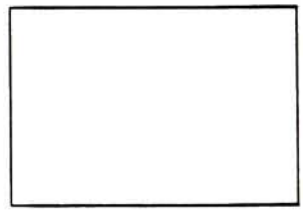

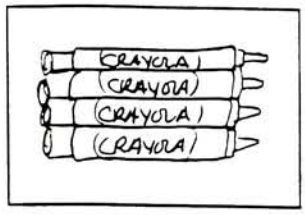

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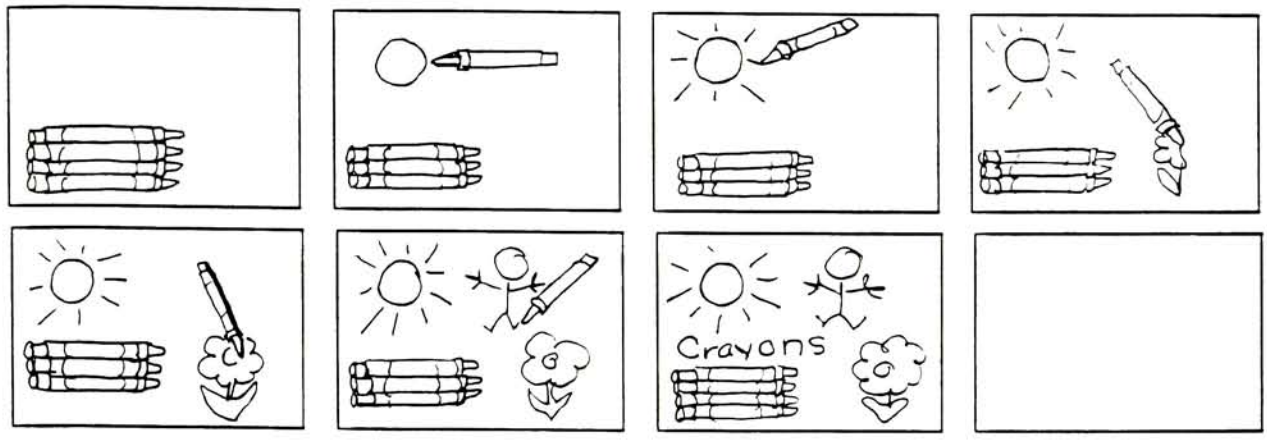

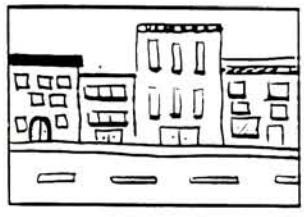

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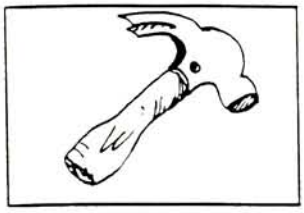

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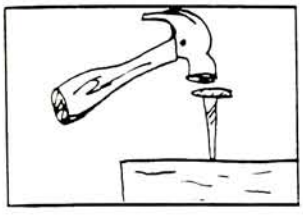
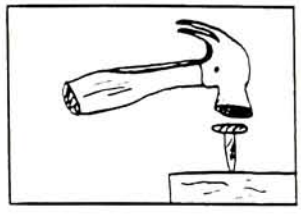
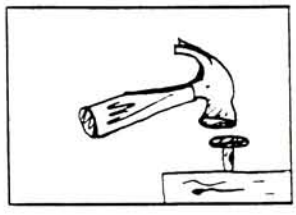
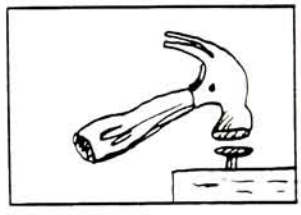
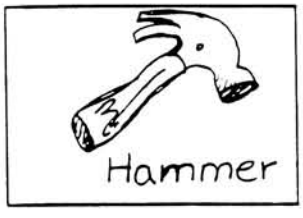

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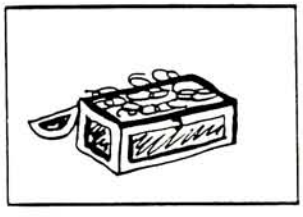

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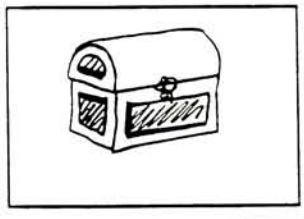
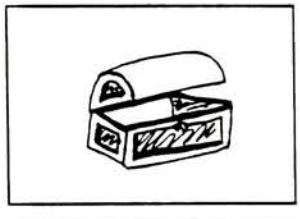
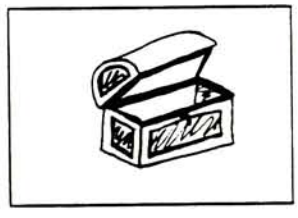
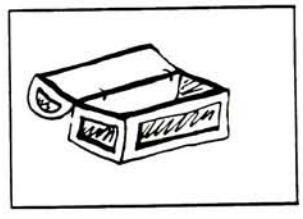
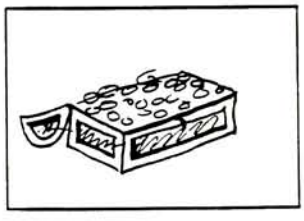
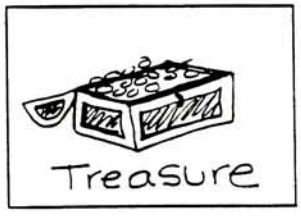

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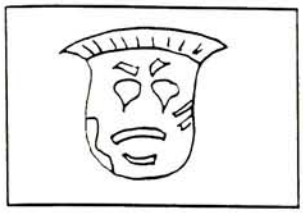

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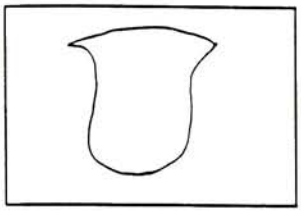
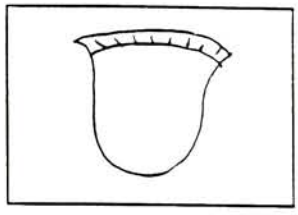
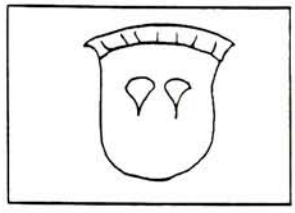
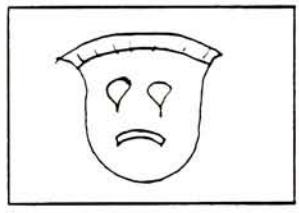
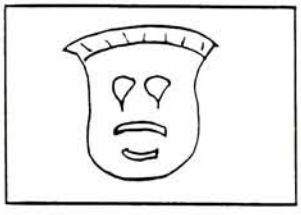
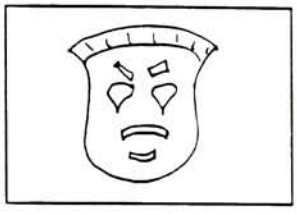
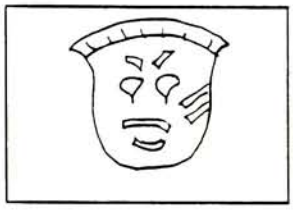
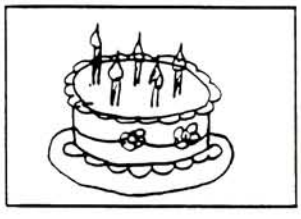
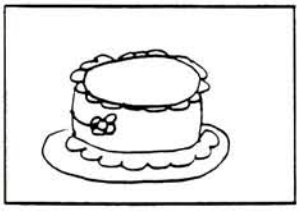
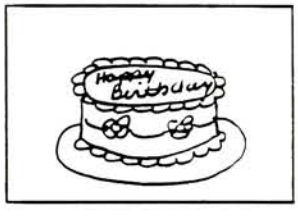
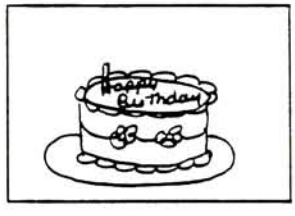
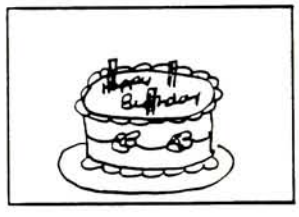
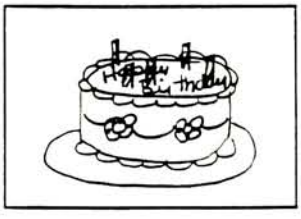
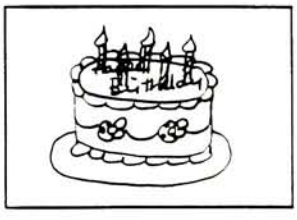
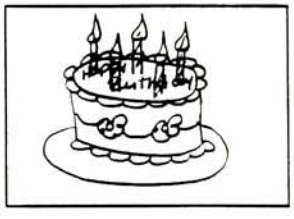
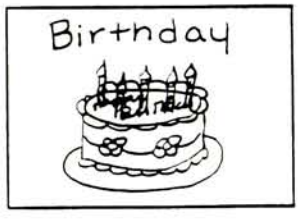
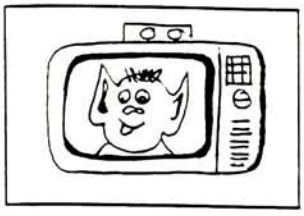








Birthday



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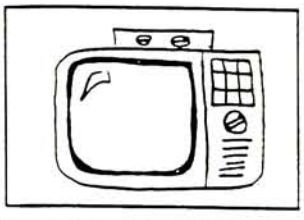
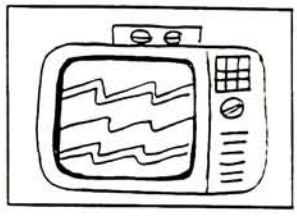
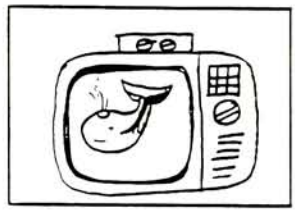
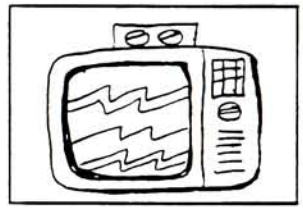
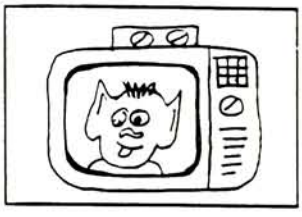
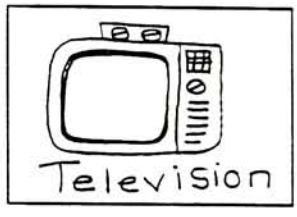

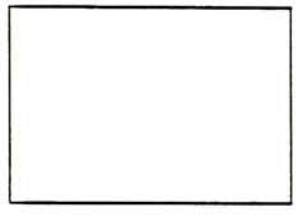
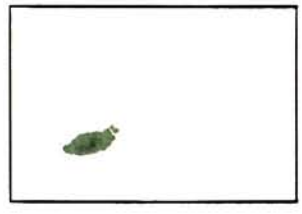

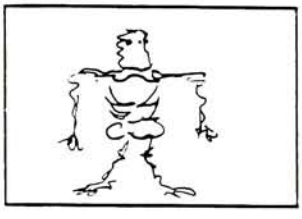

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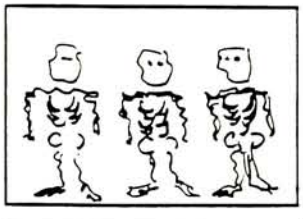
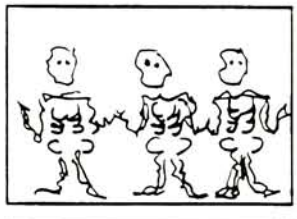
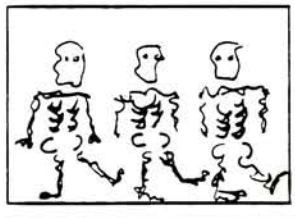
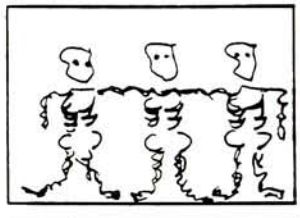
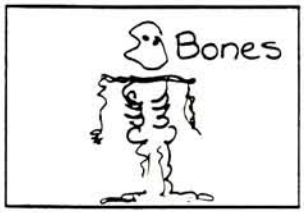
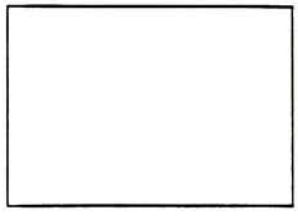
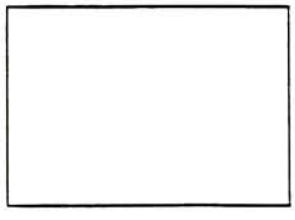
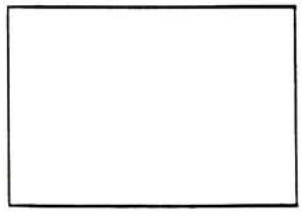
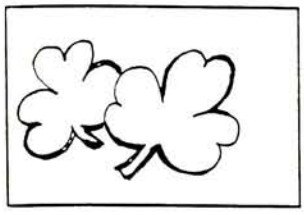
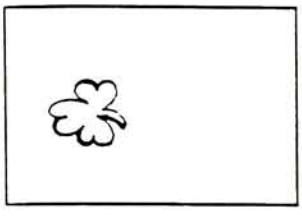
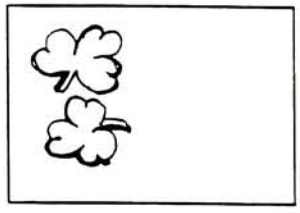






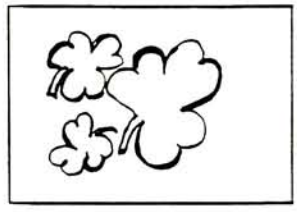




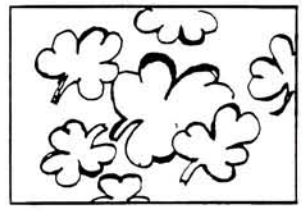


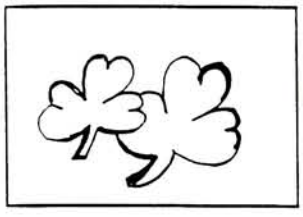
Shamrocks

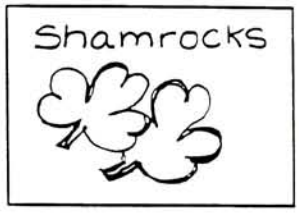


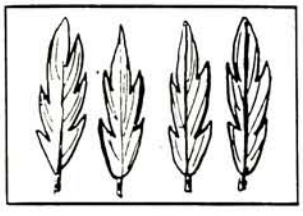












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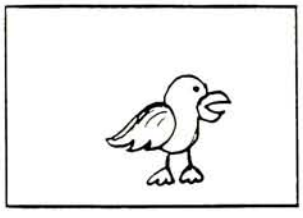

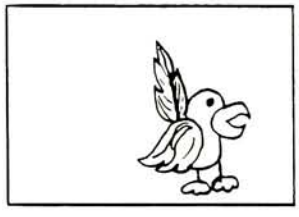

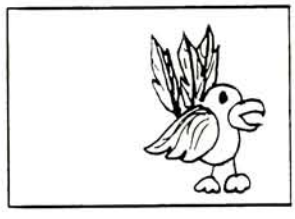

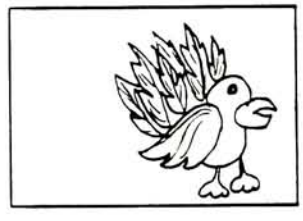

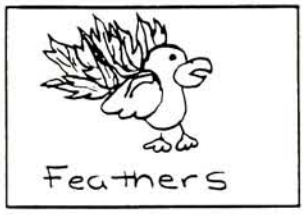

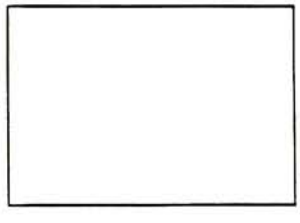

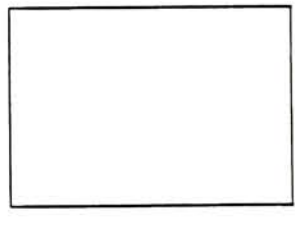

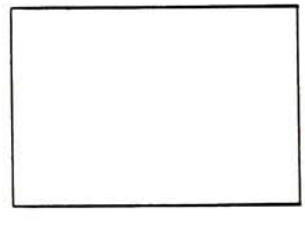

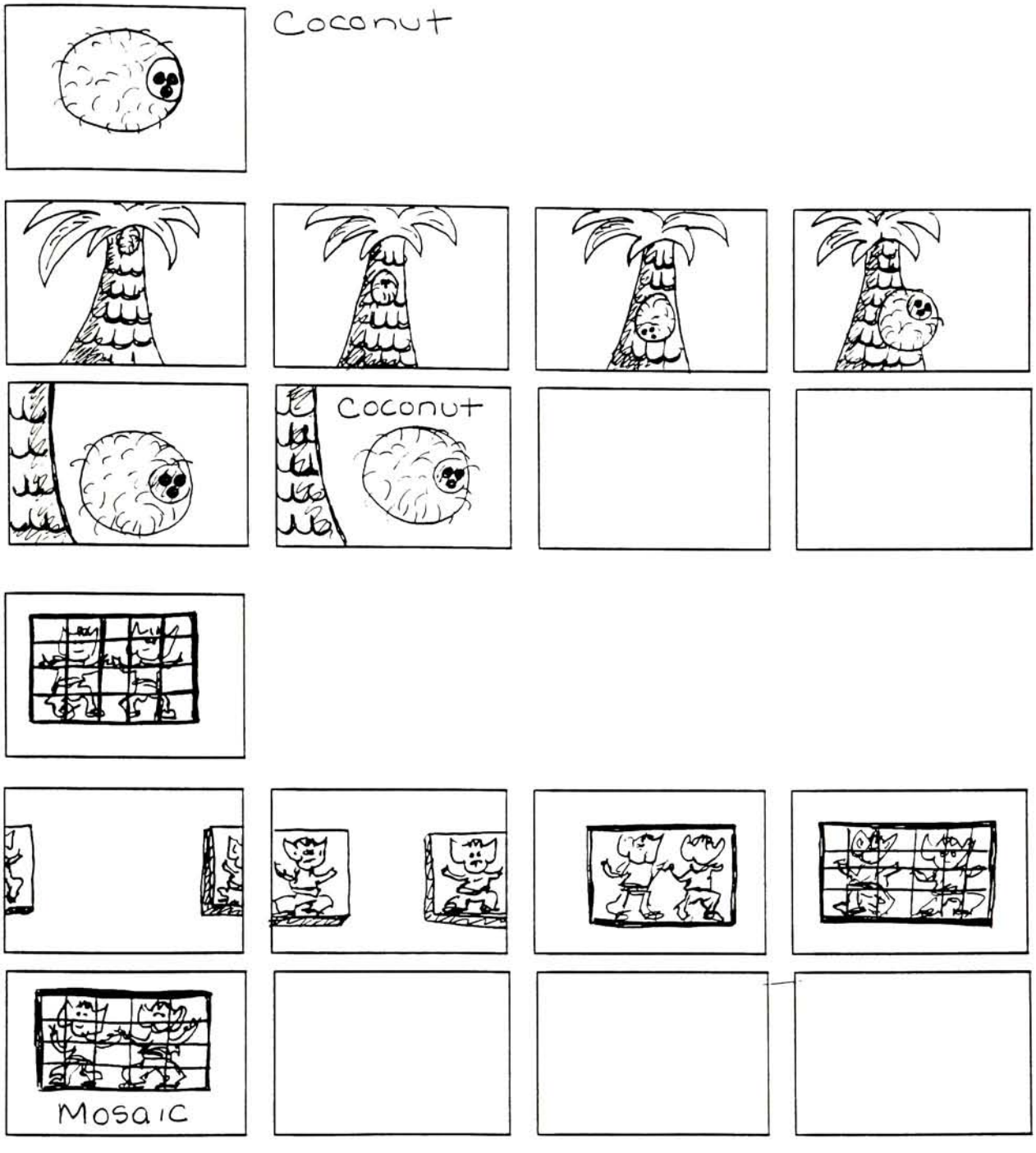
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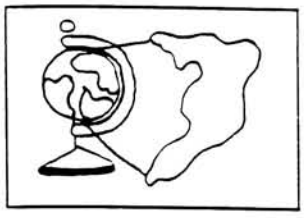
Coconut
Mosaic



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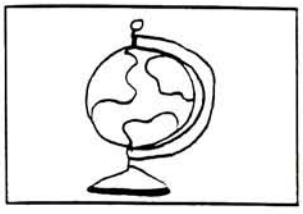
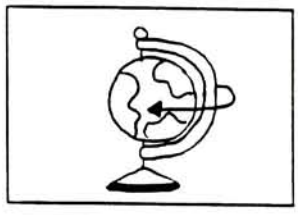
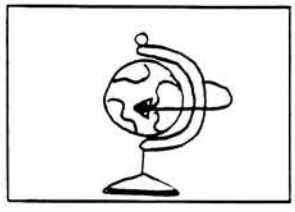
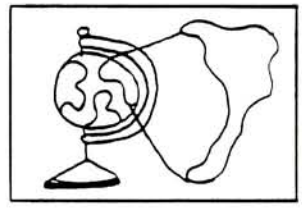

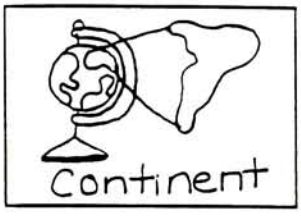

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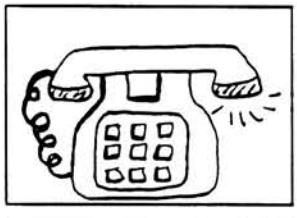
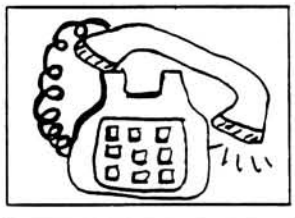
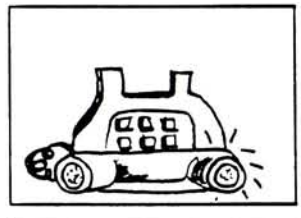
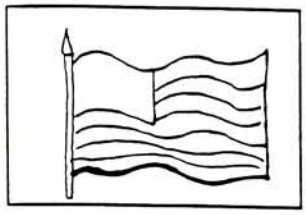
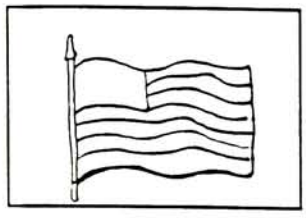
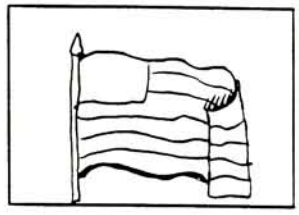
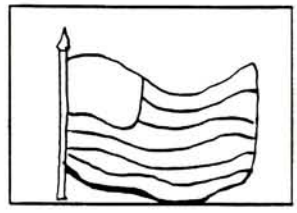




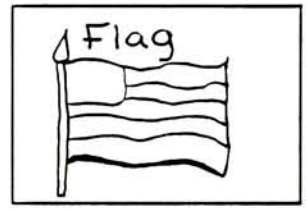


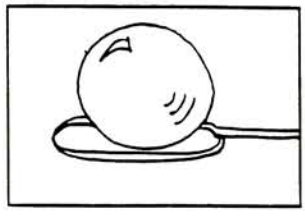
Flag



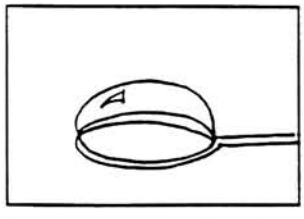


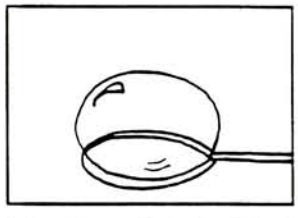


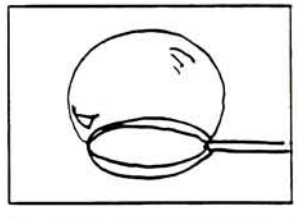


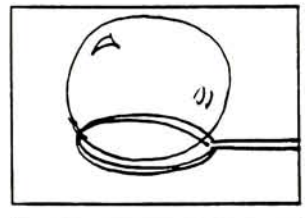


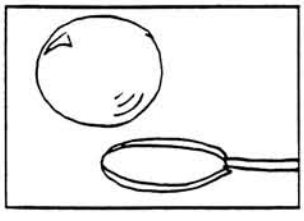
Bubble

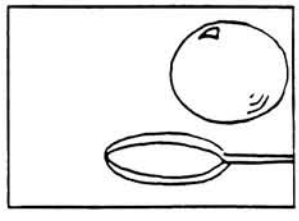


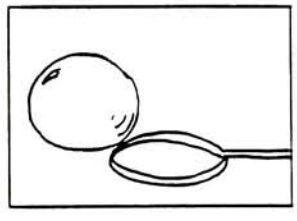


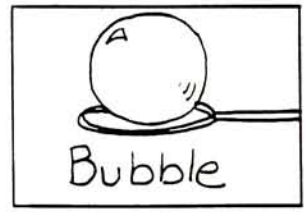


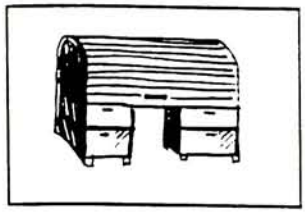












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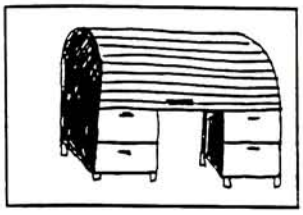
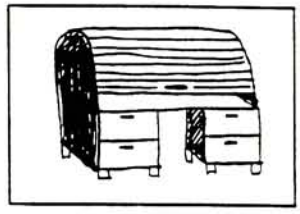
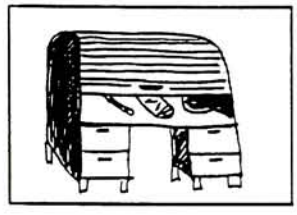
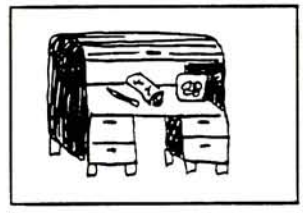
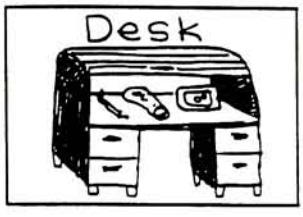
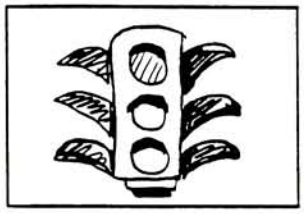




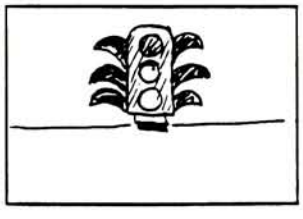


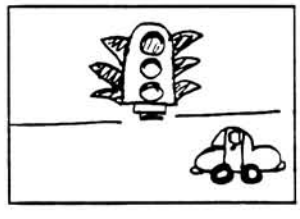


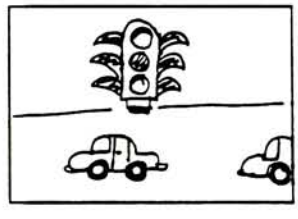


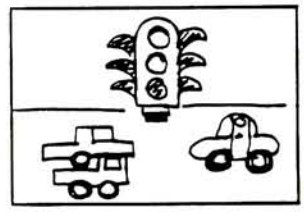


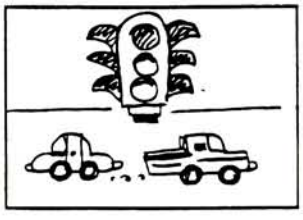
Signal

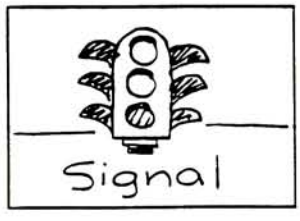












TESTING RESULTS

Karen Duerr-Clark age 8
Karen felt the monster was funny. She had virtually no trouble with using the mouse for the first time. She liked the games screen design. She felt the game was a challange and would have liked to play longer. She seemed to really enjoy the animtions. I helped her with the words a bit. She really could have used some sort of clue. She wanted to know which letters she had already choose. She suggested having some sort of box that displayed letters already used.

Jennifer Stone age 6
The monster disturbed her, too many teeth she said. She played nummerous games but I had to help her some with clues. She said the game was alot of fun. The mouse gave her some trouble but eventually she got it. She also wanted to know what letters she had choosen.

Jennifer Horton age 6
Jen thought the monster was great. She wanted to know more about him. She suggested some sort of clue if you were really stuck. She seemed to enjoy animations and often asked to see them again.

Patrick Sung age 6
Patrick liked the game. The game (level 1) was fairly easy for him. He did not react to the monster at all except that the monster should say something like "alakazam".

Each child was tested individually on Level 1. All the children watched the title animation and then choose the help section. After reading them the fist screen they wanted to play. The other two help screens were not used and none of the children wanted to see the practice game. They were familiar with the game because it relates to the popular game of Hangman. I tested six children a second time on the entire game. All changes were made and every child that played even some older children tried it loved it. None of the children had anything bad to say or anything to say at all they were so busy playing. The children also played with more than one person. This I thought was interesting. One child would man the mouse and the other would make choices. At this point I felt the game was successful in many ways.


LEVEL 2
SPELLS
SJK
W H A L E
7
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
END GAME

ADDITIONAL INFORMATION

TIMELINE

Complete Time Line For Thesis

Nov 20 - Dec 15 sketches for interactive program, concepts, flowchart
Nov 20 - Jan 10 continue and organize research
Dec 15 - Jan 30 Preliminary run through program
Jan 10 - Feb 30 First draft paper
Jan 30 - Feb 4 Test program feedback
Feb 4 - Feb 12 Implement changes, revise program
Feb 13 - Feb 15 Repeat testing, Feedback
Feb 15 - Mar 26 Revise and refine program
Feb 30 - Mar 26 Revise paper
April 16 written portion finished, refine program

Sectioned Time Line

Thesis Paper
Nov 20 - Jan 10 continue and organize research
Jan 10 - Feb 30 first draft paper
Feb 30 - Mar 26 revise and refine paper
April 16 written portion finished completed

Interface
Nov 20 - Dec 15 Sketches for interactive program, concepts, flowchart
Dec 15 - Jan 30 First run through program
Jan 30 - Feb 4 Test Program
Feb 4 - Feb 12 Implement changes revise program
Feb 12 - Feb 15 Repeat testing, feedback
Feb 15 - Mar 26 Revise and Refine Program

SEARCH WORDS / OTHER TOPICS

Interactive media

Children's books

Children's graphics

Computers

Education

Learning

Interactive Learning

Child psychology

Multimedia

Video Disk

Children's Art

Early Childhood development

Instructional Delivery Systems - magazine

CD Rom - Revive

Multimedia Video Disk Monitor

Apple Pittsford 381-7772

Boces - large collection of learning programs Larry 383-2238

The Tech Horizon Education

Seymore Papert - Interactive

Bank Street College

U of R Library

Personalize Interactive Children's stories Microzine, Apple II

AGE GROUPS

Picture Books: Ages 2-5 for youngest readers who are learning the physical skills involved in reading and are learning letters through pictures of familiar objects, such as home and neighborhood scenes, parent/child relationships, baby animals, vehicles, and favorite toy and television characters.

Easy Readers: Ages 6-9 for children beginning school and mastering basic reading skills. Because these books are geared for children to read by themselves, the format carefully designed to provide large type with only a certain number of characters per line and a small picture on each page or a two page spread.

Middle Grades: Ages 8-12 for children in the upper elementary grades who are achieving real fluency in reading. These books range from 48 to 128 pages, usually contain some illustrations, and are best suited to the writer with a discursive style. Kids this age skip from subject to subject.

Young Teenagers: Ages 10-14 for children of middle school or junior high school age. The format for these books does not vary markedly from that of a middle-grade books, but the design is somewhat snazzier and the subject matter begins to break down into bot interest (field sports, electronics) and the girl interest (biographies, art subjects). Both boys and girls are drawn to contemporary subjects, such as popular music, politics, movies and psychology.

Young Adults: Ages 12-16 for teenagers who generally prefer adult books in the nonfiction area to the carefully tailored "YA" as it's called, because they want to seem sophisticated. The young adult book is usually between 128-256 pages long, contains an index and a bibliography, and is usually more fully illustrated than its adult counterpart. Except for books that address themselves specifically to teen interests-sports, sex, grooming

Graphic Elements

the book critics silence about visual content, which is a serious problem

typical reviewers shy away from critical comments on illustrations, or else they repeat only a few generalities

this silence has allowed stereotyped illustrations, both the old-fashioned and the "mod" varieties, to flourish and remain unchallenged

art elements that are seen, and the ability of their art to communicate depends upon the sensory responses of the audience

any consideration of illustrations as less than art suggests that illustration lacks meaning in the very area it utilizes for communication - the visual

it has been suggested, children are unknowing; they merely "read" the pictures anyway

this criterion is based on the false premise that the subject content of the picture is all that children perceive when they look at an illustration

Actually the child's eyes, more than the adults see the whole of the artist's statement

untutored unaware of fashion or fad, the child's eyes take in all that the page offers

object recognition is the easiest standard for judging illustrations

and there are historical precedents for this ulitarian approach

art used to define and describe objects for the encyclopedia

technical books in the fields of science, medicine, mechanics , how to do books use illustrations to describe what is in the text

the picture illustrator has quite a different function, there is no point in being purely representational

the meaning in his picture comes from the way he arranges colors, lines, shapes and textures into a special synthesis, one that will please the senses and provide and aesthetics of common place standards, recognition, and the sense of familiarity derived from such considerations

the visual are add another dimension , this dimension is one of visual interpretation and the expression of the intrinsic nature of the tex

Color

many people can distinguish only nine colors: red, yellow, blue, green, orange, purple, black, brown,and white

the potential of color is rarely exploited to the fullest

color is solely used as a page filler much of the time, rather the as an inherent part of the arrangement

this limited use of color is in part due to an uneasy feeling among educators that too much color over stimulates children and tends to confuse their perception

Animal Motifs

It is understandable in this vast and difficult universe, that mankind values animals primarily for their usefulness, practical, spiritual and imaginative. It is even to be forgiven that our feelings about animals have grown so powerful that we are weakened in our power to see the beast himself, but truth demands that some homage be paid to the animals as independent creatures that we strike a balance between our need and their reality. In the representation of animals as independent creatures that we strike a balance between our need and their reality. In the representation of animals the worst sin against them is mockery and cuteness is the biggest blight of media for children and the representation of animals eyes are a likely index to cuteness. Cute eyes are likely to be large liquid, appealing and they have generous eyelashes. Even more damaging, they are not the eyes of animals, but the eyes of humans, and ironically the eyes of small children.

About users

The Human Interface Design Principles are based on some assumptions about people. A good interface allows people to accomplish tasks. Tasks will vary, but people share some common characteristics.

People are instinctively curious; they want to learn, and they learn best by active self-directed exploration of their environment. People strive to master their environment; they like to have a sense of control over what they are doing, to see and understand the results of their own actions. People are skilled at manipulating symbolic representations; they love to communicate in verbal, visual, and gestural languages. Finally, people are most productive and effective when the environment in which they work and play is enjoyable and challenging.

General design principles

This section describes the ten fundamental Human Interface Design Principles and discusses how each applies to designing stacks. Briefly, these principles involve

- use of metaphors
- direct manipulation
- see-and-point (instead of remember-and-type)
- consistency
- WYSIWYG (what you see is what you get)
- user control
- feedback and dialog
- forgiveness
- perceived stability
- aesthetic integrity

Metaphors from the real world

- Use concrete metaphors and make them plain, so that users have a set of expectations to apply to computer environments.
- Whenever appropriate, use audio and visual effects that support the metaphor.

People have more experience with the real world than they do with computers. To take advantage of their experience, use metaphors in your stacks that correspond to the everyday world.

HyperCard is already based on a real-world metaphor, the "card." People are familiar with using cards to organize information. The card metaphor allows users to make some important assumptions about how HyperCard works: users assume that cards can be grouped together into "stacks," that they can have both text and pictures on them, and that they can be changed or updated.

If you decide to use a new metaphor in your stack, think about how the new metaphor will affect users' expectations. For instance, a book metaphor would imply that information is presented in a linear format, that travel is limited to "forward," "backward," and "turn-to-a-given-page," and that it's possible to see all pages by simply going forward until the end.

Before you select a metaphor for your stack, make sure the content of the stack lends itself to the metaphor. Real-world metaphors tend to help users understand how to use a stack, but it's better to have no metaphor at all than to force your content into an inappropriate one.

Direct manipulation

- Users want to feel that they are in charge of the computer's activitites.
- Tell users their options by providing visible choices, ways to make their choices, and feedback acknowledging their choices.

This principle is based on the assumption that people learn best by active, self-directed exploration. People expect their physical actions to have physical results, and they want their tools to provide feedback. This feedback can be provided visually, audibly, or both.

Highlight topics of interest. Show the user what options are available. If an option is normally available, but not in a specific case, convey that information by providing a "grayed-out" version of it. If grave consequences will follow from choosing an option, warn the user before any damage is done. If a particular command is being carried out, provide visual clues. If the command can't be carried out, tell the users why it can't be carried out. Also tell them what they can do instead.

See-and-point (instead of remember-and-type)

- Users select actions from alternatives presented on the screen.
- Users rely on recognition, not recall; they shouldn't have to remember anything the computer already knows.
- Most programmers have no trouble working with interfaces that require memorization. The average user is not a programmer.

Stacks are visually and spatially oriented. The way everything appears—text, graphics, buttons, options—should be consistent and well thought out. Users should be able to anticipate what will happen when they interact with your stack by choosing objects, activities, and options.

Don't force users to remember the possible destinations and ways of getting around your stack; keep those options present on the screen, and make their use clear. Most stacks will have two kinds of see-and-point navigation options on the screen: those that are available at all times, such as Help, Return to Start, or Quit HyperCard, and those that are card specific.

There can be advantages—such as speed—to the "remember-and-type" approach. If you decide to offer keystroke alternatives, offer them in addition to, not in place of, the on-screen methods. Users who are new to your stack or who are looking for potential actions in a confused moment, must always be able to find a desired option on the screen.

Just as the average user is not a programmer, the average user is not a HyperCard power user. Don't rely on the user's knowledge of keyboard shortcuts to navigate. In fact, don't rely on the user's knowledge of stacks or HyperCard at all. Set up an environment, teach the user about it, and provide see-and-point ways to use and navigate through it.

Consistency

Effective applications are both consistent within themselves and consistent with one another.

Consistency within a stack is essential. The look, the usage, and the stack behavior should be the same throughout. The way the user does things should always be consistent within a stack. For example, your stack should have a consistent design for these elements:

- graphic look
- grouping of buttons
- placement of buttons
- visual and audio feedback
- card layout
- background for cards with similar functions
- stack structure

Consistency in these elements makes it easier for the user to focus on the content of the stack.

If you plan to use any of the standard elements of the Apple Desktop Interface in your stack (such as menus, dialog boxes, and so forth) follow the guidelines presented in *Human Interface Guidelines: The Apple Desktop Interface.*

WYSIWYG (what you see is what you get)

- There should be no secrets from the user, no abstract commands that only promise future results.
- There should be no significant difference between what the user sees on the screen and what eventually gets printed.

The WYSIWYG principle has special significance in stack modeling and navigation. The layout of your stack should not, except in special cases, be a secret to your user. Part of "What you see is what you get" is letting the users know what they're seeing, and how it relates to the whole stack.

If you provide a representation of your stack, such as a stack map, table of contents, or menu, that representation should contain an accurate and complete model. Nothing frustrates a user more than finding a part of the stack that's not on the stack map, or discovering that the stack's true structure isn't anything like what the menu implied. Make coherent models and communicate them. Let the users know where they are in relation to the whole. Provide a map, but also provide "You-are-here" indicators, or names for the individual screens.

User control

- The user, not the computer, initiates and controls all actions.

People learn best when they're actively engaged. Too often, the computer acts and the user merely reacts. Or, the computer "takes care" of the user, offering only those alternatives that are judged "good" for the user or "protect" the user from detailed deliberations.

This protective approach may seem appealing, but it puts the computer, not the user, in the driver role. In most cases, it's better to let the user try risky things. You can provide warnings, but let the action proceed if the user confirms that this action is indeed desired. This approach protects the beginner but allows the user to remain in control.

Get your user doing something quickly. Good stacks are interactive. Many stacks begin with an "attract mode," where the screen is alive with inviting animation, rich graphics, and the words "Click to begin."

Let the user choose what happens next, both in using the stack and in navigating around it. This is especially important when offering long animation or sound sequences.

Suppose you wanted your stack to provide a slide show with accompanying music. A frustrating implementation, giving the user no control, would start the slide show and music the instant the stack opened, and run for several (possibly loud) minutes until done. An implementation that gives the user more control might open on a screen that indicates the length of the slide show, asks the user to set the volume level or turn off sound, provides a button called "Start slide show" and displays an unobtrusive sentence, saying "Click any time to interrupt."

Feedback and dialog

- Keep the user informed.
- Provide immediate feedback.
- Make user activities simple at any moment, though they may be complex taken together.

To be in charge, the user must be informed. When, for example, the user initiates an operation, your stack should provide immediate feedback to confirm that the operation is being carried out, and (eventually) that it's finished.

Immediate feedback can be provided by buttons that become highlighted, click, beep, or display a visual effect. For time-consuming operations, feedback can be provided by temporarily changing the cursor into a watch or beach ball or by displaying a message that explains the reason for the delay.

If an operation can't be completed, tell the user why it can't be completed. This communication should be brief, direct, and expressed in the user's vocabulary, not the stack designer's or the programmer's.

Forgiveness

- Users make mistakes; forgive them.
- The user's actions are generally reversible—let the users know about any that aren't.
- Users get lost in stacks; help them find their way.

Most users don't like to read manuals. They would rather figure out how something works by exploration, with lots of action and lots of feedback.

As a result, users sometimes make mistakes or explore further than they really wanted to. Forgiveness means letting users do anything reasonable, letting them know they won't break anything, always warning them when they're entering risky territory, then allowing them either to back away gracefully or plunge ahead, knowing the consequences.

When options are presented clearly, with appropriate and timely feedback, alert messages should be infrequent. If the user receives a barrage of alert messages, gets lost frequently, or can't figure out how to use the stack, something is wrong with the stack's design.

Perceived stability

- Users feel comfortable in a computer environment that remains understandable and familiar rather than changing randomly.

People use computers because computers are versatile and fast. Computers can calculate, revise, display, and record information far faster than people can. If users are to cope with the complexity a computer handles so easily, they need some stable reference points.

These stable reference points are established by how your stack looks, how it acts, and how it feels. You are setting up an implicit contract with your user about the rules of this particular environment, and those rules should be clear and communicated.

Most important, your stack should provide conceptual stability. Give your user a consistent model for how to perceive the stack's function and structure. Note the emphasis on "perceived"; a user may *perceive* your stack to have a single-frame, tree, or network structure, even though in *fact* all stacks are linear sequences of cards, with different navigational control structures superimposed. Provide a clear, finite set of options, and tell the user what they are.

Your stacks should also provide visual stability. Provide a constant overall look and graphic design for your stack. Design the card layout to be constant for similar cards and visually related for all cards in the stack. Place your buttons in reliable and functionally grouped locations. Use a consistent button design; If you're using the same button on several cards, don't represent the button by an icon on one card and a text label on another.

The illusion of stability is what's important. The environment can and should change as users interact with it, but should give users a number of familiar landmarks to rely upon.

- Visually confusing or unattractive displays detract from the effectiveness of human–computer interactions.
- Different "things" should look different on the screen.
- Messes are acceptable only if the user makes them—stacks aren't allowed this freedom.

In traditional computer applications, the visual appearance of the screen has been a low priority and consequently somewhat arbitrary. In contrast, HyperCard stacks *depend* upon the visual appearance of the screen. As much as possible, commands, features, parameters, choices, navigational options, and data should appear as graphic objects on the screen.

People deserve and appreciate attractive surroundings. Consistent visual and audible communication is very powerful in delivering complex messages and opportunities simply, subtly, and directly.

Summary

These ten general design principles form a powerful basis for designing and evaluating your stacks. These principles provide general guidance. Most people don't have extensive backgrounds in user interface design; following these ten principles is a simple way to make your stacks more usable. A single principle, such as that of user control, can guide many decisions, from giving users buttons with which to control their navigation to giving them volume controls with which to turn sound up, down, or off.

If you plan to use elements from the standard Macintosh desktop interface, get the book *Human Interface Guidelines: The Apple Desktop Interface,* published by Addison-Wesley. In addition to discussing these design principles, this book specifies in detail how elements such as a Macintosh window, dialog box, or pull-down menu should act.