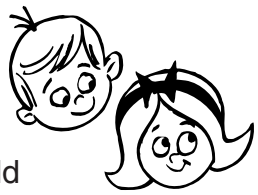
Kids Inventing Technology Series

What Is Design?

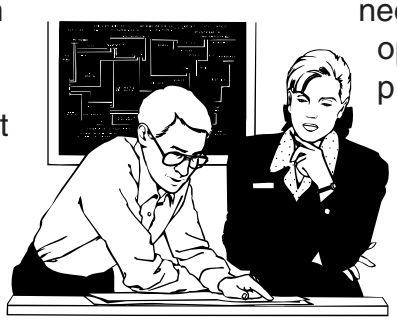
Introduction



If you were to ask children what they want to be when they grow up, you would hear a number of answers including an architect or an engineer. These professions are interesting to children because they involve solving problems and designing new objects. Many new technologies start with a design process when they are developed. Because technology is human-made, and not found in nature as science is, humans must design the technology before it is available for use. Design is the only way to develop new technologies and it has been used in some form in most technologies that have been developed.

Designers do not all follow the same process. However, all designers do follow a process. The process begins with a recognized need or a want. The need could be as complex as a more aerodynamic and efficient vehicle or as simple as a better way to open a jar of peanut butter. Without a need or a want, the designers would have no reason to design a new object. Once the designers have identified a need or a want, they can start designing a device or system that will do the job or complete the task.

Architects and engineers are not the only people who can design new technology. Anyone can design new products, structures, and systems. Some of the greatest inventions were designed by people who simply had a need or a want and developed a way to solve their problem. However, architects and engineers are trained to follow a design process that makes them efficient designers.



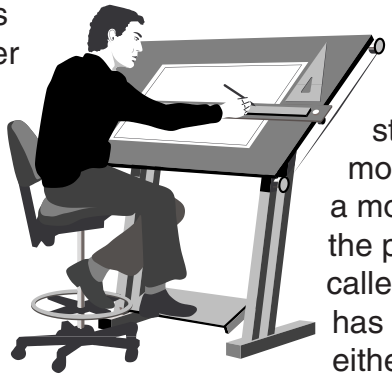
When designers design new products, systems, and structures, they start by determining exactly what the problem is that they are trying to solve. It would not be helpful if an architect designed a one-story house if the need was for a 200-room hotel. Once the problem is identified, they brainstorm and generate many different ideas. As the

Technological Literacy Standard #8

Students will develop an understanding of the attributes of design.

designers brainstorm, they begin to look at the design requirements. Design requirements include considerations such as the size, cost, and functions of the product. These requirements are used to ensure that the product will function in a way that meets the need or want.

Design is a creative process and the more ideas the designer can generate the better. It is easier to create a new and innovative product if there are a number of creative and original ideas to work with. Designers sketch these ideas onto paper as they come to them. By creating sketches, the designers can better visualize the ideas and can also show other designers their ideas. Designers often work in teams so they have other people to help them see different aspects of the design. Sometimes one designer may be stuck with a single idea and another designer can help to stimulate creativity and together they can design an innovative product.



Designers work from the sketches and develop a final set of plans for the new technology. The plans could be floor and elevation plans for a building, engineering drawings for a product, or a schematic of an electrical system. From the plans, the designers then develop a model of the device, structure, or system. A working model is known as a *prototype* and a model that is used to show how the product or structure will look is called a *mock-up*. Once the model has been evaluated the product will either be built or redesigned.

Design never ends; there is always room to redesign products. Design is used to create everything from buildings to clothes. The design process is used in every aspect of technology. It enables us to convert our own ideas into technology.

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Grades K-2

Designing a Dog "Home"

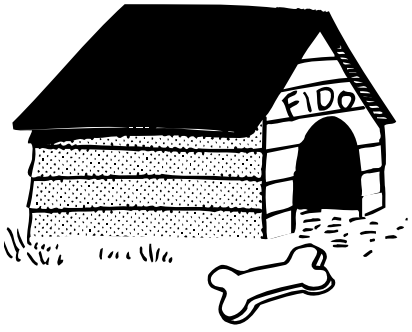
Introduction

Design is a creative process that allows designers a great amount of flexibility. The designers must first know the problem they are facing and can then approach the problem from any angle that they see fit. In this activity, your students will approach a design problem from the eye of the user of the product, a dog. Your students will put themselves in a dog's life and determine what types of things a dog would want to have in his or her home. They will then design a home for the dog, which will include the necessary equipment they feel the dog needs.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Collect children's books about dogs, for example: *Clifford, the Big Red Dog* or *McDuff Moves In*.
- Prepare a display showing different designs of similar products.
- Gather the tools and supplies listed at right.



Benchmark

This activity will help students reach the following benchmarks:

Everyone can design solutions to a problem.

Design is a creative process.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Large and small pieces of cardboard
- Paper glue
- Clear or masking tape
- Scissors
- Pencil and ruler
- Colored markers or crayons
- Construction paper
- Posterboard
- Copies of all handouts

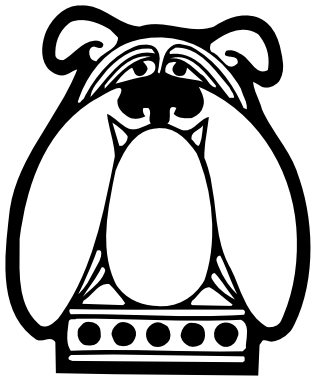
Preparing the Students

Introduce the students to design by:

- Explaining that all products and structures are designed.
- Showing them design drawings (floor plans, product designs, sketches from owners manuals).
- Discussing that design starts with a need or a want. Designers create sketches of possible solutions to a design challenge.

Conducting the Activity

1. Read a story to the students about a dog.
2. Hand out the "day in the life of" worksheet.
3. Have the students complete the hand-out.
4. Ask the students how they responded to the questions. Write the responses on the board.
5. Discuss the different answers and explain that they are doing what is called brainstorming.
6. Hand out the "Dog Home Design" handout.
7. Have the students think about the responses on the board and draw their own dog home.
8. Once the handout is completed, group the students into groups of four.
9. Have each group member show the rest of the group his or her dog home.
10. Hand out posterboard and markers to each group.
11. Have each group draw a new dog home on the posterboard, using the ideas of the group.
12. Once the groups have completed their dog house drawings, give each group a set of construction supplies (scissors, cardboard, markers, masking tape, construction paper, and glue) and a place to work.
13. Have each group build a dog home that would be the appropriate size for a dog.
14. Give the groups an opportunity to decorate the home.
15. Ask each group to show the rest of the class its dog home.



Checking for Understanding

Throughout the activity, encourage students to be as creative as possible. Ask why they are designing their house the way they are.

When the activity is completed, ask the students about the design process and how it is used to design things.

How has the design of the following objects changed during your lifetime?

- ✔ Computers
- ✔ Automobiles
- ✔ Lunch boxes
- ✔ Televisions

A day in the life of . . .

What types of things do dogs do:

In the morning?

In the afternoon?

In the evening?

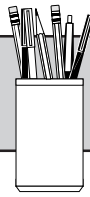
If you were a dog, what would you want in your home?

Dog House Design

Draw how you would want your house to be if you were a dog.

Grades 3-5

Designing a Desk Organizer

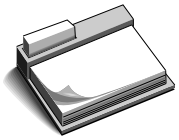


Introduction

The use of the design process enables us to create solutions to problems in our everyday life. The automobile was a solution to the problem of slow travel. The dishwasher was the solution to the problem of the time wasted in washing dishes by hand. In this activity, your students will design a solution to a problem that they face every day: how to keep their desks clean and organized. The students will begin by developing design requirements. They will then design and build a solution that they can use in their own desk.

Teacher Preparation

To prepare to introduce the students to this activity, you should:



- Collect various types of desk organizers.
- Create a display that focuses on the use of the design.
- Gather the following tools and supplies.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Copies of all handouts
- Tape measures
- Cardboard

Benchmark

This activity will help students reach the following benchmarks:

The design process is a purposeful method of planning practical solutions to problems.

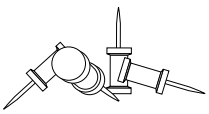
Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design.

- Thin strips of balsa or bass wood
- Coping saws
- Brads
- Small hammers
- Wood glue
- Colored markers or wood finish
- Tape
- Construction paper

Preparing the Students

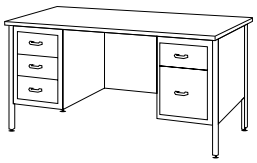
Set the stage for the design activity by:

- Introducing the students to the design process.
- Describing the design process as a creative way to solve problems.
- Explaining that all human-made objects are designed.



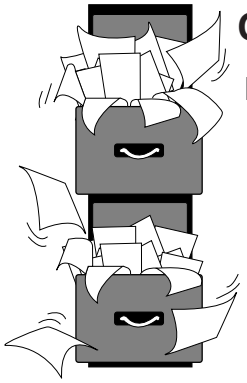
- Explaining that some designs have design requirements and that examples of design requirements are size, shape, cost, and function.

Conducting the Activity



1. Tell the students that they will use a design process to design a desk organizer.
2. Hand out the *Desk Inventory* worksheet and tape measures. See page 9 for a sample worksheet.
3. Have the students share the tape measures as they complete the worksheet.
4. Hand out the *Design Requirements* worksheet like the one shown on page 10.
5. Have the students fill in the blanks with data from the *Desk Inventory* worksheet. This worksheet provides the students with a set of requirements for their product.
6. Have the students make several sketches of possible solutions. They should use a *Preliminary Design* sheet like the one shown on page 11.
7. Once the students have made sketches, have them measure the different objects in their desks. They should use the measurements to make sure the objects will fit in the organizer that they are designing.
8. Using the measurements, have the students create a final design of their desk organizer. They should use a *Final Design* sheet like the one on page 12 and draw the organizer as if they were looking straight down at it.
9. Have the students place dimensions on the organizer so they know how big the sections will be.
10. When the students have completed their sketches, they should build a model (prototype) of their organizer. It should be built out of either cardboard or balsa wood.
11. Show the students how to use the tools they will be using, such as utility knives and coping saws. Review safety rules with the students
12. Have the students:
    a. Measure and cut all of their pieces.
    b. Use either the glue or the brads and hammers to assemble their products.
    c. Apply finish or use colored markers to decorate the organizer.

13. Once they have completed their model, have the students place the organizers in their desks. They can then evaluate the organizers by placing their objects back into their desks.
14. If any changes need to be made, have the students redesign their organizers.
15. When all students have completed any final changes to their models, have them show their desk organizers to the rest of the class.



Checking for Understanding

During the activity, check to make sure the students measured their desks correctly and that their design has allowed for all of the items they have on their list. Understanding has been attained when they have a functional solution to the problem of organizing their desks.

Desk Inventory

List and measure all the objects that you keep in your desk.

Object	Size

Measure the inside section of your desk.

Length from the front to the back

Width from side to side

Height from the bottom to the top

Design Requirements

Select the items from your inventory that you want to keep in an organizer.

Object	Size

Establish the maximum size that the organizer can be. Remember to leave room in the desk for larger items that will not be in the organizer.

Length from the front to the back

Width from side to side

Height from the bottom to the top

Preliminary Designs

Sketch several designs for a desk organizer on the grid below.

Final Design

Select the best ideas from your preliminary designs and sketch a final design for a desk organizer on the grid below.

Extending the Activity
Designing a Playground

Discuss the different playgrounds students have seen. List the different playground equipment that they have used.

Have the students design a different playground for the school.

Have the students design a new piece of playground equipment.

Evidence of Attainment

Students who have developed an understanding of the attributes of design are able to:

Develop, modify, and evaluate designs.

Develop criteria and constraints for a design problem.

Develop appearance and working models of a design solution.

Design solutions to different problems.

Design products within certain design requirements.

Connections to Other Subjects

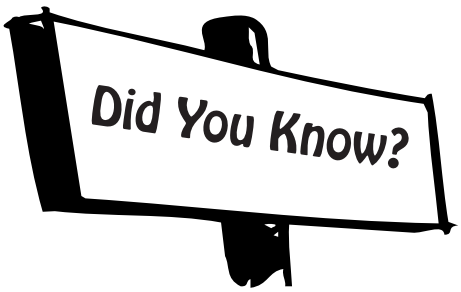
Science: Designing products to withstand natural forces.

Mathematics: Using tape measures to measure linear distances.

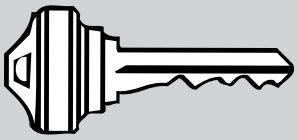
Social Studies: How different designs have influenced society.

Language Arts: Writing design requirements, technical writing.

Art: Graphic design, sketching.



- ✔ Adi Dassler, founder of Adidas, was once a famous shoemaker and had more than 800 patents.
- ✔ George Washington Carver, who was born of slave parents, developed crop-rotation methods for conserving nutrients in soil and discovered hundreds of new uses for crops such as the peanut.
- ✔ The world's first useful antifungal antibiotic, nystatin, was developed by Elizabeth Lee Hazen and Rachel Fuller Brown.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.	Model	A representation of an object used to test ideas.
Design	A creative process used to develop solutions to a problem.	Design criteria	Key features and operational characteristics that a design must have.
		Design constraints	Market, regulatory, economic, and engineering limits placed on the design.

Books

Bridwell, Norman. (1985). *Clifford, The Big Red Dog.* New York: Scholastic. ISBN: 0-590-44297-X.

McNiven, Helen and McNiven, Peter. (1995). *Models.* New York: Thomson Learning. ISBN: 1-56847-214-5.

Moss, Miriam. (1991). *Fashion Designer.* New York: Macmillian Publishing Company. ISBN: 0-89686-610-6.

Oxlade, Chris. (1994). *Inventions.* Sussex, England: Zigzag Publishing. ISBN: 1-85993-166-9.

Wells, Rosemary. (1997). *McDuff Moves In*. New York: Hyperion Books for Children. ISBN: 0-7868-0318-5.

Young, Robert. (1991). *Sneakers: the Shoes We Choose.* Minneapolis, MN: Dillon Press. ISBN: 0-87518-460-X.

Web resources

American Institute of Graphic Arts.
URL: http://www.aiga.org

Industrial Designers Society of America.
URL: http://www.idsa.org

Core77 Design Magazine.
URL: http://www.core77.com

Kids Inventing Technology Series

What Is Engineering Design?

Introduction

Each of us lives in a designed world. We spend most of our time in artificial or human-built environments that seek to reduce the negative impacts of the natural world. We use heating systems and air conditioning units to make our homes more comfortable. Modern transportation vehicles move us and our possessions rapidly from place to place. Farms provide us with an array of food choices that people in some other countries cannot believe. Our retail stores present us with countless options for clothing, appliances, entertainment, and household goods.

This human-built world around us is the product of a process we call *engineering design.* It is the result of human creativity, innovation, and inventiveness.

The engineering design is, essentially, a process of recognizing a human need or want; seeking information needed to understand the situation; identifying possible products or systems that will satisfy the opportunity; and selecting, making, evaluating, and modifying the solution.

One model of this engineering process has seven steps. These are:

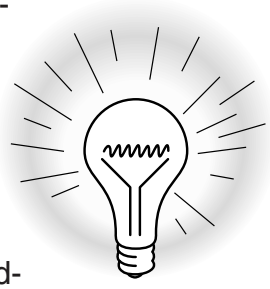
1. Identify the problem:

Most engineering problems start with a problem that has no clear solution. People know that the situation needs improving but don't know how.

For example, they may know that a kitchen utensil constantly slips from the operator's hand, the light in the room is too dim to read by, that traffic is snarled during rush hour, or an appliance uses too much electricity. The first step in engineering design is to clearly describe the problem and the requirements a solution must meet.

2. Gather information:

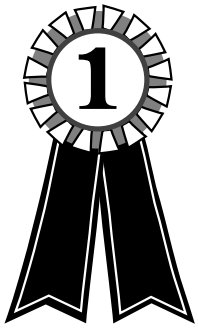
The engineering design process is an ongoing process. It is based on advances in scientific and technological knowledge and prod-



Technological Literacy Standard #9

Students will develop an understanding of engineering design.

ucts already developed. A good designer reviews how other people solved similar problems and gathers information that could be used to solve the design problem.



3. Develop possible solutions: With almost every problem there is more than one adequate solution. Designers generally develop several product or system designs that could solve the problem.

4. Select a promising solution: Only one solution can be used at a time to solve a problem. Designers and engineers use their knowledge of the problem to select the best solution from the several they have identified.

5. Modeling: The designer needs to know that the selected solution will adequately address the problem. Since most engineering designs are developed for products that will be produced in large quantities, often a model is built to see if the design can be manufactured and if it will function properly.

6. Evaluation: The design model is assessed to see that it functions properly, can be operated easily, and can be safely used.

7. Refine and release: The results of the design evaluation are used to alter and refine the final design. The refined solution may be modeled and tested again. Finally, it is released for pilot or full-scale production.

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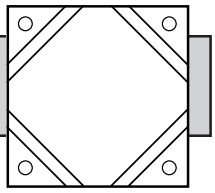
Grades K-2

Designing a Simple WallTile



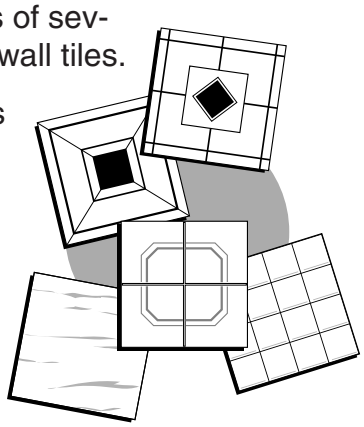
Introduction

Engineering design is a creative process that challenges designers to develop a product or system that meets some stated limitations or criteria. The designers must identify the specific problem they are facing and then develop a solution that addresses the challenge. Quite often the designers will first explore a number of possible solutions, then select and refine the best solution. Your students will play the role of product designer as they design a tile they can use for a wall tile or a trivet (hot dish holder).

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Gather some simple products that have been designed. (All products are the product of engineering design.)
- Prepare a transparency that presents the steps of engineering design. See Transparency #1 on page 6.
- Gather samples of several decorative wall tiles.
- Gather the tools and supplies listed at right.



Benchmark

This activity will help students reach the following benchmark:

The engineering design process includes identifying the problem, looking for ideas, developing solutions, and sharing solutions with others.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Air-dry clay
- 1/4" thick x 1" wide wood or plastic strips
- Rolling pins or 8" lengths of 2" diameter PVC pipe
- Plastic table knife
- Poster paint
- Round end pens (stylus for forming tile details)
- 4" x 4" template (wood, posterboard, or plastic)

Preparing the Students

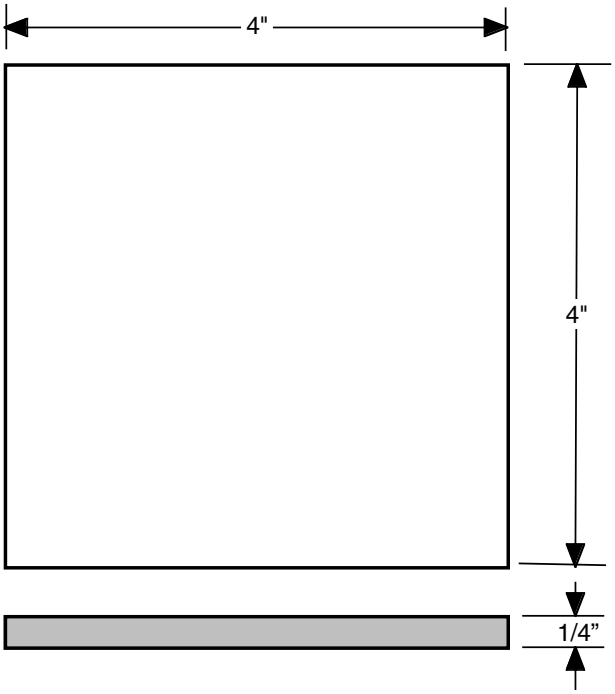
Introduce the students to design by:

- Explaining that all products and structures are designed by people.
- Discussing the use of criteria to limit or direct a design effort.
- Explaining that design starts with a designer identifying a need or a want.
- Explaining that designers create sketches of possible solutions to a design problem (brief).

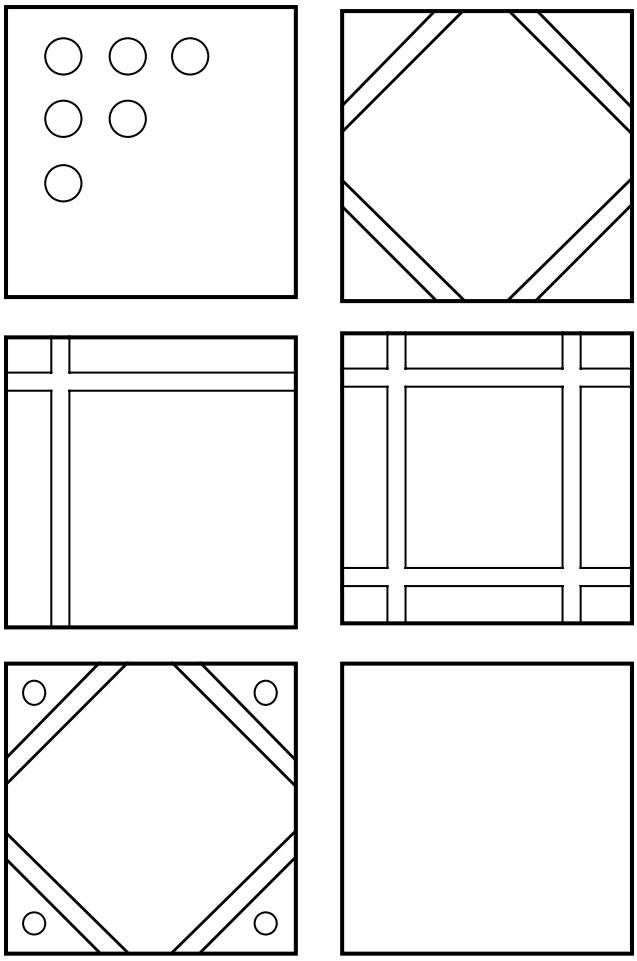
Conducting the Activity

1. Show the students samples of clay tile.
2. Discuss the design challenge:

   Develop a 4" x 4" wall tile that is attractive to look at.



3. Introduce the design process shown on Transparency #1:
   a. Write the problem.
   b. Develop at least two designs that will solve the problem.
   c. Select the best design.
   d. Make a model of the design.
4. Have the students:
   a. Write the design problem on a product design worksheet like the one shown on page 6.
   b. List the limitations or criteria for the design (i.e., 4" x 4" square, 1/4" thick, attractive.) You may want to develop these using a class discussion.



How has the design of the following objects changed during your lifetime?

- ✔ Computers
- ✔ Automobiles
- ✔ Lunch boxes
- ✔ Televisions

5. Have the students draw two possible designs on their product design worksheets.

   Examples of possible designs are shown on page 4.

6. Have each student select his or her best designs and show it to a fellow classmate.

7. Demonstrate how to make a blank tile as shown in the drawings below:

   a. Place two strips of 1/4" thick plastic or wood about 6" apart.

   b. Place a lump of clay between the strips.

   c. Use a rolling pin or piece of PVC pipe to roll out the clay. Keep each end of the rolling pin on the strips.

8. Have each student:

   a. Make one or two blank clay tiles.

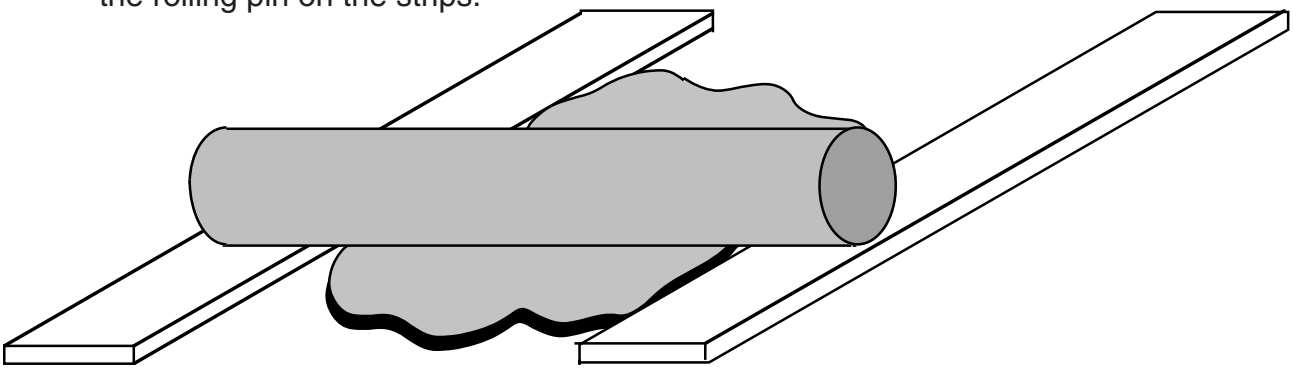
   b. Decorate the tiles by either:

      (1) making indentions with a round-tipped object (pen cap, etc.) and letting the tile harden OR

      (2) letting the tile harden and then painting a scene with poster paint.

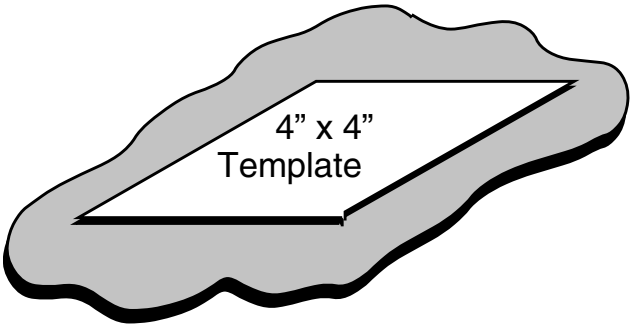
9. Have each student evaluate his or her tile by showing it to a fellow classmate. He or she should ask for suggestions for ways to improve the design.

   Each student should complete the "Improving the Design" section of their design worksheet.



Making a 1/4" thick slab of clay.

   d. Use a table knife to cut around a 4" square template.



Make a blank tile from a 1/4" thick slab of clay by cutting around a 4" x 4" template.

Checking for Understanding

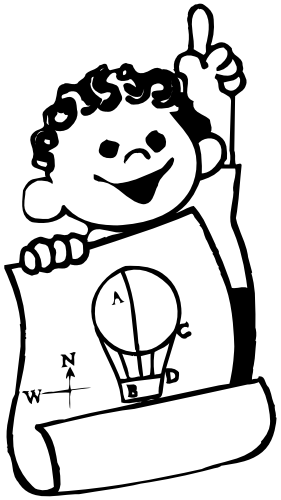
Throughout the activity, encourage students to be as creative as possible. Ask how their designs meet the design problem. Ask them to relate their designs to the constraints or criteria they have developed.

When the activity is completed, ask the students about the steps in the engineering design process and how they used them to design their tiles.

Steps in Engineering Design

Develop Possible Solutions

Select the Best Solution



Build and Test the Solution

Transparency #1

Designing a Wall Tile

Design Problem (Statement)

What is your design problem?

Design Limitations (Criteria)

What limitations must the design meet?

1.

2.

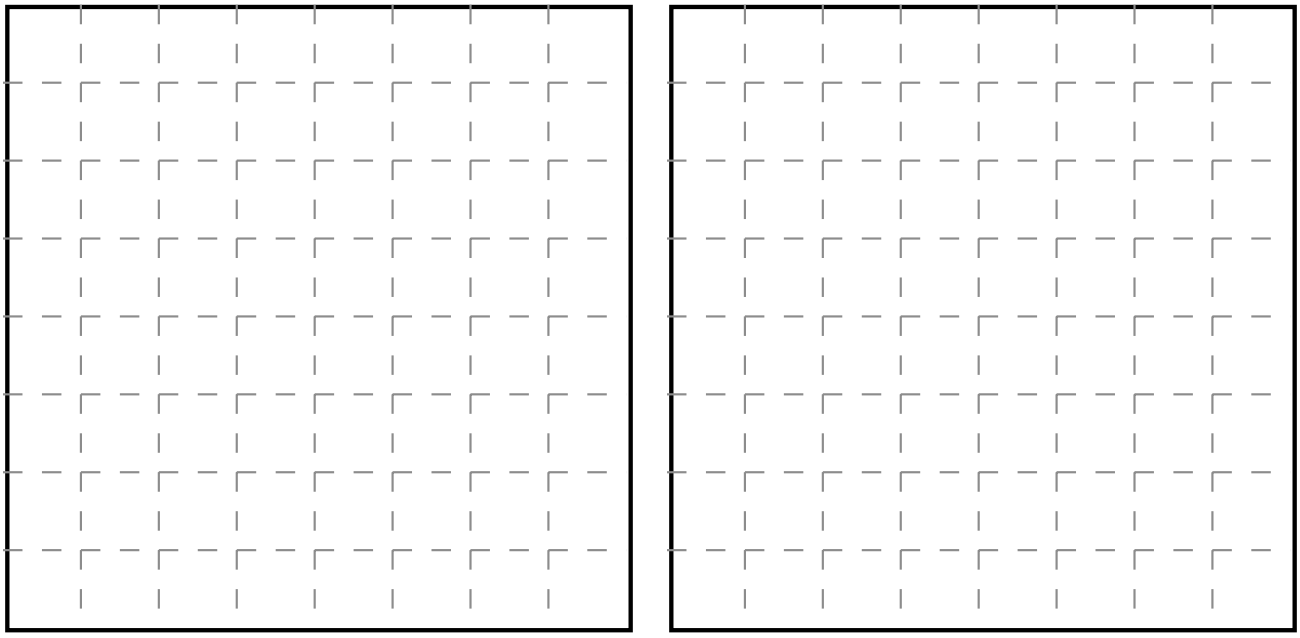
3.

4.

Designing a Wall Tile

Possible Designs

Sketch two designs for wall tiles on the grids below. Each line equals a 1/2" space.

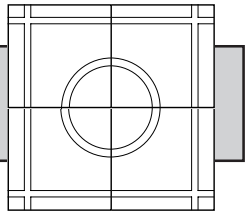


Design Evaluation:

How could you improve your design?

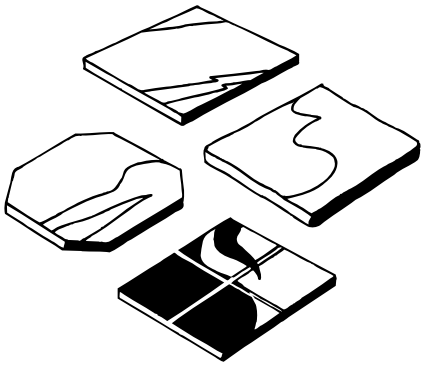
Grades 3-5

Designing a Set of Wall Tiles



Introduction

Engineering design is a creative process that challenges designers to develop a product or system that meets some stated limitations or criteria. The designers must identify the specific problem they are facing and then develop a solution that addresses the challenge. Quite often the designers will first explore a number of possible solutions, then select and refine the best solution. Your students will play the role of product designer as they design a multi-tile set they can use for a wall tile or a hot dish holder.



Teacher Preparation

To prepare to introduce the student to this activity, you should:

- Gather some simple products that have been designed. (All products are the product of engineering design.)
- Prepare a transparency that shows the steps of engineering design. See Transparency #2 on page 12.
- Gather samples of several decorative wall tiles that can be placed together to make a pattern. These can be geometric or pictorial tiles.
- Select a type of tile that the students will design. Examples would be commemorative, geometric, and pictorial.
- Gather the tools and supplies listed in the next section.

Benchmark

This activity will help students reach the following benchmarks:

The engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results.

When designing an object, it is important to be creative and consider all ideas.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Air-dry clay
- 1/4" thick x 1" wide wood or plastic strips
- Rolling pins or 2" dia. x 8" long PVC pipe
- Plastic table knife
- Poster paint
- Round end pens (stylus for forming tile details)
- 4" x 4" template (wood, posterboard, or plastic)
- Copies of all handouts

Preparing the Students

Introduce the students to design by:

- Explaining that all products and structures are designed by people to meet an identified need or want.
- Discussing how designers use criteria to limit or direct their design efforts.
- Explaining that:
  a. Designers start their work with a need or a want statement. This is sometimes called a design brief.
  b. Designers create sketches of many possible solutions, then select the best solution.
  c. Designers use models to test and evaluate their solution.

Conducting the Activity

1. Introduce the design challenge to the students.

   Design a set of decorative clay wall tiles that go together to produce a desired effect.

   Note: This is an extension of the K-2 activity in this package. This activity for grades 3-5 requires the students to design a set of tiles that fit together to form a pattern or a picture. See the examples below. You may want to review the K-2 activity before you introduce this design challenge.

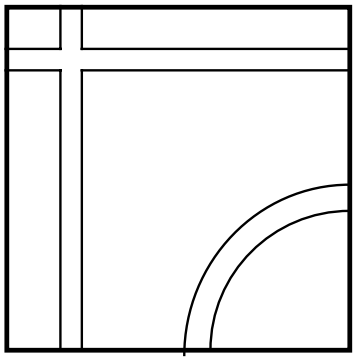
2. Work with the students to enlarge this statement to include:

   a. A focus or theme (commemorative, kitchen decorative, fine art decoration, etc.).

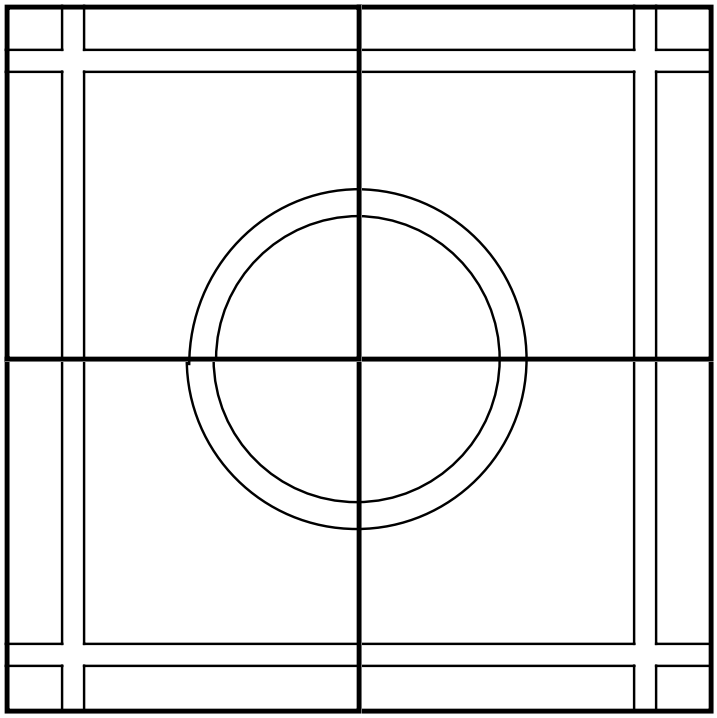
   b. A set of criteria that limits the size of the tiles (4" x 4"), number in a set (4 or more), etc.

   Have them include the results of this step on a *Design Brief* sheet like the one found on page 13.

3. Have each student use a *Preliminary Design* worksheet like the one on page 14 to:



Single tile

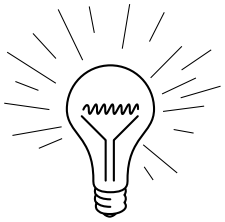


Four single tiles arranged to make a pattern

a. Prepare at least two overall designs for the set of tiles.

b. Prepare an enlarged drawing of one key tile in the set.

4. Have each student:



a. Present the set of tile designs to two other classmates.

b. Ask the classmates for suggestions for improving the designs.

c. Select the best design.

d. Prepare a final design using a worksheet like the one shown on page 15.

5. Demonstrate techniques for producing tiles. See the illustrations and directions included in the K-2 Activity in this package.

6. Have the students work in pairs to produce sets of tiles.

7. Have each student:

a. Present his or her tiles to the class.

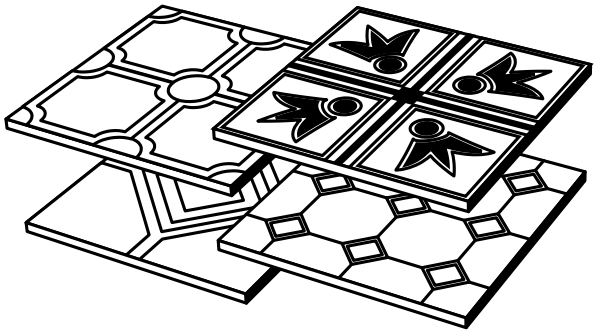
b. Ask for suggestions for improving the designs.

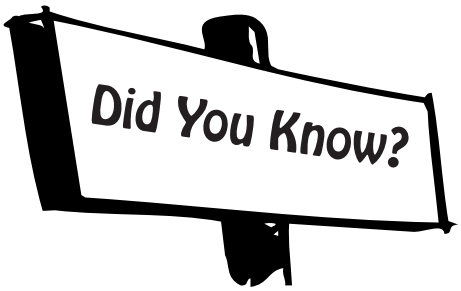
c. Complete the design review section at the bottom of his or her *Design Brief* worksheet.

Checking for Understanding

At various times during the activity, ask the students which step of the engineering design process they are working on. Ask them why the step is important.

Ask them why they are developing a specific design. (The answer should relate to the design brief—the design statement and constraints.)





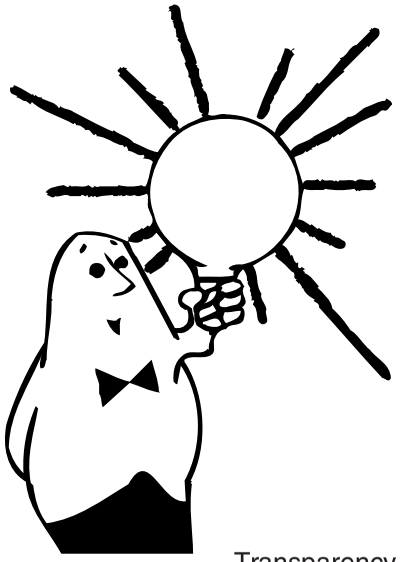
- ✔ Did you know that the word ceramic comes from the Greek word 'Keramos´? It means "potters earth."
- ✔ Bricks have been used from at least 2300 BC.
- ✔ Porcelain was first made in China 1,000 years ago.
- ✔ The world of ceramics includes the manufacturing of dinnerware and cookware, building materials, such as a wide range of bricks; wall and floor tiles; bathroom fittings; pipes for drainage and sewerage; and a range of speciality products.
- ✔ A layer of ceramic tiles provides the thermal protection, that enables the space shuttle to return safely to earth.

Steps in the Engineering Design Process

Identify a Need or Opportunity

Gather Information

Develop Possible Solutions



Select the Best Solution

Build a Model of the Solution

Test and Revise the Solution

Transparency #2

Design Brief

Write a statement of the problem.

Prepare a set of constraints or criteria that will direct the design effort.

1.

2.

3.

4.

5.

6.

When you have finished the design process, list ways that the design could be improved.

1.

2.

3.

4.

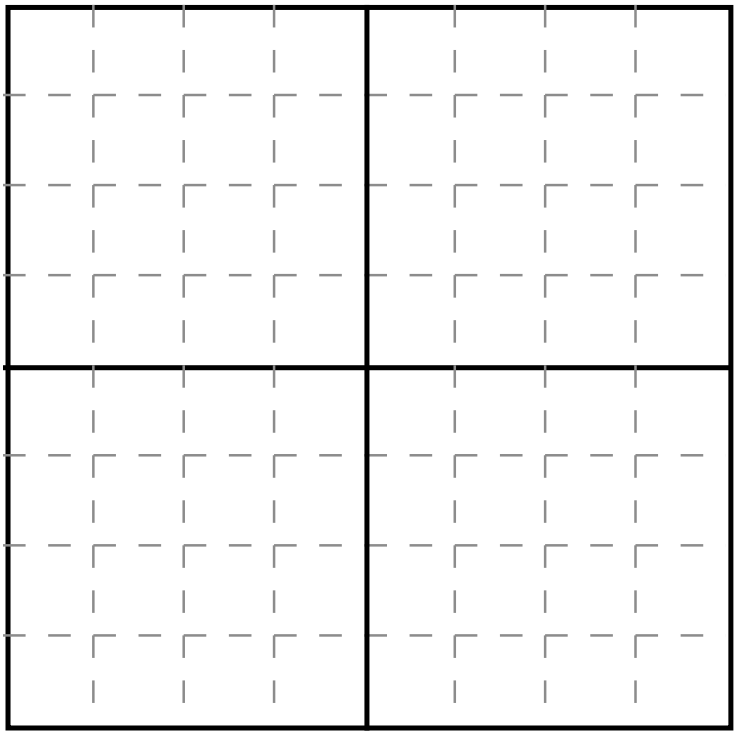
5.

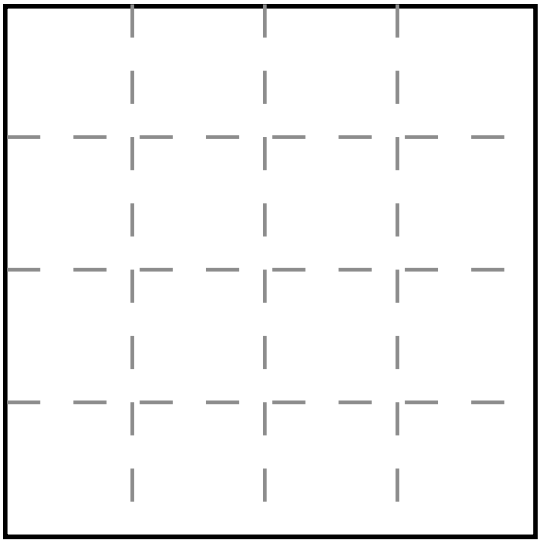
Preliminary Designs

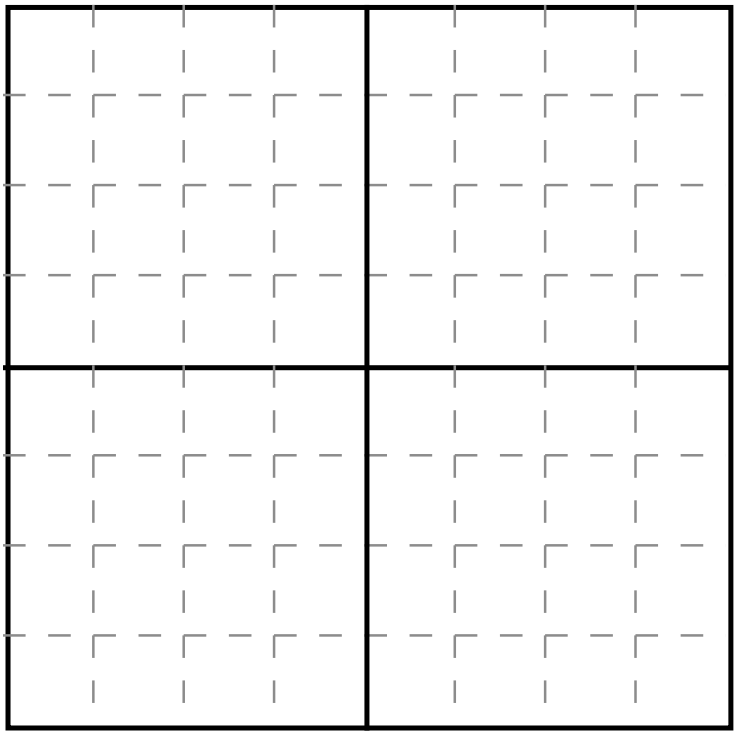
Sketch several designs for the set of tiles on the grids below.

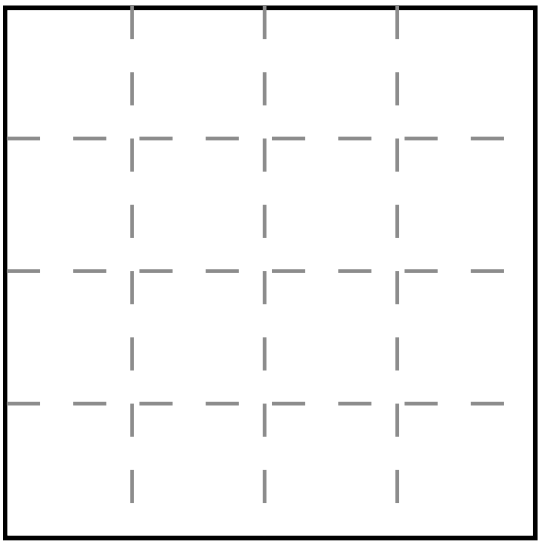
How the set will look

Design for repeating tile



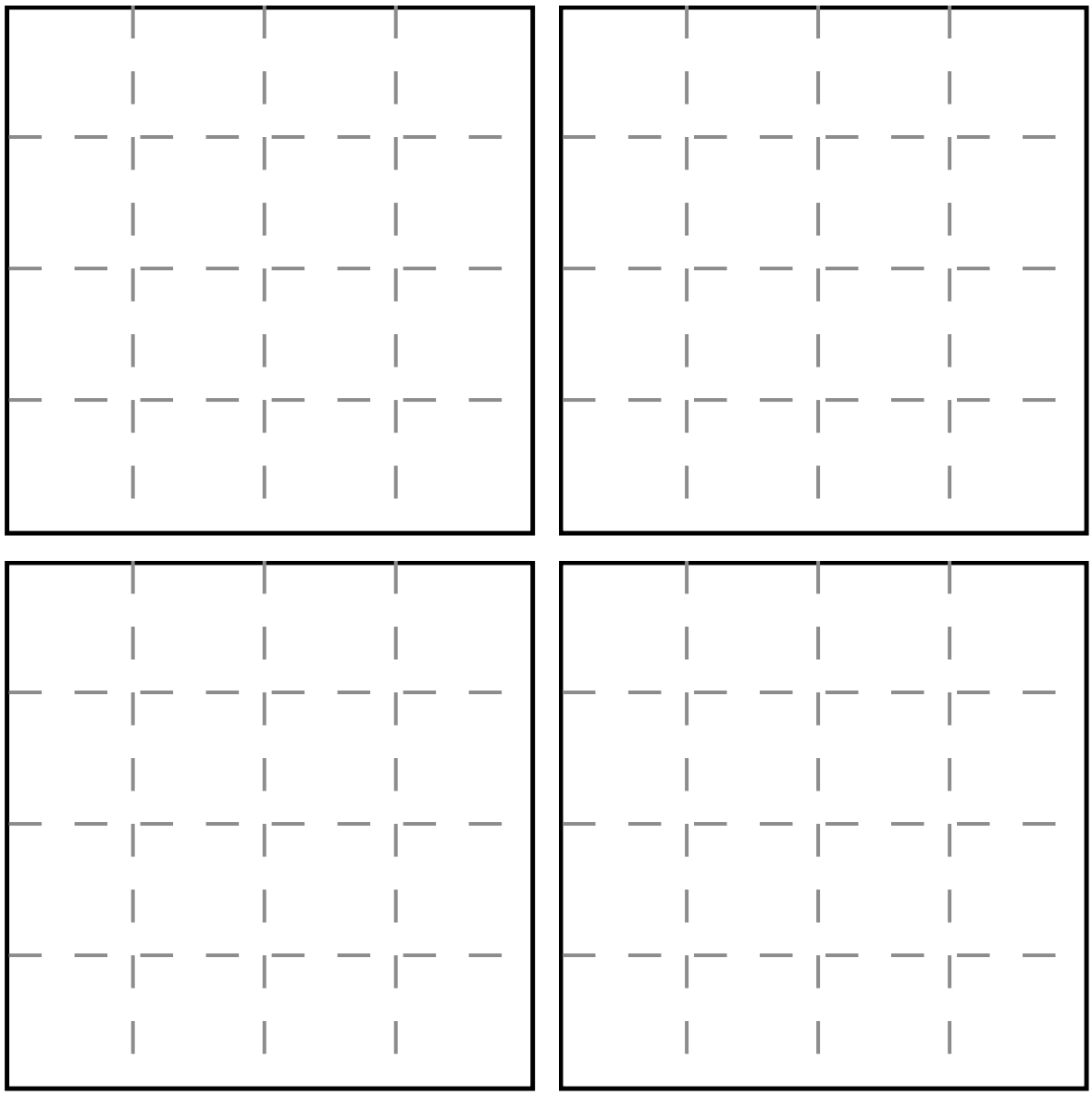






Final Design

Select the best ideas from your preliminary designs and sketch a final design for the tile set on the grid below.



Special directions and notes:

Extending the Activity

Commemorating Special Events or People

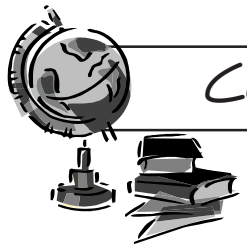
Have the students design a set of tiles that commemorates special events in the school. Have them use commercial clay and have the tiles fired by a local potter or a school's art department. This will require an initial (bisque) firing followed by applying glaze (colors) and another firing of the tiles.

Have the students prepare and fire sets of tile that commemorate special people and their accomplishments. These people could be community leaders, teachers in the school district, etc.

Evidence of Attainment

Students who have developed an understanding of engineering design are able to:

- ✔ Identify the steps in an engineering design process.
- ✔ Develop a design statement with appropriate criteria and constraints.
- ✔ Develop preliminary and final solutions to a design challenge.
- ✔ Develop and test a model of a design solution.
- ✔ Recommend ways to improve an engineering design.



Connections to Other Subjects

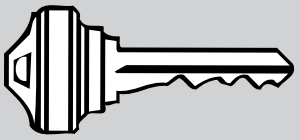
Science: Material properties and their use in designing products.

Mathematics: Using standard or metric measurements to indicate linear distances.

Social Studies: How designs can be used to commemorate people and events in a community.

Language Arts: Writing design requirements, technical writing.

Art: Artistic design, color, balance, sketching.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
Design	A creative process used to develop solutions to a problem.
Engineering Design	Developing a new or improving an existing product or system to meet a stated need.
Problem	A situation that can be improved by a new or improved product or technological system.
Opportunity	A situation in which a new or improved product or technological system will be accepted and used.
Design criteria	Key features and operational characteristics that a design must have.
Design constraints	Market, regulatory, economic, and engineering limits placed on the design.
Sketch	A two-dimensional graphic representation of a three-dimensional device.
Model	A representation of an object used to test ideas.

Resources

Books

Hutchison, J. and Karsnitz, J. (1994) *Design and Problem Solving in Technology*. Albany, NY: Delmar. ISBN: 0-8273-5244-1.

Moss, M. (1991). *Fashion Designer.* New York: Macmillian Publishing Company. ISBN: 0-89686-610-6.

Peter, R. (1995). *Models.* New York: Thomson Learning. ISBN: 1-56847-214-5.

Wright, R. T. (2000) *Technology.* Tinley Park, IL: Goodheart-Willcox. ISBN: 1-56637-50-0

Web resources

Engineering and design sites such as:

American Institute of Graphic Arts.
URL: http://www.aiga.org

Bad Human Factors Designs.
URL:http://www.baddesigns.com/

Centre for Sustainable Design Homepage.
URL:http://www.cfsd.org.uk/

Core77 Design Magazine.
URL: http://www.core77.com

Industrial Designers Society of America.
URL:http://www.idsa.org/

Praxis Product Design.
URL:http://www.praxisdesign.com/

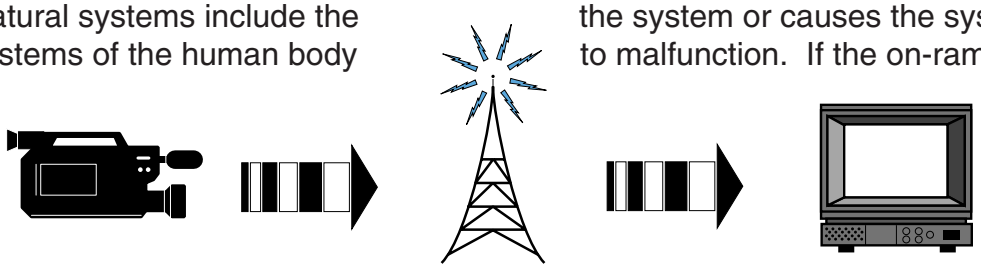
Kids Inventing Technology Series

What Is a System?

Introduction

The study of any field most often starts with its core concepts, and the study of technology is no different. These core concepts are the underlying ideas that make technology different from the other fields of study. One of those concepts is the knowledge and use of systems.

Systems are a collection of parts working together to complete one task. Systems are found in both the natural and human-built world. Natural systems include the systems of the human body and the streams, rivers, and oceans of the world. Humans did not create those systems; however, human-built systems do exist. Examples of human-built systems are the highway system, phone networks, and manufacturing lines.



All human and natural systems have parts, and they work together to accomplish the same goal. In the human body's circulatory system, the heart, veins, and arteries all work together to pump blood throughout the body. In a computer, the keyboard, processor, disk drive and monitor all work together to open or save a file. The parts of the highway systems include a major roadway, on and off ramps, secondary highways, and access roads. When all of these roads are used together, you can move from one part of the country to another, quite easily.

However, when one of the parts to the system is not working, it disables the system or causes the system to malfunction. If the on-ramp to the highway is closed, the driver must find a new route, which wastes time and energy. If the disk drive in the computer is not working, the computer system will not be able to open or save a file on the disk. When a system is not working properly, you must troubleshoot the system.

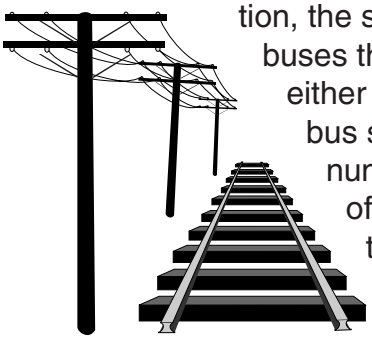
When you troubleshoot a system, you locate the part of the system that is not working properly. For example, you may find that the light in your classroom isn't working. To trouble-

Technological Literacy Standard #2

Students will develop an understanding of the core concepts of technology.

shoot the system, you would separate it into the parts of the system: the light bulb, light fixture, switch, and electricity. If one of these parts is not working, the system would not achieve the goal of controlling the light. You may start with replacing the light bulb. If that doesn't work, you may check the fuse, then replace the switch, and so on until the system works again.

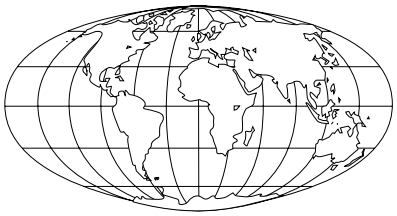
Some systems are known as subsystems. A subsystem is a complete system that is part of a larger system. The circulatory, digestive, and respiratory systems are examples of some of the subsystems that make up the human body. The electrical system in a school is a subsystem of the city's electrical system. Another example of a subsystem is a bus transportation system. Many school systems have buses that pick the students up from each of the schools and drop them off in a centralized location. At that location, the students catch buses that take them either home or to a bus stop. There are numerous examples of subsystems in this example.



The bus system is a subsystem of the school system, the buses at each school are subsystems of the larger bus system, and the bus stops are also a subsystem.

If a subsystem is not working, it may affect the main system, and vice versa. It could even affect other subsystems. If the electrical system in your school overloads the city's system, it could force the power station to shut down. If that were to happen, all of the other subsystems hooked to the power station would also be shut off.

Systems are a vital part of our civilization. They are as far-reaching as the World Wide Web and as simple as a bicycle that a young child may ride. Either way, they are a core concept of technology. The study of technology cannot be achieved without the examination of systems; they are at the heart of technology.



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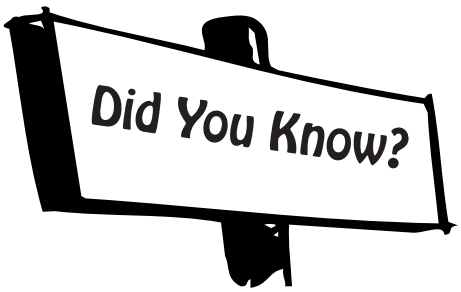
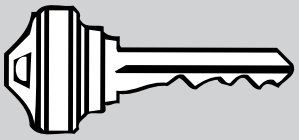


- Systems for waste disposal and running water have been found in the Indus Valley civilization dating back to 2500 BC.
- The first computer network, ARPANET, was developed in the 1960s and led to the current-day Internet.
- The Roman Empire developed a 50,000-mile long road system. The system included 29 highways coming out of the city of Rome.
- Around 100 billion letters and packages are processed by the U.S. Postal Service every year.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
System	A group of interrelated components designed to achieve a desired goal.
Subsystem	A complete system that functions within a larger system.
Human-made	A system designed and built by humans to meet a need or want.
Natural System	A system that occurs in nature without human design or interference.

Think About

What would life be like without systems? Would we have:

a. lakes, rivers, streams, and oceans?

b. plumbing?

c. the telephone?

d. veins and arteries in our bodies?

Grades K-2

Production Systems

Introduction

Most things around us have been built using mass production systems. In this activity, your students will assemble ball point pens in a mass production setting. They will then examine the parts that it took to complete the pens. At the conclusion of the activity, they will determine what would happen if parts of the system were missing.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Prepare a bulletin board with pictures of different systems (for example: highways, Internet, telephone lines, etc.).
- Gather the supplies and tools listed for the activity.
- Designate four tables for the production of the pens.
- Disassemble the pens and group each part together on the four tables. See the layout drawing on page 5. There should be enough parts on each table to make 10 pens.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- 40 round ball point pens or other simple multipart product
- 4 small boxes (to hold the pens)
- Posterboard
- Markers, crayons, or colored pencils

Benchmark

This activity will help students reach the following benchmarks:

Some systems are found in nature and some are made by humans.

Systems have parts or components that work together to accomplish a task.

Preparing the Students

Set the stage for the systems activity by:

- Defining a system as a collection of parts that work together to complete a common goal.
- Explaining that some systems are natural and some are human-made. See Transparency #1 on page 6.
- Explaining that a manufacturing line is a system because there are many components and actions that take place to make a product. The product that results is not necessarily a system, but the process of making the product is a system.
- Giving other examples of systems such as a bicycle, plumbing, e-mail, telephone lines, and the human body.
- Informing the students that all systems have parts and components. For example, a bicycle has handle bars, tires, brakes, pedals, and a seat. All the bike's

components work together to move the person from one place to another.

Conducting the Activity

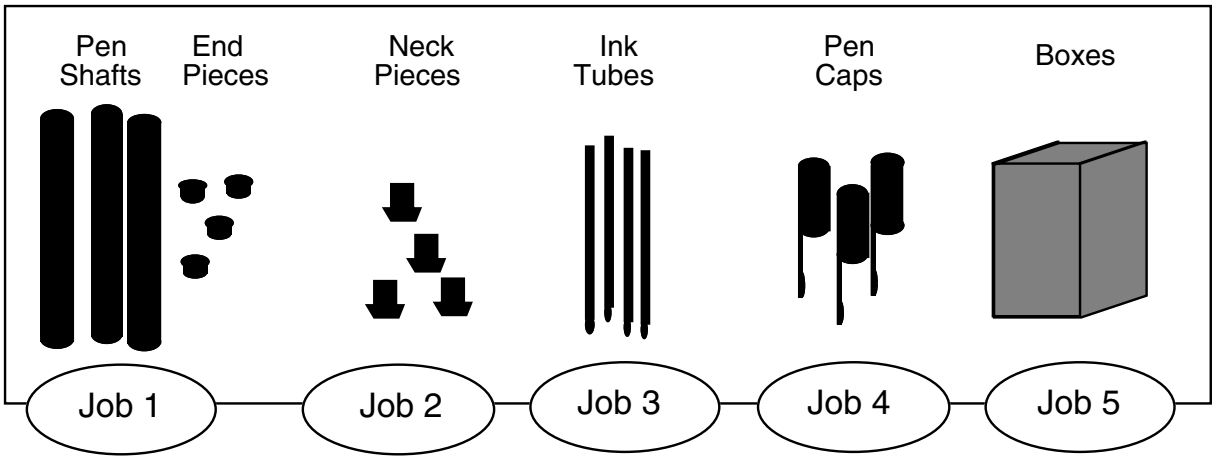
Present the activity using the following steps:

1. Inform the students that they will be taking part in a manufacturing system and that they will assemble ball point pens.
2. Take the students to one of the tables and show them how a pen is produced. Show each of the five jobs.
   - Job 1: This student will place the end piece on the pen shaft and hand it to person #2.
   - Job 2: This student will take the shaft and place the neck piece on it and hand it to person #3.
   - Job 3: This student will place the ink well into the pen shaft and hand it to person #4.
   - Job 4: This student will place the cap on the pen and hand it to person #5.
   - Job 5: This student will put all the finished pens in the box.
   - Supervisor (if needed): This student will watch the production and make sure it is running smoothly.
3. Divide the class into four groups of five. If you have extra students they can be supervisors.
4. Give each group a table and assign jobs to each student.
5. Run the assembly.
6. When the pens have been assembled, pass out the *Assembling a Ball Point Pen* handout to each student. A copy of the handout can be found on page 7. Work on the handout as a class.
7. Once the handouts are completed, have each group use markers, crayons, or colored pencils, and posterboard to draw the manufacturing system. They should label the parts of the system.

Checking for Understanding

To see if the students understand the concept of systems, ask the students:

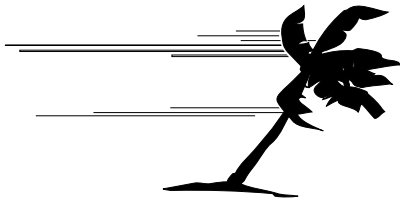
- ✔ What are some examples of systems?
- ✔ Are all systems found in nature or are some human-made?
- ✔ Do systems have different parts?



Types of Systems

Natural

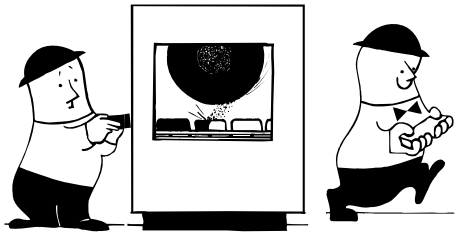
Weather



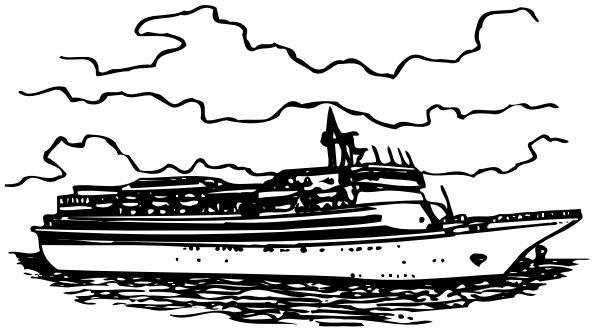
Human Body

Human-made

Manufacturing



Transportation



Transparency #1

Assembling a Ball Point Pen

What was your job on the pen assembly line?

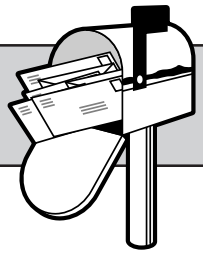
What would happen if you did not do your job?

Why is assembling pens a system?

Is it a natural or human-made system?

Grades 3-5

Designing a Mail System



Introduction

One of the largest nationwide systems is the postal service. The U.S. Postal Service is a system that efficiently moves mail anywhere around the country. In this activity, your students will develop a mail system for their classroom. After development, the system can be used to distribute information and assignments to the students. If your school has a policy against students seeing other students' grades, you can use the system solely to distribute worksheets to be completed, lunch room menus, newsletters, etc.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Gather the supplies and tools listed for this activity.
- Copy enough of the System Handout, found on page 13, for each student. Write the name of each student at the top of the page.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Six plastic “in/out” trays
- Cardboard boxes (shoe box size)
- Construction paper
- Crayons, markers
- Tape, glue, and stapler

Benchmark

This activity will help students reach the following benchmarks:

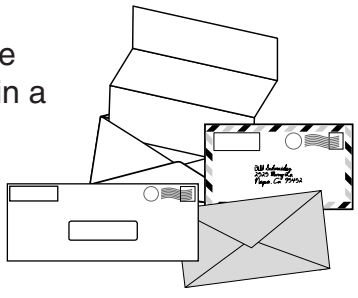
A subsystem is a system that operates as part of another system.

When parts of a system are missing, it may not work as planned.

Preparing the Students

Prepare the students for this activity by discussing systems:

1. Explain that a system is a collection of parts that work together to complete a common goal.
2. Provide some examples of systems such as an electrical circuit, plumbing, e-mail, telephone lines, and manufacturing lines.
3. Explain that all systems have parts and components. For example, a computer has a keyboard, monitor, printer, disk drive, and processor. All of the computer components work together to function in the way the user intends.
4. Explain that if one of the components is missing, the system may not work right.
5. Some systems have smaller systems inside them. The braking system in a bicycle is a subsystem of the bicycle.



Conducting the Activity

Discuss systems and point out that the postal service is a system, and that the students will create a mail system for the classroom.

Discuss the steps of mail collection and distribution by the postal service.

Designing a Mailbox

1. Distribute cardboard boxes, markers, crayons, colored paper, glue, and tape to the students.
2. Have each of the students design a mailbox.
3. Have each student attach the mailbox to the side of his or her desk.

Laying out the System

1. Have the students divide the classroom into four zones. The zones are the routes that each mail carrier will use to deliver mail.
2. Pass a sheet of construction paper around each zone.
3. Have the students write their names on the paper that corresponds with their zone.
4. Attach each of the four lists of names to a plastic tray.
5. Designate a fifth tray as the teacher's zone.
6. Place the trays in the front of the room or in a place designated as the mail sorting area.
7. Label the remaining plastic tray, "Mail to be Sorted."
8. Place the "Mail to be Sorted" tray beside the zone trays.

Putting the Students to Work

1. Designate one person in each zone to be the mail carrier for that zone.
2. Explain that the job of the mail carriers is to collect the mail from the mail boxes in their zones and place it in the "Mail to be Sorted" tray.
3. Have the students gather the mail from their zone trays and carry it to the sorting area.
4. Give the job of mail sorter to one or two other students.
4. Describe the job of the mail sorters.
5. Have the students place the mail from the "Mail to be Sorted" tray into the zone trays that correspond with the people to whom the mail is addressed.
6. The teacher will serve as the Postmaster, making sure the system is working.

Putting the System to Work

1. Place the Systems worksheets you labeled for each student in the "Mail to be Sorted" tray.
2. Have the mail sorter(s) place the mail in the appropriate zone boxes.
3. Have the mail carriers pick up the mail from their trays and deliver it to the mailboxes in their zones.
4. Have each student complete the worksheet.
5. When the students are finished, have them fold the worksheet in half and address the worksheets to the teacher.

6. They can then place the worksheet in their mailboxes.
7. Then have the mail carriers collect the mail. They should place all mail in the "Mail to be Sorted" tray.
8. The mail sorters should place the mail in the corresponding tray.
9. Once you have graded the papers, you can place them in the "Mail to be Sorted" tray.
10. At mail time, the mail sorters can place the mail in the appropriate zone trays and the mail carriers can deliver the mail to the correct mailboxes on their route.

Continued Use of the System

The mail system can be used to pass out and collect all assignments. You may choose to rotate mail carriers and mail sorters and even delegate the responsibilities of the Postmaster to a student.

Checking for Understanding

To check for understanding, have the students complete a bulletin board that shows the parts of the mail system. They should also describe what would happen if part of the system were missing. The display should also show any subsystems in their mail system.

Evidence of Attainment

Students, who have developed an understanding of a system as a core concept of technology, can:

- ✔ Identify parts of a system.
- ✔ List human-made systems.
- ✔ Create a system with subsystems.

Extending the Activity

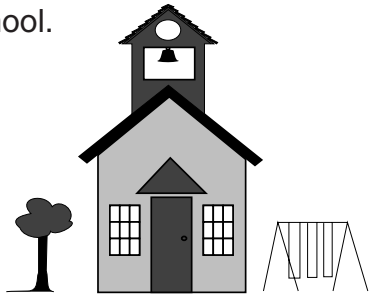
School-wide Systems

Discuss other systems that are in existence around the school. Examine your school and the entire school system.

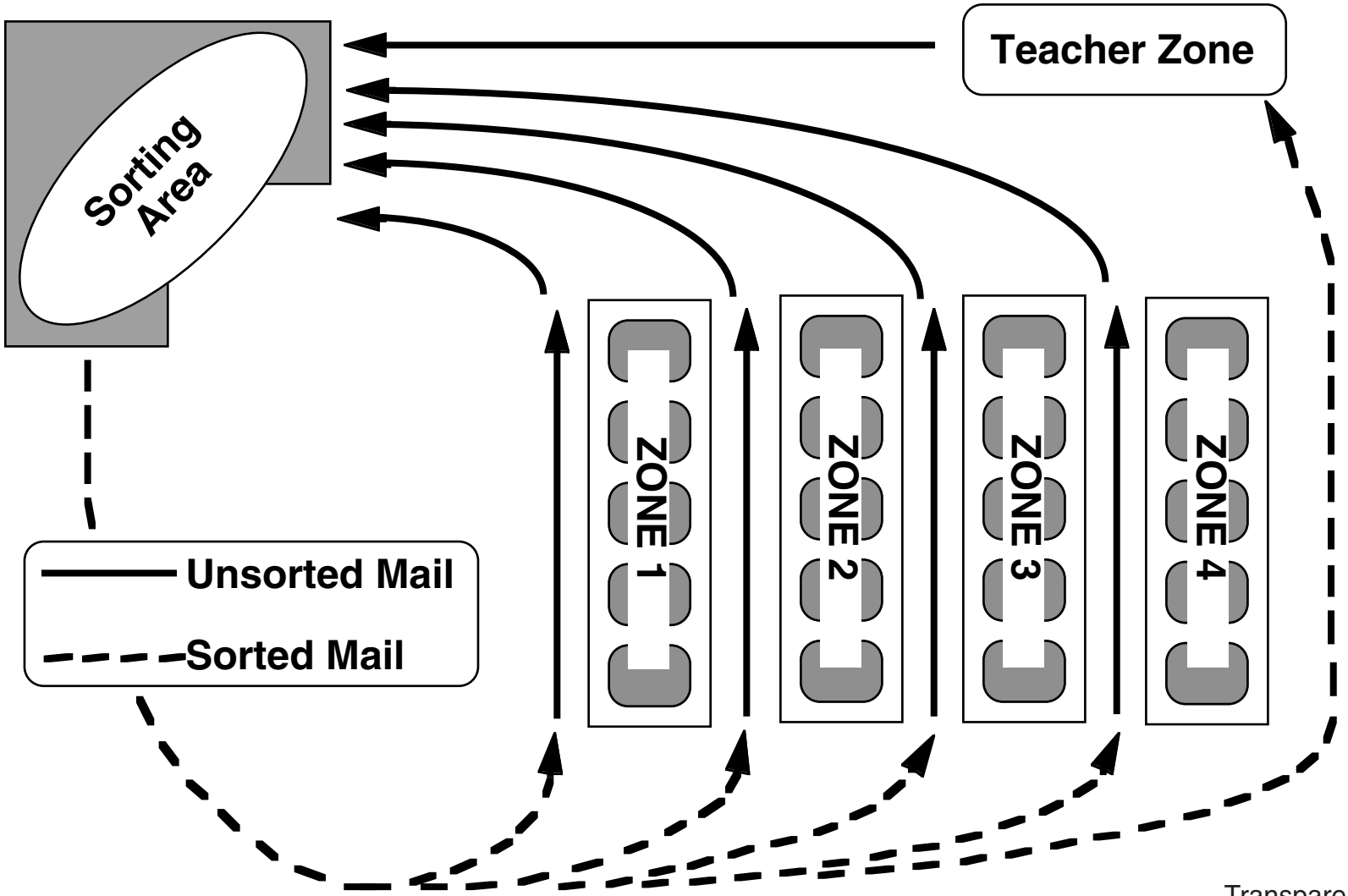
Have your students design a better communication system for the teachers.

Examine the system used to prepare the school lunch.

Brainstorm other ways the bus system could work.



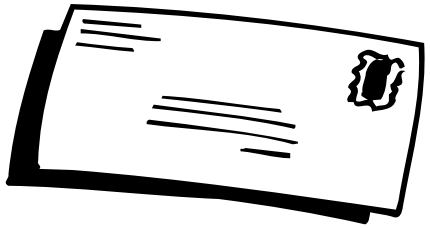
An Example of a Classroom Mail System



Transparency #2

Steps in the U. S. Postal Service

1. Mail carriers collect the mail from mail boxes
2. Mail is sorted between in-town and out-of-town
3. Out-of-town mail is sorted by ZIP code
4. Mail is sent to other post offices according to ZIP code
5. Mail is sorted by address
6. Mail carrier delivers the mail to the address



Transparency #3

Systems Handout

List the steps used in your classroom mail system.

What would happen if one of these steps was missing?

What are the benefits of a mail system?

Connections to Other Subjects

Science: Types and parts of natural systems.

Mathematics: Calculate the time it takes different systems to work.

Social Studies: Contributions and implementation of different systems to our society.

Language Arts: Write a letter and mail it using the U.S. Postal System.

Resources

Books

Gibbons, Gail. (1982). *The Post Office Book: Mail and How it Moves*. New York: Thomas Y. Crowell. ISBN: 0-690-04198-5.

Matthews, Morgan. (1900). *What is it like to be a Postal Worker.* Mahwah, NJ: Troll Associates. ISBN: 0-8167-1813-X.

Ventura, Piero. (1994). *Communication: Means and Technologies for Exchanging Information*. Boston: Houghton Mifflin Company. ISBN: 0-395-66789-5.

Walker, Colin. (1994). *Shaping Our World: Technology and the Environment.* Bothell, WA: The Wright Group. ISBN: 0-7802-1464-1.

Walker, Colin. (1994). *The Comfort Solution: Technology in Our Homes.* Bothell, WA: The Wright Group. ISBN: 0-7802-1456-0.

Web resources

A public school site that has sections on technology and technological literacy.
http://www.madison.k12.wi.us/toki/teched.htm

The Smithsonian Institution site which allows you to search for various systems such as communication, transportation, and manufacturing.
http://www.si.edu/

The *Popular Science* website that allows students to explore new technologies and technological systems.
http://www.popsci.com/

Kids Inventing Technology Series

Needs and Wants in the Design Process

Introduction

In this KITS unit, students will study a part of the design process (determining needs and wants) as they design money (coins and note) for an imaginary country. You may review the design process shown in the figure that can be found of page 3.

Throughout history, people have had a need to exchange the fruits of their technological efforts. They had things of value that they wanted to exchange with other people. They had the products of their labor to exchange for other items they needed. In early times, exchange of unessential articles, such as jewelry, was common, however no group could afford to rely on another group for the necessities of life. They depended on their family or tribal unit to produce these life-supporting goods such as food, clothing, and shelter. As civilization progressed, division of labor developed. People concentrated on doing those things they could do well and depended on other people to supply their other needs. For example, one person would make shoes (a shoe cobbler) while another person would grow crops (a farmer) and another would make dwellings (a carpenter). In the early stages of this economic development, the cobbler would trade shoes for the farmer's grain. However, these exchanges became complicated as societies grew and more products became available. This challenge of trade was met with the development of money.

Money is a product of technology. It is designed and produced using technological means. Also, it affects technology. It allows for the development and application of technology in homes and businesses across the society.

Technological Literacy Standard #17

Students will develop the abilities to apply the design process.

From the earliest times, precious metals have been used for money. They were formed into coins that were easy to handle, had a fairly long life, and had a high intrinsic value. The coin had value as money and for the metal it was made from. However, over time, the actual value of the coin (the value of the metal) has become widely separated from the value it has as a means of trade. A quarter is not worth 25 cents as a metal but 25 cents in trading value.

As trades became larger, coins to represent large values were not practical. Therefore, paper currency first appeared about 300 years ago. At first the paper notes were usually backed by some "standard" commodity of intrinsic value, such as gold. The notes could be converted on demand into the standard (gold).

The monetary system of the United States was based on a full gold standard from 1900 to 1933. This allowed for free coinage of gold and full convertibility of currency into gold coin. In 1934, the Gold Reserve Act established a modified gold standard in which the dollar was legally defined as having a certain fixed value in gold. The connection between the dollar and gold became less direct. Also, the 1934 Act stipulated that gold could not be used as a medium of domestic exchange. By the 1970s, all U.S. paper money and coins were disconnected from a gold standard. All American coin and paper money in circulation is now legal tender and by law must be accepted at face value by creditors in payment of any public or private debt.

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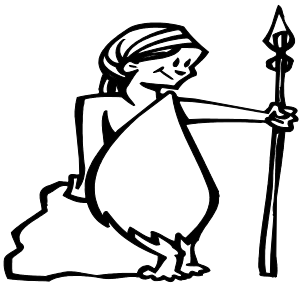
Engineering Design Process

1. Identify the problem

The first step in engineering design is to clearly describe the problem and the requirements a solution must meet.

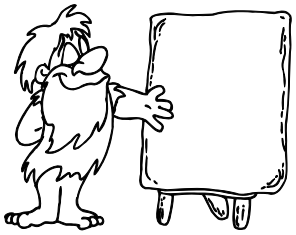


2. Gather information

A good designer reviews how other people solved similar problems and gathers information that could be used to solve the design problem.

3. Develop possible solutions

Designers generally develop several products or system designs that could solve the problem.

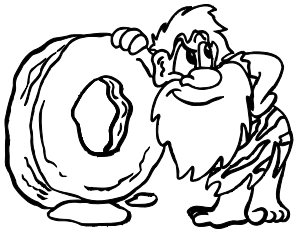


4. Select a promising solution

Designers and engineers use their knowledge of the problem to select the best solution from the several they have identified.

5. Modeling

Often a model is built to see if the design can be manufactured and if it will function properly.



6. Evaluation

The design model is assessed to see that it functions properly, can be operated easily, and can be safely used.

7. Refine and release

The design is altered and refined as needed before it is released for pilot or full-scale production.

Grades K-2

Design Paper Money

Introduction

Producing United States paper currency involves over 65 separate steps that begin with a hand-engraved soft steel plate, called a master-die. The die includes the portions of the design, such as the portrait, the vignette, the ornamentation, and the lettering, that are produced using numerous fine lines, dots, and dashes, which vary in size and shape.

Periodically, U.S. bank notes are redesigned to reduce the threat of counterfeiting. A new series of U.S. currency will be issued starting in 2003. The first note to be redesigned will be the $20 note. It will be followed by the $50 and $100 notes 12-18 months later.

In this activity, the student will design a new paper bill. They will brainstorm the needs of the bill such as ease of use, ability to be identified, difficulty to counterfeit, etc. They will then design a new paper note for the country of Bear Island.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Review the Department of Treasury Web site for information about currency.
- Prepare a bulletin board about "Bear Island" that the students can use to envision their imaginary country.
- Duplicate the worksheets included with this unit.
- Gather the tools and materials listed with this unit.

Benchmark

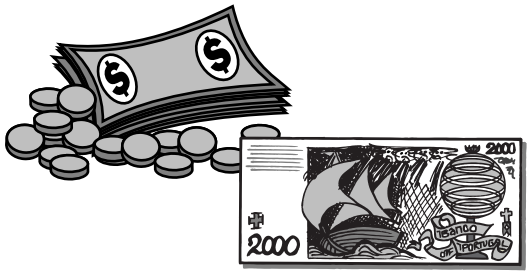
This activity will help students reach the following benchmark:

Brainstorm people's needs and wants and pick some problems that can be solved through the design process.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Pencils
- Rulers
- Colored markers or crayons
- Scissors
- Stickers or pictures (for illustrating the bills)



Preparing the Students

Set the stage for the money design activity by discussing:

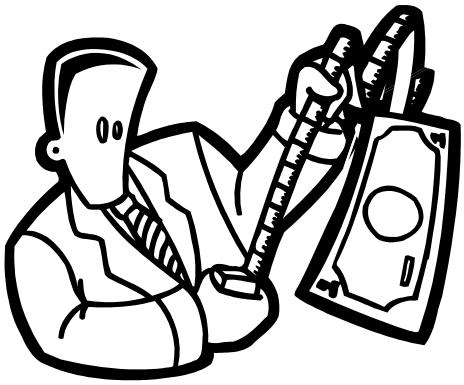
- The design process
- The difference between a need and a want
- The role of money in society

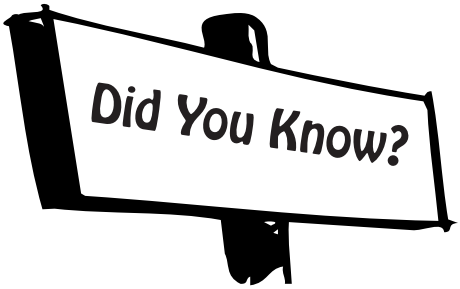
Conducting the Activity

1. Discuss how the design process was used to identify needs and wants and create a new product (currency).
2. Introduce the challenge: "Develop a new Enor (dollar) Bill for the new nation of Bear Island that meets the country's needs and highlights its island and culture (want)."
3. Use discussion to identify the needs for the new bill. Have the students write the five most important on the top section of their Needs and Wants for Paper Money worksheet. See page 6.
4. Use discussion to identify the wants for the new bill. Have the students use the bottom section of their Needs and Wants for Paper Money worksheet. See page 6.
5. Have each student design the front and back of a bill using a worksheet like the one found on page 7.
6. Have each student share his or her designs with the class or display them on a bulletin board.

Checking for Understanding

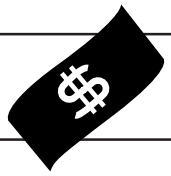
Throughout the unit, the students should be asked questions about how they are using needs and wants to guide their designing activities.





Shells were the most widely used type of ancient currency. They derived their value from their use as jewelry and in rituals. The scarcity of the type of shell or the way the shell was shaped often determined its value. Shells were useful because they could be used as a single unit value in exchange or strung in long strips of proportionate value.

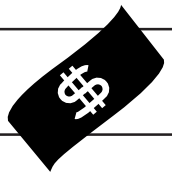
- Cowrie shells were the most common shell media and the oldest type used for exchange.
- Wampum, used in North America, was usually fashioned from thick-shelled clams.
- Dentalia, or tooth shells, were popular with the coastal Native Americans of western North America.
- Mother-of-pearl and tortoiseshell were used for trade in ancient China.



Needs and Wants for Paper Money

What features MUST your money have?

What features would be NICE for your money to have?



Designing Paper Money

What will be on the front?

Sketch the front here.

What will be on the back?

Sketch the back here.

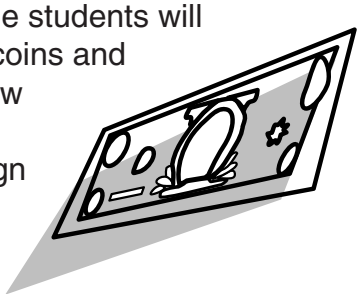
Grades 3-5

Designing Currency

Introduction

Many inventions and designs deal with abstractions. One of the most abstract ideas that became an invention is money. It replaces real goods and services with a medium of exchange. The first stage predated recorded history. People, in this process, used common frames of reference to set the value of goods. Prehistoric people started referring to all goods in terms of commonplace merchandise such as cattle or metal. In the next stage, governments developed a standard medium of exchange. This happened in China about 2800 years ago. This was followed by the use of coins over 2650 years ago when the Greeks minted the first coins. These were followed by paper money, which is a *symbol* of material goods with no value of its own. The Chinese used private paper notes over 1200 years ago. Paper money has been widely used in Europe and America only during the last 300 years.

In this activity the students will develop currency (coins and paper bills) for a new country, Sunlandia. They will form design teams that will deal with the needs and wants of the citizens for their currency and then develop a design for the paper money and coins that they could use to meet these criteria.



Benchmark

This activity will help students reach the following benchmark:

> *Identify and collect information about everyday problems that can be solved by technology, and generate ideas and requirements for solving a problem.*

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Review the Department of Treasury and the Bureau of Engraving and Printing Web site for information about currency.
- Prepare a bulletin board about "Sunlandia" that the students can use to envision their imaginary country.
- Duplicate the worksheets included with this unit.
- Gather the tools and materials listed with this unit.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Pencils
- Rulers
- Colored markers or crayons
- Scissors
- Stickers or pictures (for illustrating the bills)
- Air-drying clay
- Clay modeling tools
- Gold and silver paint

OPTIONAL

- Computer system and printer
- Graphics or page layout software
- Clip art

Preparing the Students

Discuss the design process and how needs and wants fit into the process.

Conducting the Activity

1. Introduce the challenge: "Develop a new set of currency for the new nation of Sunlandia."
2. Discuss how the design process can be used to solve everyday problems.
3. Discuss or have the students use the Internet to determine the types of coins and notes used for currency. (A discussion of the development of currency in America using the sheets on page 10 and 11 may be appropriate at this time.)
4. Use discussion to identify the common elements found on a coin and a note.
5. Divide the class into design teams of three to four students each.
6. Have the teams brainstorm and select a theme for their coins and notes. (Pictures of tourist sights, historical events, economic elements, etc.)
7. Have the teams assign a coin(s) or a note(s) to each member.
8. Have each member use the worksheets on pages 12 to 14 to:
   a. Prepare some possible designs for his or her element.
   b. Refine the best design.
   c. Present the suggested design to the design team.
9. Have the design team:
   a. Select a design for each coin or note.
   b. Discuss ways to improve the designs.
   c. Make enlarged (double-sized) copies of each final design.
10. Have each team share its designs with the class or on a bulletin board.

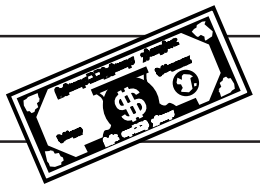
As of July 31, 2000, of the $539,890,223,079 in total currency in worldwide circulation, $364,724,397,100 is in the $100 denomination.

The 8 billion U.S. notes printed each year are enough to wrap around the earth's equator over 30 times.

The approximate weight of a currency note, regardless of denomination, is 1 gram. There are 454 grams in a pound, so one pound of currency would contain 454 notes.

You would have to double-fold a U.S. currency note about 4,000 times before it would tear.

The largest note ever printed by the Bureau of Engraving and Printing was the $100,000 Gold Certificate, Series 1934.



History of American Currency

1690 Colonial Notes
The Massachusetts Bay Colony, one of the Thirteen Original Colonies, issued the first paper money to cover costs of military expeditions. The practice of issuing paper notes spread to the other colonies.

1739 Franklin's Counterfeit Deterrent
Benjamin Franklin's printing firm in Philadelphia printed colonial notes with nature prints—unique raised impressions of patterns cast from actual leaves.

1764 British Ban
Following years of restrictions on colonial paper currency, Britain finally ordered a complete ban on the issuance of paper money by the Colonies.

1775 Continental Currency
The Continental Congress issued paper currency to finance the Revolutionary War. Continental currency was denominated in Spanish milled dollars. Without solid backing and easily counterfeited, the notes quickly lost their value, giving rise to the phrase "not worth a Continental."

1781 The Bank of North America
Congress chartered the Bank of North America in Philadelphia as the first national bank, creating it to support the financial operations of the fledgling government.

1785 The Dollar
Congress adopted the dollar as the money unit of the United States.

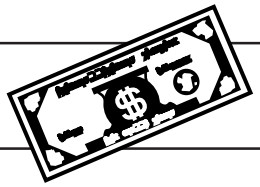
1791 First Central Bank
Congress chartered the Bank of the United States for a 20-year period to serve as the U.S. Treasury's fiscal agent. The bank was the first to perform central bank functions for the government and operated until 1811, when Congress declined to renew the bank's charter. Congress chartered a second Bank of the United States in 1816 for another 20-year period.

1792 Monetary System
The Coinage Act of 1792 created the U.S. Mint and established a federal monetary system, set denominations for coins, and specified the value of each coin in gold, silver, or copper.

1861 Greenbacks
The first general circulation of paper money by the federal government occurred in 1861. Congress authorized the U.S. Treasury to issue non-interest-bearing Demand Notes. These notes acquired the nickname "greenback" because of their color.

1862 The Design
By 1862, the design of U.S. currency incorporated fine-line engraving, intricate geometric lathework patterns, a Treasury seal, and engraved signatures to aid in counterfeit deterrence. Since that time, the U.S. Treasury has continued to add features to thwart counterfeiting.

1863 National Banking System
Congress established a national banking system and authorized the U.S. Treasury to oversee the issuance of National Bank Notes. This system established Federal guidelines for chartering and regulating "national" banks and authorized those banks to issue national currency secured by the purchase of United States bonds.



History of American Currency - continued

1865 Secret Service
The United States Secret Service was established as a bureau of the Treasury for the purpose of controlling the counterfeiters whose activities were destroying the public's confidence in the nation's currency.

1877 Bureau of Engraving and Printing
The Department of the Treasury's Bureau of Engraving and Printing began printing all U.S. currency.

1905 Paper Currency With Background Color
The last U.S. paper currency printed with background color was the $20 Gold Certificate, Series 1905, which had a golden tint and a red seal and serial number.

1931 Federal Reserve Act
The Federal Reserve Act of 1931 created the Federal Reserve as the nation's central bank which issued new currency called Federal Reserve Notes.

1929 Standardized Design
The first sweeping change to affect the appearance of all paper money occurred in 1929. Standardized designs were instituted for each denomination across all classes of currency, decreasing the number of different designs in circulation.

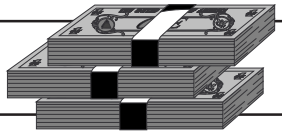
1957 In God We Trust
The use of the National Motto "In God We Trust" on all currency has been required by law since 1955. It first appeared on paper money with the issuance of the $1 Silver Certificates, Series 1957, and began appearing on Federal Reserve Notes with the 1963 Series.

1990 Security Thread and Microprinting
A security thread and microprinting were introduced to deter counterfeiting by advanced copiers and printers. The features first appeared in Series 1990 $100 notes. By Series 1993, the features appeared on all denominations except $1 and $2 notes.

1996 Currency Redesign
In the first significant design change in 67 years, U.S. currency was redesigned to incorporate a series of new counterfeit deterrents. The Bureau of Engraving and Printing announced that new designs would be undertaken every 7-10 years to stay ahead of currency counterfeiters.

2003 The New Color of Money: Safer. Smarter. More Secure.
To stay ahead of currency counterfeiters, the U.S. government announces new designs to be issued, beginning with the $20 note in late 2003. New designs for the $50 and $100 will follow in 2004 and 2005. The new currency will feature subtle background color. Different colors will be used for different denominations.

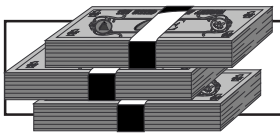
Reprinted and modified from materials on the U.S, Bureau of Engraving and Printing Web site.



Design Ideas for Paper Money

Name: _____ Class: _____

	Idea #1	Idea #2	Idea #3
Back			
Front			



Final Design Idea for Paper Money

Name: _____ Class: _____

Front

Back

Final Design Ideas for Coins

Name: _____ Class: _____

INITIAL DESIGNS

Front

Back

Idea # 1

Idea # 2

FINAL DESIGN

Front

Back

Extending the Activity
Checks and Credit Cards

You can extend this activity by asking students to use their design abilities to:

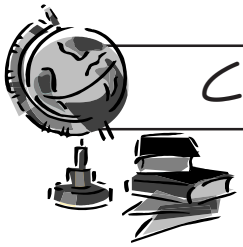
Design a credit card that promotes the school.

Design a decorative check.

Evidence of Attainment

Students who have developed the abilities to apply the design process can:

- Identify a problem needing a design solution.
- Distinguish between needs and wants.
- Gather information needed to solve a design challenge.
- Identify constraints that must be dealt with in developing a design solution.
- Develop a solution to a design challenge.



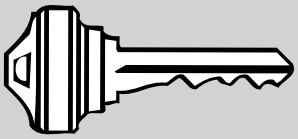
Connections to Other Subjects

Mathematics: Decimal system as applied to money, counting money, and making change.

Social Studies: History of currency, currency and trade, bartering.

Language Arts: How money is described in prose and poetry.

Art: Decorations and art on coins and bills.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.	Want	An item or condition that is not essential for life, but is desired by a person.
Design	A creative process used to develop solutions to a problem.	Design criteria	Key features and operational characteristics that a design must have.
Need	An item or condition that is essential for life.	Design constraints	Market, regulatory, economic, and engineering limits placed on the design.

Resources

Books

Barabas, Kathy. (1997) *Let's Find Out About Money.* New York: Scholastic. ISBN: 0590738038.

Cribb, Joe. (1990). *Money (Eyewitness Books).* New York: Knopf. ISBN: 0679804382.

Maestro, Betsy. (1995). *The Story of Money.* New York: HarperTrophy. ISBN: 0688133045.

Parker, Nancy. (1995). *Money, Money, Money: The Meaning of the Art and Symbols on United States Paper Currency.* New York: Harpercollins Juvenile Books. ISBN: 0060234113.

Williams, Rozanne. (2001) The Coin Counting Book: New York: Charlesbridge Publishing. ISBN: 0881063266.

Web resources

United States Department of Treasury
URL: *http://www.ustreas.gov/*

United States Mint
URL: http://www.usmint.gov/kids/

BEP (Bureau of Engraving and Printing) for Kids
URL: *http://www.moneyfactory.com/section.cfm/17*

Online NewsHour Web Site for Students - (feature on money includes sections on the History of Money, Making Money, and Designing Dollars).
URL: *http://www.pbs.org/newshour/on2/money.html*

American Numismatic Association
URL: *http://www.money.org/*

Kids Inventing Technology Series

Developing Design Solutions

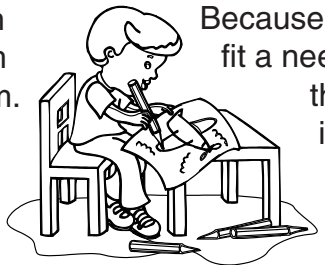
Introduction

One of the most natural human functions is design. For millions of years, humans have designed technological devices to assist them. They designed tools to help them hunt and for protection. As their knowledge of the world and technology advanced, so did the devices that our ancestors designed. Today, we design devices and technological systems to fulfill our needs and improve our lives.

Design is a process with several steps that ends with a product, device, or system. In this process, the designers complete a number of tasks that lead them from identifying a problem to creating the solution. The process is one type of problem solving that is not one reserved for only professional designers and engineers. Anyone can design a solution to a problem.

However, professional designers often have the upper hand at solving problems because they have been trained to use a design process. They are able to use the design process efficiently. Once people know the process of design, solving problems can become much easier. Unfortunately, the design process is not a concrete set of steps. Many designers use different steps to design solutions. Some designers may create a number of small models before they create sketches. Others may work solely on a computer to make sketches, drawings, and models.

No matter which steps the designer uses, they can always be broken down into two stages.



Because a design solution must fit a need and solve a problem, the first stage is identifying the problem. In this category, the designers must identify the problem they are trying to solve. They will create problem statements, develop design criteria, and gather information about the problem.

The second stage of design is the development of a solution. In this stage, the designer completes tasks that lead them from the problem to a finished design. This stage is best understood by dividing it into steps. Again, these steps may not be the exact steps used by all designers, but it is a good example of a typical design process. The steps would

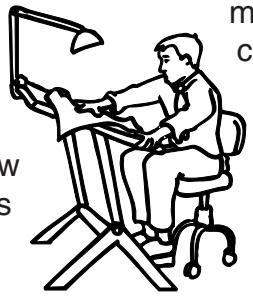
Technological Literacy Standard #17

Students will develop abilities to apply the design process.

include (1) creating solutions, (2) selecting and refining solutions, (3) modeling the solution, (4) testing the solution, and (5) communicating the solution.

The first step of this stage, creating solutions, is when most of the ideas are generated. Designers try to develop as many ideas as possible using sketches as a way to communicate. These sketches allow others to see the ideas that designers have in mind. These initial sketches are rough and basic. They may show only basic shapes and forms of different ideas.

Next, the designer selects and refines the solutions that will best solve the problem. Once the solution is chosen, new drawings and sketches are created. The new drawings are given text that shows the sizes of the design. These indicators are called dimensions. Colored or shaded sketches, called renderings, are then created to show how the finished designs will look.



After all of the sketches and renderings are completed, the designer typically creates a model of the solution. Models allow the designer to see how the design will look and function. There are two different types of models that are often created: mock-ups and prototypes. Mock-ups show what the design looks like in three dimensions. An example of a mock-up is a model house. Prototypes are actual working models.

The next step is to test the solution. There are many different types of tests that can be conducted. Most use the model as the testing subject. For example, wind tunnels test models of the automobiles or airplanes. The tests help the designer decide whether or not the design is a successful solution. If the solution does not pass the test, the designer will redesign it.

The last step for the designer in the development of a design solution is to communicate the solution. Designers may communicate designs in several ways. The first is by using technical drawings that are very accurate drawings of the solution. Technical drawings are used by the manufacturers to ensure the measurements are correct. The second way designers communicate designs is through presentations. Designers present their ideas to clients, other designers, and those interested in the solution.

There is no set length of time the design process should take. Some people may develop a design solution in one or two days. Other more complex solutions may take years. Remember that design solutions can be developed by anyone. Those who are familiar with the design process will have an easier time developing solutions.

This issue of the
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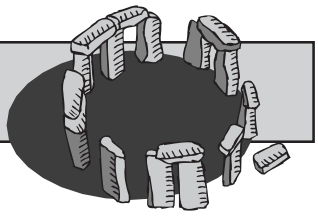
Grades K-2

Designing a Monument



Introduction

All of the technology around you has been designed. It is easy to recognize that objects like computers, skyscrapers, and automobiles have been designed by engineers, architects, and designers. However, there is a lot of technology that may not instantly come to mind when you think of design. In this activity, your students will have the opportunity to design such an object. Your students will design a monument for your school. Monuments are produced in the civil construction area of construction technology. In this activity, the problem statement has been provided. So, your students will be dealing with only the developing solutions stage of the design process. Your students will create sketches, renderings, and a model of the solution. They will also show their solution to the rest of the class.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Prepare a display showing different monuments (Mt. Rushmore, Washington Monument, local statues and monuments, etc.).
- Gather the tools and supplies listed with this activity.

Benchmark

This activity will help students reach the following benchmark:

Build or construct an object using the design process.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Paper
- Pencil
- Colored pencils or markers
- Large and small pieces of cardboard
- Modeling clay or play dough
- Wax paper
- Aluminum foil
- Hobby sticks
- Glue
- Masking tape
- Scissors
- Construction paper
- Posterboard
- Various other building materials and suppiles
- Copies of all handouts

Preparing the Students

Introduce the process of developing designs to the students by:

- Discussing sketches, renderings, and models.

- ✔ A sketch is a quick drawing that shows ideas. Sketches can be made in two or three dimensions. A two-dimensional sketch shows each side individually. A three-dimensional sketch shows all of the sides together.
- ✔ A rendering is a colored sketch. Renderings are used to show how the solution will look in color when it is complete.
- ✔ Models are three-dimensional objects. They can be made to either look and/or function like the final design.

- Showing examples of sketches, drawings, and models.
- Explaining the importance of developing many different ideas. The more ideas they create, the better the final solution will be.

Conducting the Activity

Present this activity to the students using the following stages and steps:

Problem Statement

1. Hand out a *Monument Design Problem* worksheet like the one on page 6.
2. Review the worksheet with the students, making sure they understand the problem.
3. Have the students complete the bottom of the page.
4. Discuss the three things that the students feel are important parts of the school.
5. List ideas on the board.
6. Discuss how these ideas can be designed into a monument.

Sketching and Rendering

7. Have each student create sketches of three possible designs for their monument on the *Monument Design Sketches* worksheet like the one on page 7.
8. Once they are complete, have them choose their favorite.
9. Have the students:
   a. Use the monument rendering sheet to create a larger drawing of their design.
   b. Color the design on the same sheet.

Modeling

10. Once the color rendering is complete, have the students:
    a. Gather the building supplies (cardboard, modeling clay or play dough, wax paper, aluminum foil, hobby sticks, construction paper, etc.).
    b. Use the supplies to build a model. The models should be small enough to fit inside a shoebox.
    c. Decorate the models as desired.

Completion

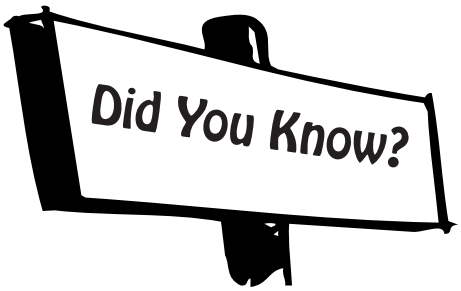
11. Ask each student to show the rest of the class his or her monument. (You may ask the principal or other school administrator to view the presentations.)

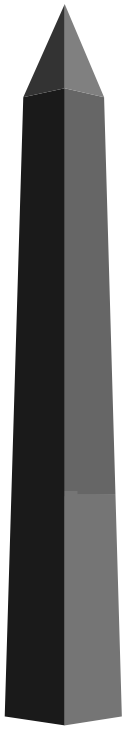
Checking for Understanding

Throughout the activity, encourage students to be as creative as possible. When the activity is complete, ask the students about the design process and how designs are developed.

Do you know what these monuments stand for?

a. Statue of Liberty
b. St. Louis Arch
c. Sphinx
d. Eiffel Tower
e. Tomb of the Unknowns
f. Taj Mahal

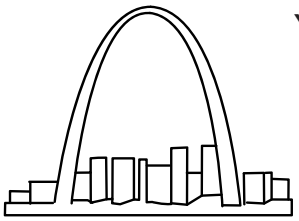




- ✔ The St. Louis Arch is part of the Jefferson National Expansion Memorial, which consists of the Gateway Arch, the Museum of Westward Expansion, and St. Louis' Old Courthouse. In 1948, architect Eero Saarinen created the design for a 630-foot stainless steel arch to commemorate the spirit of the western pioneers. Construction of the Arch began in 1963 and was completed on October 28, 1965. The Arch has foundations that extend 60 feet into the ground and is built to withstand earthquakes and high winds. It sways up to one inch in a 20 mph wind and is built to sway up to 18 inches.
- ✔ The megalithic ruin known as Stonehenge stands on the open downland of Salisbury Plain in Southern England. It is not a single structure but consists of a series of earth, timber, and stone structures that were revised and remodelled over a period of more than 1400 years.
- ✔ The Washington Monument was designed to follow the form of an Egyptian obelisk. It rises more than 550 feet above the city and is the largest masonry structure in the world. The actual construction of the monument began in 1848 and was not completed until 1884 due to lack of funds and the intervention of the Civil War.
- ✔ The Lincoln Memorial, in Washington, DC, was constructed in the style of a classical Greek temple. It has 36 columns to represent the Union at the time of Abraham Lincoln's death.

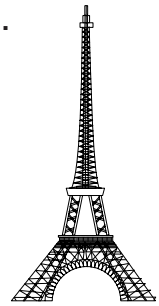
Monument Design Problem

Many places have special objects that honor a person or event. They are found on traffic circles, in parks, and at cemeteries. These may be statues of famous people. They may, also, be a structure like the St. Louis Arch or the Eiffel Tower. These structures are called monuments.



Your school wants a monument.

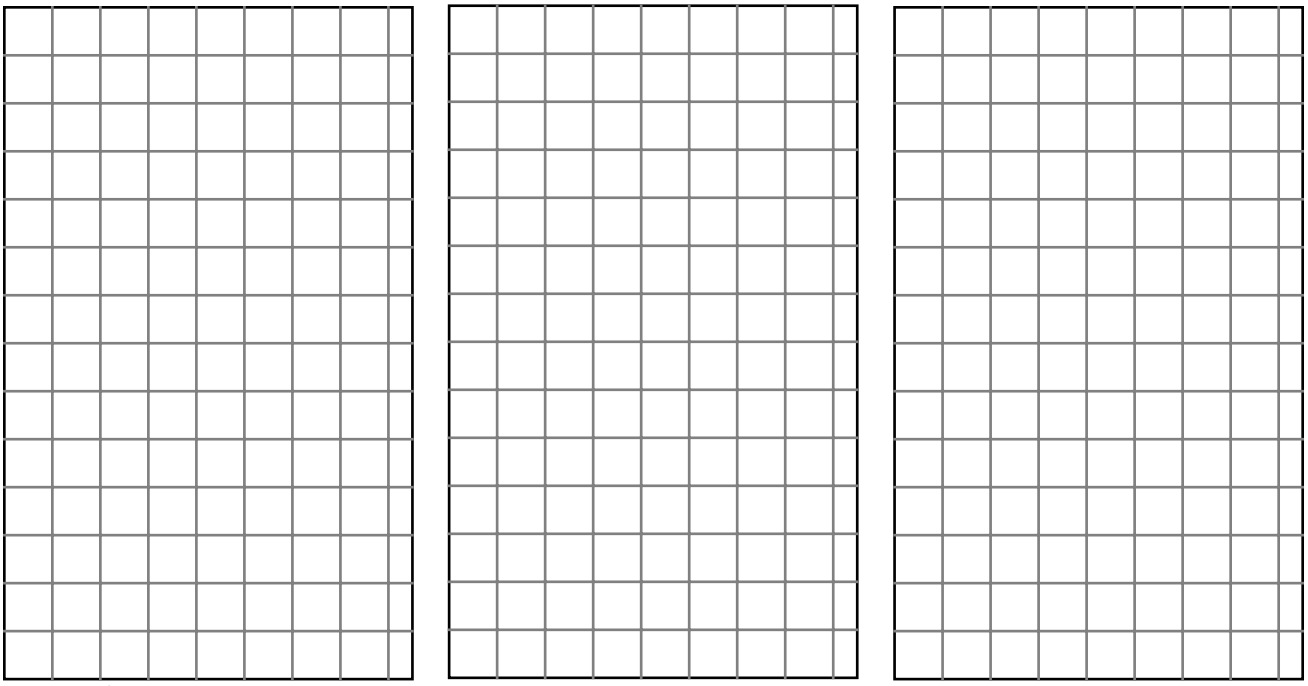
They want you to design it!

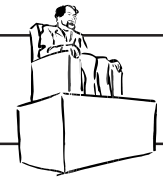


In the boxes below, draw three things that make your school important. These can be used in the monument.

Monument Design Sketches

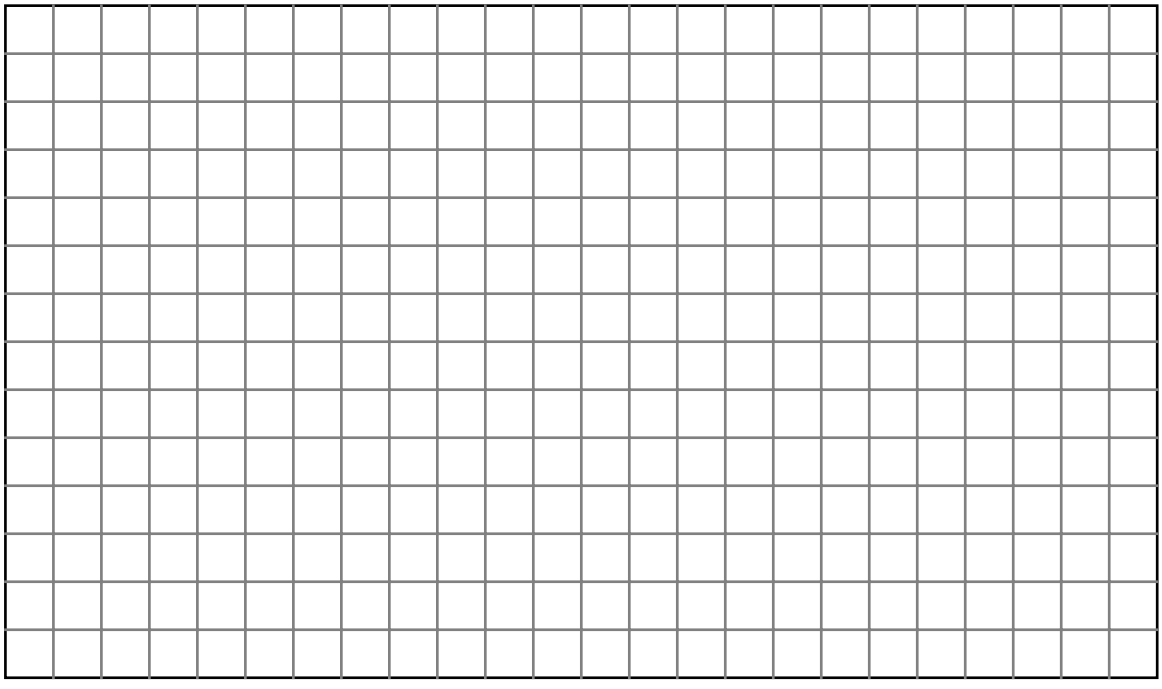
In the boxes below, sketch three ideas for your school monument.





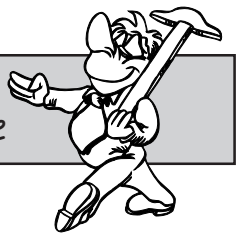
Monument Design Rendering

In the box below, draw and color your best monument design.



Grades 3-5

Designing a Technological Device



Introduction

Anyone can use the design process. Some people use the process to design products to make money. Others design to help society, while others use the design process to make creative devices as a hobby. These people enjoy tinkering and having fun with design. They often design products that are useful and fun. In this activity, the students will have the opportunity to "tinker" with design and create a technological device.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Create a display that focuses on the use of the design.
- Gather the following tools and supplies.
- Set up the testing area. Place one tennis ball and one golf ball on a shelf about four feet above the ground. Tape a 4" by 4" piece of cardboard on the bottom of a plastic cup. Place the plastic cup on the ground at least 10 feet from the balls.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Tape measures
- Cardboard
- Thin strips of balsa or bass wood
- Dowel rods
- Coping saws

Benchmark

This activity will help students reach the following benchmarks:

The process of designing involves presenting some possible solutions in visual form and then selecting the best solution(s) from many.

Test and evaluate the solutions for the design problem.

- Small springs
- Paper clips
- Rubber bands
- Brads
- Small hammers
- Wood glue
- White glue
- Tape
- Markers
- Construction paper
- Tennis ball
- Golf ball
- Plastic cup

Preparing the Students

Set the stage for this activity by completing the following tasks:

- Introduce the students to design and the design process.
- Discuss that the design process is a creative way to create solutions to problems.
- Explain the importance of presentations in the design process. They are used to inform other designers and clients on the progress of the design. Presentations

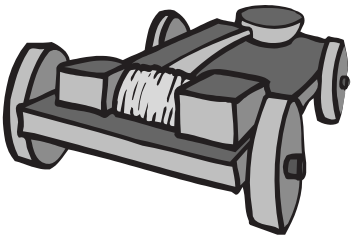
are also used to present ideas for other people to review.

- Describe the use of testing and evaluation in design. Testing aids designers in evaluating the solutions. If a solution passes a test, it receives a good evaluation. Otherwise, the solution must be redesigned.

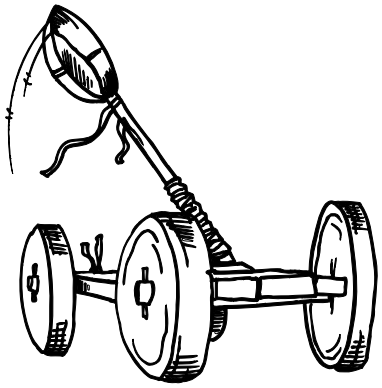
Conducting the Activity

Present this activity using the following steps:

1. Divide the class into small groups of two or three students.
2. Project or distribute copies of the *Technological Problem* sheet like the one on page 10.
3. Discuss the problem and the rules.



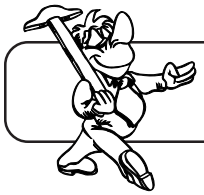
4. Have each student:
   a. Generate three sketches of designs that solve the design problem using a *Product Design* worksheet, like the one on page 11.
   b. List the advantages and disadvantages of each idea.
   c. Present their ideas to the rest of the group.
5. Have each group select the best solution presented by its members.
6. Have each group:
   a. Create a final sketch of the design using a Final Design Sheet, like the one on page 12.
   b. Label the parts and place size (dimensions) on the drawings.
7. Show the students how to safely use the tools provided.
8. Have the students in each group:
   a. Use the tools and materials provided to build their devices.
   b. Test their designs.



9. Have the class participate in a design demonstration in which each group attempts to move the tennis and golf ball into the cup. Each group should have three tries.
10. Have each student complete a *Product Evaluation Sheet,* like the one on page 13.
11. Discuss the results of the devices, once all students have completed the evaluation form.

Checking for Understanding

During the activity, check to make sure the students understand the problem and that their designs are workable. Also, collect the evaluation sheets to ensure all students understand the use of tests in the design process.

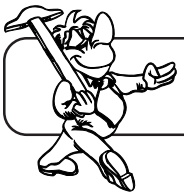


Technological Problem

You are to design and create a device that can be used to move a tennis ball and a golf ball at least 10 feet and place them in a cup.

RULES

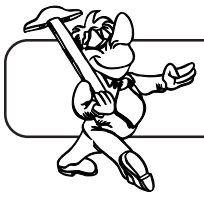
1. Once you begin to move the tennis and golf ball, a person cannot touch them.
2. You can only use the materials and tools supplied.
3. Both balls must fit inside the cup at the finish.



Product Design Sheet

In the boxes below, draw three ideas for the device. List the advantages and disadvantages for each design.

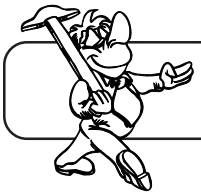
	Advantages: Disadvantages:
	Advantages: Disadvantages:
	Advantages: Disadvantages:



Product Final Design Sheet

In the box below, draw and label your group's final design. List the materials you will need to make the device.

Materials:



Product Design Evaluation

1. How did your device work in: _____

   Test #1? _____

   Test #2? _____

   Test #3? _____

2. How well did the overall design work? _____

3. What was wrong with your design? _____

4. What should be changed to make your design better? _____

Extending the Activity

Sailing Away

Sailboats are one of the oldest types of boats. They are still being used today for sport and recreation. They also continue to be redesigned.

Have your students design a foam or paper boat.

Test the boats for speed, distance, and the amount of weight they can carry.

Evidence of Attainment

Students who have developed an understanding of the attributes of design are able to:

- ✔ Build an object using the design process.
- ✔ Present possible solutions to a design problem.
- ✔ Select the best solution of a number of possible solutions.
- ✔ Test and evaluate solutions of the design process.

Connections to Other Subjects

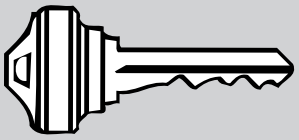
Science: Designing products to deal with scientific principles.

Mathematics: Measure sizes and using scales.

Social Studies: How different designs have influenced society. The development of design tastes over time.

Language Arts: Planning and presenting skills, technical terms, and writing.

Art: Sketching and rendering skills.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.	Test	An experiment conducted to determine the outcome of a design solution.
Design	A creative process used to develop solutions to a problem.	Sketch	A drawing that is used in generating ideas.
Model	A representation of an object that is used to test ideas.		

Books

Ayer, Eleanor. (1992). *Our National Monuments*. Brookfield, CT: The Millbrook Press. ISBN: 1-56294-078-3.

Hutchison, J. and Karsnitz, J. (1994). *Design and Problem Solving in Technology*. Albany, NY: Delmar. ISBN: 0-8273-5244-1.

Wright, R. Thomas and Smith, Howard. (1998). *Understanding Technology*. Tinley Park, IL: Goodheart-Willcox. ISBN: 1-56637-374-3.

Web resources

American Institute of Graphic Arts homepage.
URL:www.aiga.org

Design Central.
URL:www.design-central.com

A commercial site that contains designs for products, services, environments, and digital experiences.
URL:www.ideo.com

Jefferson National Expansion Memorial and the St. Louis Arch.
URL:www.nps.gov/jeff/

Learn To Draw Figures.
URL:www.learnhowtodraw.com

Lincoln Memorial Homepage.
URL:www.nps.gov/linc/home.htm

Mt. Rushmore trivia.
URL:www.mtrushmore.net/

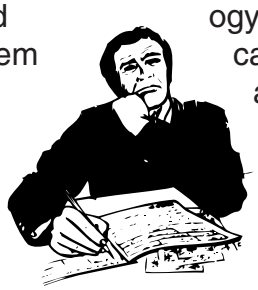
Washington Monument home page.
URL:www.nps.gov/wamo/home.htm

Kids Inventing Technology Series

Invention and Innovation

Introduction

Look at the room around you. Every object in the room was created to solve a problem. Some problems were as basic as needing a device to wipe chalk from a blackboard and others as advanced as the need to receive information from other parts of the world. Whether a person was creating an eraser or the computer and Internet, they used a problem solving process. The process could have been one of engineering design, research and development, troubleshooting, or invention and innovation.



Whichever process the creator used, it began with a problem. A problem is simply a situation that has no clear solution with the technology at hand. There is no problem present if a fisherman has a fishing pole, reel, hook and bait. However, think of the early civilizations that did not have those tools. A problem existed.

There are many paths to solving problems. Some paths are very scientific, others are systematic, and several are creative.

Invention and innovation are two problem-solving processes that are very creative. The process of invention deals with the creation of new and unique devices and systems. Innovation is the improvement of existing products and systems. These processes combine creativity and imagination with the use of technology. Inventions and innovations can be small and simple or large and complex. However, they all start with a problem.

In the past, most inventions were created by people to solve problems in their own lives. Alexander Graham Bell, for example, was a teacher of the deaf and wanted to convert speech to electric signals which he could use to help his students. His research led to his creation of the first telephone in 1876. Other inventors created devices and inventions because they enjoyed tinkering with tools and materials. Thomas Edison was one such tinkerer. He set up his own laboratory dedicated to inventing many types of devices.

Invention, however, didn't begin in the 1800s with Bell and Edison. Invention began when early civiliza-

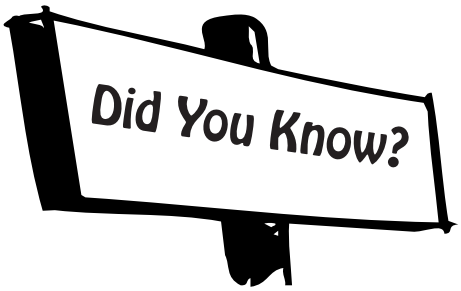
Technological Literacy Standard #10

Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

tions began to solve problems by rounding stones to create wheels and chipping stones to create pointed devices they could use to kill animals for food and clothing. Many inventions from the early years of human existence are still used today. Innovations in the use of materials and production are all that separate early tools from those we use today, such as the axe.

It is impossible to know the individual who invented objects like the wheel or the stone axe. One of the first recorded inventors was Archimedes who lived in Greece about 2,250 years ago. He was the first to use the pulley and screw for practical uses. Today, inventors and inventions are cataloged and recorded by the U.S. Patent and Trademark Office. It began recording inventions in 1646 and granted the first patent to Joseph Jenks for creating a better sawmill and scythes. A patent is the record that explains and diagrams an inventor's new invention. For a patent to be granted, a large amount of research must be done to insure that the invention is new and unique and that it is completely the idea of the inventor. A patent insures that the idea is not stolen from the inventor and created without the inventor's permission.

Invention and innovation are two important paths in problem solving. Without invention and innovation, it would be very hard for society to advance. Imagine if the telephone, radio, or even the wheel would have never been invented. Where would we be today?



- ✔ Rube Goldberg, an ingenious inventor, does not have any patents. His inventions were created for comic strips and not actually produced.
- ✔ Leonardo Da Vinci, who painted the Mona Lisa, was also an inventor. He sketched many different inventions that were hundreds of years ahead of their time, including flying machines, parachutes, military tanks, and submarines.

This issue of the
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Grades K-2

Innovations in the Classroom

Introduction

Inventions and innovations are important to us and help our technology advance. Inventions are brand new ideas that have never been used before. Innovations are changes to old ideas that make them better. Innovations often come from inventions. Take your shirt for instance; it is probably made of cotton and polyester. Polyester is a type of fiber that was invented. It is used to make innovations in clothing. It is added to cotton shirts so they don't shrink when washed. In this activity, your students will take an existing toy and make an innovation with it. The innovation can be as simple as adding something new to it or they can create the toy using a different material.

Benchmark

This activity will help students reach the following benchmark:

Invention and innovation are creative ways to turn ideas into real things.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Collect a series of toys that show innovation. For example, train sets and dolls have evolved and have gone through many innovations. A few examples from different time periods would show innovations.
- Create a display of pictures showing innovations in many different areas (housing, automobiles, bicycles, toys).
- Gather the tools and supplies listed below.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Cardboard
- Construction paper
- Modeling clay
- Craft sticks
- Glue
- Tape
- Markers
- Crayons
- Pipe cleaners
- Scissors

Preparing the Students

To prepare the students for this activity:

- Introduce the concepts of invention and innovation. Invention is a new and unique idea. An innovation is a modification of a current idea or product. Discuss that inventions and innovations always begin with a need.
- Show the students, through products and pictures, innovations in different areas including toys.
- Discuss how the different objects found in the classroom and in their homes have been innovated.
- Have the students bring in a toy or object from home that they would like to innovate.

Conducting the Activity

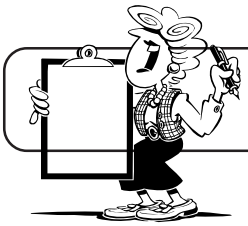
1. Have the students get their toys or objects out.
2. Distribute the Innovations worksheet to the students.
3. Have each student make a "before" sketch of the toy or object they wish to innovate.
4. Once the students have completed the sketch, have them create a sketch of the innovation they plan to create.
5. Hand out the modeling supplies and have them build their innovation.
6. Help the students come up with ways to model the innovations.
7. When the students are done building the models, have them show their innovations to the rest of the class.

Checking for Understanding

Throughout the activity, check to make sure that the students understand the activity and are creating an innovation to their object. When the students are done, have them answer the questions on the Why Innovate? Worksheet.

Inventions and innovations are very important to us. Can you think of inventions and innovations:

a. At home?
b. At school?
c. On the bus?
d. At the library?
e. Other places?



INNOVATIONS WORKSHEET

Draw what your toy or object looks like now.

Draw what your toy or object will look like after you make innovations.

Why Innovate?

What was your toy or object?

What did you change?

Why did you change it?

Grades 3-5

Helpful Inventions

Introduction

The reason many people invent things is to help themselves and others around them meet their needs and wants. Inventors start with a need or problem and work from there. They may watch people to see what they need or they may listen to others and hear them say, “I wish I had a…” For many inventors that is all it takes and they work until they have solved the problem. Once they have created a solution, the next step is to get a patent. A patent insures that the object they created is their own idea and no one else can take it. In this activity, your students will observe the world around them and invent an object to help themselves or others. They will make sketches and then build a model of the device. Once they are complete, they will apply for a patent.

People invent things to help themselves and others.

Benchmark

This activity will help students reach the following benchmark:

Invention and innovation are creative ways to turn ideas into real things.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Become familiar with the process of invention.
- Create a display showing different inventions and famous inventors.
- Prepare invention ideas for students who do not come up with their own. For example, a device that helps open a jar, a device that holds the students' desks open for them, or a device that makes turning a door handle easier.
- Gather the tools and supplies needed.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Cardboard
- Construction paper
- Modeling clay
- Craft sticks
- Glue
- Tape
- Markers
- Crayons
- Pipe cleaners
- Scissors
- Pieces of Styrofoam

Preparing the Students

To prepare the students for this activity:

- Discuss the process of invention and innovation with the students.
  - ✔ Invention and innovation begin with a problem.
  - ✔ The inventor creates sketches and chooses a best solution.
  - ✔ The inventor builds the invention to test if it works.
  - ✔ Inventions don't always work. When they don't, the inventor tries to find out what went wrong and fixes the invention.
- Introduce the students to the idea of a patent.
- Describe the way inventors come up with ideas.
  - ✔ Many of them observe people and find out their needs.
  - ✔ Ask the students to watch their classmates and family members at home and find problems that they could invent devices to solve.
- If the problem the students are using is at home, remind them to bring in objects from home to simulate their problem.

Conducting the activity

1. Distribute the Invention Log sheets to the students.
2. Have the students complete the first section with their own problem statements. If any students do not have a problem they want to work with, assign them one you have thought of.
3. Have the students develop sketches of the problem and the solution. Remind the students that the first sketch is to show the problem before they invent their device.
4. Once the sketches are complete, give the students an opportunity to build the devices. Make the materials available to the students and help them come up with ways to build their devices.
5. When the students are done building the models, have them name and explain their device on the Invention Log.
6. After the devices and Invention Logs have been completed, have the students show and explain their inventions to the rest of the class.
7. During this time, complete the patent forms and distribute them to all students.

Checking for Understanding

To check for understanding conduct a class discussion on the importance of invention to solve real problems. Discuss life without inventions or innovations and the importance of patenting inventions. Also, examine the students' Invention Logs and their inventions.

Invention Log

Name of Device: _____

Explain the problem you are trying to solve:

Create a sketch of the *Problem:*

Create a sketch of the *Solution:*

Explain how your device solves the problem:

Official Classroom Patent

This Patent is awarded to

_____

for the invention of

_____

on the date of

_____

Extending the Activity

Often the invention of new products creates a want that people did not have before the invention. For example, people did not know that they wanted a phonograph before Thomas Edison invented it. People's interest in the phonograph led to the development of the gramophone, which can be seen as an early ancestor to the CD and DVD players of today.

- ✔ Have the students trace inventions that we use today to their early roots and create a display and presentation.
- ✔ Lead the students in developing a model of a new entertainment device that people would want to have and then imagine how that device would evolve.

Evidence of Attainment

Students who have developed an understanding of the role of trouble-shooting, research and development, invention and innovation, and experimentation in problem solving can:

1. Explain the process of invention and innovation.
2. Create a model of an innovation.
3. Build an invention to solve a problem.
4. Examine the history and evolution of inventions.

Connections to Other Subjects

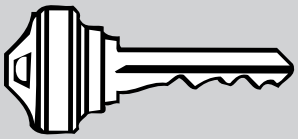
Science — Examine inventions that have led to scientific discoveries.

Mathematics — Study the evolution of mathematical aids from counting stones to the calculator and computer.

Social Studies — Look at the effects that inventions have had on society.

Language Arts — Study the technical writing and explanations on a patent.

Art — Examine how inventions have changed how art is produced.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
Invention	A new and unique idea, product, or system that is created.
Innovation	A modification of an existing product or system.
Problem Solving Process	A set of steps that begins with a problem and ends in a solution.
Patent	A government document that certifies an idea as being original and as belonging to the inventor.

Resources

Books

Bender, L. (1991*). Invention.* New York: Alfred A. Knopf. ISBN: 0-679-80782-9.

Caney, S. (1985). *Invention book*. New York: Workman Publishing. ISBN: 0-89480-076-0.

Davies, Eryl. (1995). *Inventions*. New York: DK Publishing. ISBN: 1-56458-889-0.

Flack. J. (1989). *Inventing, inventions, and inventors.* Englewood, CO: Teacher Ideas Press. ISBN: 0-87287-747-7.

Lafferty, P. and Rowe, J. (1993). *The inventor through history*. New York: Thomson Learning. ISBN: 1-56847-013-4.

Miccolis, Dominic (Ed). (1993). *Inventor and inventions*. Chicago, IL: World Book, Inc. ISBN: 0-7166-0693-3.

Smithsonian book of invention. (1979). New York: W. W. Norton. ISBN: 0-89599-002-4.

Taylor, R. (1991). *Journey through inventions.* New York: Smithmark Publishers. ISBN: 0-8317-5266-1.

Wood, R. (1995). *Great inventions*. Alexandria, VA: Time Life Books. ISBN: 0-7835-4766-8.

Web resources

A presentation of some of America's most famous inventors and inventions.
URL: http://www.150.si.edu/150trav/remember/amerinv.htm

A national inventors hall of fame that recognizes inventors and invention.
URL: http://www.invent.org/

United States Patent and Trademark Office.
URL:http://www.uspto.gov

The Great Idea Finder.
URL:http://www.ideafinder.com

A site that lists the greatest Inventions.
URL:http://library.thinkquest.org/C002942

Kids Inventing Technology Series

Communication Media

Introduction

Every day information and messages are transferred to us in many ways. You may wake up to an alarm, watch the morning news, grab a newspaper on the way to school, write on the chalkboard, and receive a phone call at the end of the day. All of these activities use communication. Communication is the exchange of information using a medium.

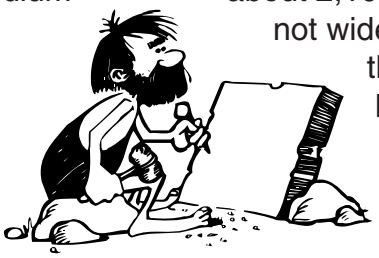
graphic (or printed communication) and electronic communication. Graphic communication is the older of the two and can be traced to cave paintings. In cave paintings, the rock walls were the medium. The rock allowed the paint to display the message. Some cave drawings that exist today are believed to be thousands of years old.

As technology advanced, graphic communication media advanced as well. People began to use clay tablets and animal skins to record messages. Around 2,200 years ago the Greeks began to produce parchment from animal skin which helped their society record more information. The next advancement in graphic media was the invention and use of paper. The Chinese began producing paper about 2,105 years ago, but it was not widely used in Europe until the early 11th century. Paper is now one of the most widely used forms of graphic media. Paper is used to carry infor-

> Communication is the exchange of information using a medium.

Media, plural for medium, are the devices or technologies that are used to carry the information or data that is being communicated. Without the use of a medium, information could not be sent from the sender to the receiver. An example of a medium is air. When we speak to one another, the air between us is the medium that carries the sound waves.

The types of media that are used help to divide communication into two major types,



Technological Literacy Standard #17

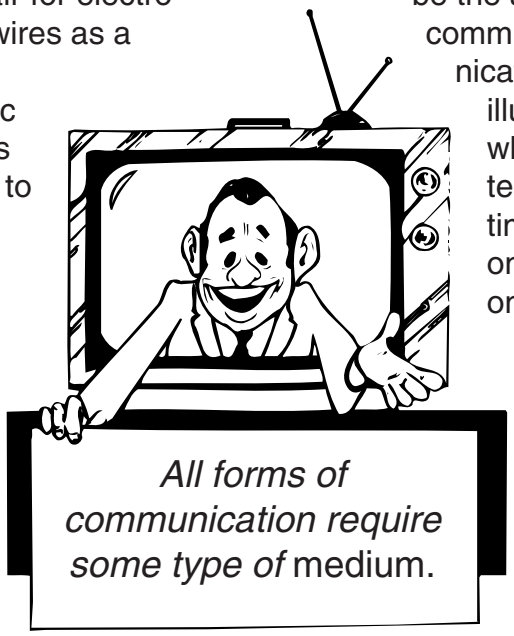
Students will develop an understanding of and be able to select and use information and communication technologies.

mation in books, magazines, posters, and signs. Paper, much like media used in electronic communication, is very versatile.

Air and wires are versatile media that are used in electronic communication. Air has been used for thousands of years to carry information. Speech uses air to transmit sound waves. Our ancestors used air as a medium when they used drums and horns to communicate. Today we use air to move electromagnetic waves that allow us to use cell phones, radios, and televisions. However, before we could use air for electromagnetic waves, we used wires as a medium.

One of the first electronic communication devices was the telegraph. It used wires to transmit the electric signals created when the key was depressed. Telephones also use wires to carry signals from the sender to the receiver. Today, wires are commonly used to transmit information through the use of the Internet. The medium of air is also used in communication through the Internet when satellite systems are used. The wires and air media used with the Internet allow users to send, store, and retrieve data from various parts of the world.

All forms of communication require some type of medium. The medium could be the air in speech and radio communication, paper in communication through drawings and illustrations, or even wires when communicating with a telephone or computer. Every time we communicate with one another we are relying on communication media.



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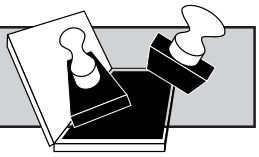
Grades K-2

Making Your Mark



Introduction

Throughout history, stamps have been used with various media to designate the owners of property. Letters were marked with the insignia of the sender, animals were branded with the symbol of the owner, and documents were stamped with the logo of the writer. These stamps were used to identify the person who owned, sent, or wrote the material. The same stamp design was used on all media. In this activity, your students will create a design that will serve as their marking. They will then produce a stamp they can use to identify their own belongings.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Prepare a discussion on the types of communication.
- Prepare a bulletin board showing different types of communication media.
- Design and produce your own stamp as described on page 4, to serve as an example.
- Gather the tools and supplies needed.
- Copy the Official Marking Form onto the parchment paper, one for each student.

Benchmark

This activity will help students reach the following benchmark:

People use symbols when they communicate by technology.

Supplies and Tools Needed

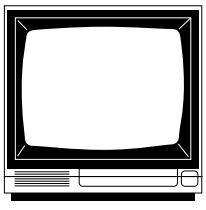
The following tools and supplies are needed to complete this activity:

- Vinyl or rubber erasers
- Hobby knives
- Small wood blocks, slightly bigger than the erasers
- Pencils
- Ink pens
- Ink pads
- Paper
- Parchment (resume type) paper
- Super glue

Preparing the Students

Set the stage for the activity by:

- Introducing the concept of different types of media.
- Discussing the use of special markings to inform others who the property belongs to.
- Informing the students that the use of the marking on media is a use of communication technology.



Conducting the Activity

Present the activity using the following steps:

Designing the Marking

1. Hand out the Special Marking Design Form to each student.
2. Have the students complete the form.
3. Distribute an eraser and piece of tracing paper to each student.
4. Have each student:
    a. Trace the outline of the eraser onto the paper.
    b. Redraw his or her marking on the paper inside the eraser outline with a pencil.

Making the Stamp

5. Have the students:
    a. Turn the paper over and place the image over the eraser.
    b. Use the side of the pencil to rub the paper so it leaves a copy of the image on the eraser.
6. Give the students an ink pen and let them darken the image on the eraser.
7. Have each student carefully cut around the image with a knife or scissors leaving the inside of the lines and images.You may want to have parent helpers available for this task.
8. Distribute the pieces of wood to the students.
9. Have the students turn over their stamps and glue the backs to the wood.

Using the Stamps

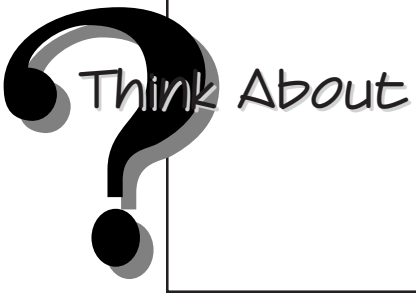
10. Organize two or three stamping stations. Each stamping station should include several ink pads, newspaper to keep the tables clean, and blank paper so the students can practice.
11. Have the students place their stamps in the ink and then create an inked image on the blank paper.
12. Let the students practice making images with their stamps.

Identifying the Stamps

13. Distribute the Official Marking Forms to the students.
14. Have them write their name and place an ink image on the paper.

Checking for Understanding

To check for understanding, watch the students to ensure they create the stamps correctly. You can also have a discussion that asks the students why they would use the stamp and what types of materials (media) they could use it on.



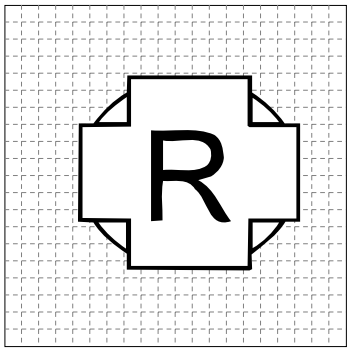
How do you use the following things as forms of communication media every day?

A. Air
B. Wires
C. Paper
D. Metal
E. Other

Special Marking Design Form

In the space below, create a design that will be your marking. The design should be brand new. You can use your initials or some other shape.

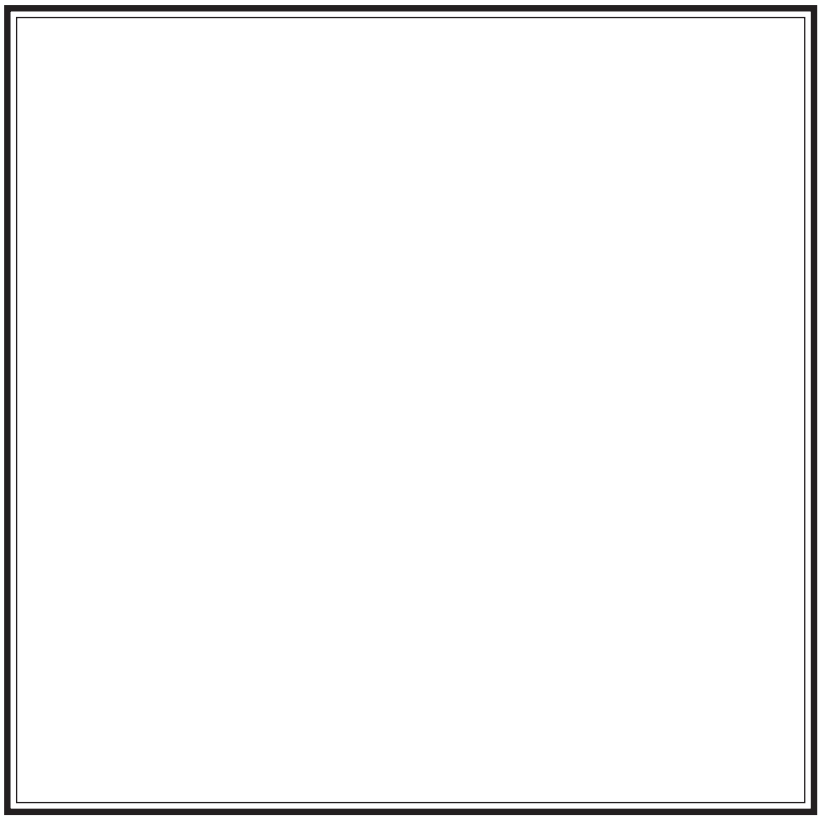
For example:



Draw your marking here:

Official Marking Form

Stamp



Your name:

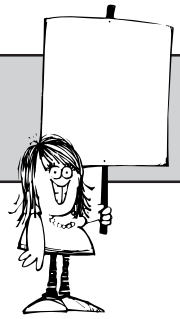
_____

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

_____

Grades 3-5

Creating a Sales Flyer



Introduction

Many different types of communication media are used for both research and advertising. Graphic and electronic media are used in research. Typical libraries include books, magazines, and encyclopedias, as well as the Internet and electronic encyclopedias. Both media are very useful and have advantages and disadvantages. Advertisers use various media to reach different consumers. Newspapers, magazines, billboards, posters, and Internet banners are all examples of types of media that are used to advertise products. In this activity, you will use an electronic media to research a technological device. You will then create a sales poster to promote your historic device as if it were a new product. You will present your flyer to the rest of the class.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Prepare a presentation on the types of communication.
- Create a display showing various types of communication media.
- Collect copies of advertisements, both printed and electronic.
- Make copies of needed handouts.
- Gather the tools and supplies identified in the next section.

Benchmark

This activity will help students reach the following benchmark:

Information can be acquired and sent through a variety of technological sources including print and electronic media.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Computers with access to the Internet or electronic encyclopedias.
- Markers
- Colored pencils
- Crayons
- Posterboard
- Tape
- Colored paper
- Paper

Preparing the Students

To prepare the students for this activity:

- Discuss different forms of communication media.
- Describe how communication media has evolved, just like other technologies.
- Identify ways that information can be gathered through the use of the computer. Discuss search engines and online encyclopedias.

Conducting the Activity

1. Divide the class into seven teams.

Research

2. Distribute a research sheet, like the one on page 9, to all students.
3. Have the teams research on the Internet or electronic encyclopedia. Give the students sites to help them begin to search; for example, http://www.inventors.about.com
4. Once the students have answered all of the research questions, have them gather at a table as a team.

Laying out the Advertisement

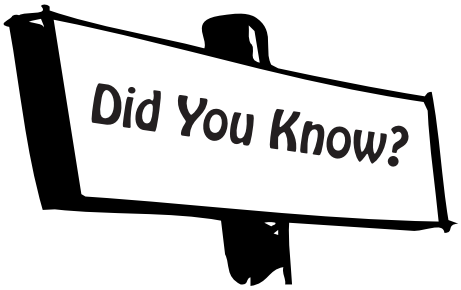
5. Hand each student an advertisement layout sheet like the one on page 10.
6. Show the students examples of advertisements of new products. Explain that they are to advertise their products as if they are new and no one knows what they are.
7. Have them list the features and other descriptions they think are important on their advertisement layout sheets.
8. Have each student:
   a. Design a sample advertisement in the space provided.
   b. Present it to his or her group.
9. Have each group select one advertisement to produce.

Creating the Advertisement

10. Hand out a posterboard to each group and make the markers, colored pencils, and other poster-making supplies available to the students.
11. Have each group create its advertisement on its posterboard.
12. Once all the groups have completed their work, allow each group to discuss its device and show its product.

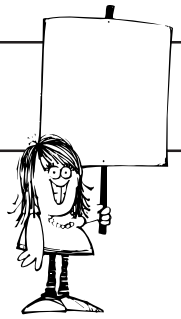
Checking for Understanding

During the activity, ask the students questions about the type of media that they are using. After the activity, conduct a discussion. Ask the students if they could have researched and advertised their devices using other forms of communication media.



- ✔ Archaeologists found over 1,900 clay tablets dating back to 2000 BC in the Royal Palace at Ebla.
- ✔ The early Egyptians used papyrus, instead of paper, to write on. The sheets of papyrus were made from a papyrus plant.
- ✔ The Chinese were the first to make paper. Only the Chinese knew the art of papermaking for 500 years.
- ✔ The first printed books started to appear in China in the ninth century.

Research Sheet



Check the technological device your group has chosen

- ❑ Airplane
- ❑ Automobile
- ❑ Radio
- ❑ Farm Combine or Harvester
- ❑ Camera
- ❑ Telescope
- ❑ Radio

Research Questions

1. Who invented the device?

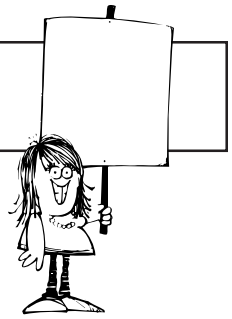
2. What does it do?

3. What devices or procedures did it replace?

4. How does it work?

5. What other important features does it have?

Advertisement Layout Sheet



List the important features of your device.

Draw a layout for an advertisement that could be used to introduce this device.

Extending the Activity

Communication media can take many forms. Explore other media using the following activities:

- ✔ Divide your class into typical divisions of a newspaper staff. Have your students plan and produce a photocopied newspaper.
- ✔ Have your students plan a television commercial that advertises a function at school. Check out video cameras and have the students record the commercials.

Evidence of Attainment

Students who have developed an understanding of and are able to select and use information and communication technologies can:

1. Describe the types of media used in communication and information technologies.
2. Use various types of media to display a message.
3. Gather information through electronic communication media.

Connections to Other Subjects

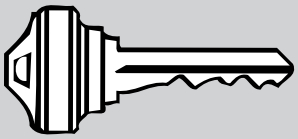
Science — Examine sound and electromagnetic waves.

Mathematics — Explore the shapes used in the stamps.

Social Studies — Research how different societies communicate.

Language Arts — Write text on different media.

Art — Explore the design elements used in designing advertising.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
Communication	The exchange of information using a medium.
Communication media	The product or device that is used to transfer information (paper, wires, air, etc.).
Electromagnetic waves	Waves that are carried by air to transmit information. Radio waves, visible light, and X-rays are all electromagnetic waves.
Sound waves	Waves that are used to transmit sound.

Resources

Books

Gardner, Robert. (1995). *Communication (Yesterday's Science, Today's Technology)* New York: Twenty First Century Books. ISBN: 0-8050-2854-4.

Mead, Richard. (1996). *I Wonder Why the Telephone Rings and Other Questions About Communication.* New York: Kingfisher Books. ISBN: 0-7534-5015-1.

Oxlade, Chris. (1997). *Electronic Communication (Hello Out There).* New York: Franklin Watts, Inc. ISBN: 0-531-14474-7.

Wilkinson, P. and Dineen, J. (1994) *Scrolls to Computers.* Limpsfield, Great Britain: Dragon's World Children's Books. ISBN: 1-85028-282-X.

Web resources

History of Paper.
URL:http://www.mead.com/ml/docs/facts/history.html

Internet Timeline.
URL:http://www.pbs.org/internet/timeline

Invention and Inventors search.
URL:http://www.inventors.about.com

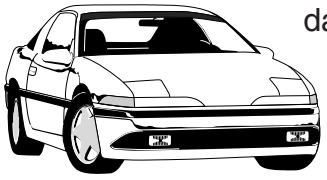
Paper Online.
URL:http://paperonline.org/index.html

Recording Technology History.
URL:http://history.acusd.edu/gen/recording/notes.html

Technological Symbols

Introduction

Imagine yourself getting into a car to visit a friend in the hospital. You turn on the car and are ready to put it in gear; however there is a light on the dashboard that is reminding you to put on your seatbelt. You begin to drive toward the hospital, stopping at all stop signs and slowing at pedestrian crossings. You stop to get gas because a light on your dashboard in the shape of a gas pump is illuminated. You finally get to the hospital by following a number of signs with an H in the center. You park in a lot taking care not to park in the space with a picture of a wheelchair.



What was the purpose of all the pictures that you encountered on your trip to the hospital? Did they help you make the trip safely? Those pictures were symbols. Symbols are graphic representations of actual objects. Your knowledge of the symbols lets you understand that a picture of a gas pump on your dashboard means that your car's gas tank is almost empty. It also allows you to know that a drawing of a wheelchair means that the space is reserved for handicapped people. We use symbols every day and often do not even realize that we are using them.

The use of symbols is not a new idea. Our early ancestors used symbols to communicate and record history in cave drawings. The cave drawings eventually led to the development of a collection of symbols used to tell stories. That collection would be refined over thousands of years into an alphabet of letters and a collection of numerals. The Phoenicians, Greeks, and Romans developed the alphabet and numerals we use today.

> Symbols are graphic representations of actual objects.

Many symbols, like the alphabet, are used in sets. Sign language, Morse code, and the International Flag Alphabet are all used in sets that represent letters and words. However, not all symbols are used as letters in an alphabet. Many symbols are drawings or images that represent entire words or ideas. For example, the United States of America has symbols used to represent the coun-

Technological Literacy Standard #12

Students will develop the abilities to use and maintain technological products and systems.

try. The picture of Uncle Sam, a bald eagle, and the U.S. flag all represent the United States.

The U.S. is not unique. All countries have symbols and flags that are used to represent them. Even the individual states have flags and seals that are used to depict the state. Companies do this as well. The symbols used by companies are called logos. Logos are used on products to help identify which company produced the item. Many logos have become commonplace and are easily recognized. It is normal to see a can with a red, white, and blue ball and know that it is a can of Pepsi or an appliance with GE written in cursive and recognize it as a General Electric product.

Companies, states, and countries use symbols because they are simple and easy to recognize. That is the same reason they are used on road signs. Symbols on road signs show direction and communicate warnings better and faster than writing out the information. A red and white triangular sign is quickly recognized as a yield sign. It would be wasteful and possibly dangerous if, instead of using the symbol for yield, the sign was written out and read "Slow down and check for other vehicles; if no other vehicles are present proceed with caution. If other vehicles are present, stop and proceed after all vehicles have passed." It is easier to learn what symbols mean than to use the written explanation every time.

Many technological devices use symbols in their operation. Almost any device that uses batteries has symbols showing the direction in which the batteries should be placed in the device. Technological symbols are often common pictures or icons that mean the same thing in all applications. A circle with a diagonal line through it means that you should not do something. The object you should avoid is usually in the middle of the circle. For example, a no smoking sign would have a cigarette with a circle around it and a diagonal line through it. This is a very simple symbol that is easily recognized.

Symbols can be very complex sets of symbols or simple line drawings. No matter how simple or complex, they are used to communicate a word or idea. Technological symbols allow viewers to receive information easily and without a lot of words. They are an important part of communication and technology.

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Grades K-2

Everyday Symbols

Introduction

We come into contact with symbols every day. Symbols help to direct us, show us where the exits are located, and remind us to be safe. Symbols are often very simple drawings of objects and figures. For example, the signs used on bathrooms to distinguish the men's from the women's bathroom is a simple drawing. In this activity, your students will record the symbols that they see throughout the day. They will make drawings of the symbols and create a new symbol they feel is needed.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Prepare a discussion on symbols.
- Prepare a bulletin board showing different examples of symbols.
- Gather the tools and supplies listed below.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Posterboard
- Crayons and markers
- Pencils
- Rulers
- Tape
- Symbol Recording Sheet

Benchmark

This activity will help students reach the following benchmark:

Recognize and use everyday symbols.

Preparing the Students

To prepare the students for this activity you should:

- Discuss the definition and use of symbols.
- Discuss that symbols are:
  - ✔ Signs and drawings.
  - ✔ Used to represent other objects.
  - ✔ "Shortcuts" to writing the information that is on signs.
  - ✔ Used in many places including school, bus, and home.

Conducting the Activity

Present the activity using the following steps:

1. Introduce the activity.
2. Distribute a Symbol Recording Sheet, like the one on page 5, to each student.
3. Discuss the students' assignment.

   They are to make sketches of symbols they see during the next day. Make sure all of the students know what they are looking for. It can be any symbol that they see. For example, a stop sign or handicapped parking sign.

4. Once the students have had time to record symbols, hand out posterboard, crayons, and markers to all of the students.
5. Have each student draw a line down the center of the posterboard from the top to the bottom.

   The poster should be divided into two equal sections. In the section on the left side, have the students redraw the symbols they drew on their recording sheets. They should color the symbols in the same colors that they saw.
6. After they have completed the drawings, distribute a Symbol Design Sheet like the one on page 6.
7. Discuss the symbol design sheet with the students.
8. Help the students come up with ideas for the symbols.
9. Have the students draw and color their symbols on the right side of the posterboard.

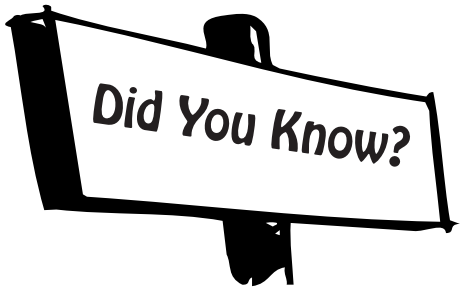
   When the students have completed their work, they should have a posterboard of several existing and one new symbol.
10. Have the students present their posterboard to the rest of the class.

Checking for Understanding

Ensure that the students understand that symbols are used in our daily lives by having them look at the symbols their classmates have identified.

Discuss the use of symbols and ask the students:

Why are symbols used?
Are they easy to understand?
What symbols do you use everyday?



- ✔ Flags, symbols of countries, were placed on new territories to mark possession. The United States of America placed a U.S. flag on the moon in 1969.
- ✔ The colors, shapes, and images on flags are used to represent the city, state, or country to which the flag belongs.

What symbols do you recognize in the following areas?

a. Clothing
b. Food
c. Beverages
d. Games

Draw company logos that you know from the areas listed above.

Symbol Recording Sheet

Draw all the symbols that you see in one day.

Symbol Design Sheet

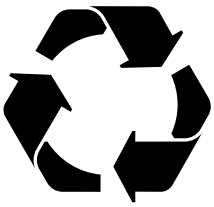
Symbols help people locate things. Bathrooms, exits, stairways, and fire extinguishers all have symbols. Draw a new symbol below that would help other people locate something (closet, elevator, fire escape).

Grades 3-5

Technological Explanations with Symbols

Introduction

Symbols are normally created using pictures without text. Because symbols do not rely on words, people of many different languages can understand them. Companies use symbols when they are creating products and instruction manuals because they know that all users and readers should be able to understand the symbols. In this activity, your students will create an instruction manual using symbols to show the use of a device. The students will write the directions and then create symbols for the steps of the process they are explaining. Once they have completed the manual, they will let other students try to complete the processes they described.



Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Collect various instruction manuals for technological devices.
- Create a display on the use of symbols.
- Gather the tools and supplies needed.

Benchmark

This activity will help students reach the following benchmark:

Use common symbols, such as numbers and words, to communicate key ideas.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Various technological devices (tape players, CD players, flashlights, radios, padlocks, etc.)
- Pencils
- Colored pencils
- Markers
- Crayons
- Construction paper
- Copies of the procedure sheets

Preparing the Students

To set the stage for this activity:

- Review the topic of symbols.
  - ✔ Symbols are found in everyday life.
  - ✔ The alphabet, Morse code, and signs are all symbols.
  - ✔ Symbols can be used without words.
- Discuss the activity that they are going to complete.

Conducting the Activity

Use the following steps to facilitate the activity:

1. Introduce the activity to the students. Inform the students that they will be writing instructions for a technological procedure.
2. Have the students identify a short procedure for which they would like to write instructions; for example, playing a tape, replacing batteries, opening a padlock, loading and playing a CD.
3. Have the students locate in the classroom or bring from home the devices needed to follow their procedure.
4. Distribute a procedure sheet like the one on page 9.
5. Review the sample procedure and discuss how to write a procedure.
6. Have the students work with their devices and record their procedure at the bottom of the page.

7. Give each student a sample instruction sheet and blank instruction sheet like the ones shown on pages 10 and 11.
8. Review the sample instruction sheet found on page 10.

   Note: On the sample sheet there are two columns and one row for each step of the procedure. The first column is the action, or verb, of the step and the second is the object, or noun, of the step. It may help if your students write their steps the same way so they have two symbols (an action and object) for each step.
9. Have your students:
   a. Write the steps of their procedure in the small rows on a blank instruction sheet like the one found on page 11.
   b. Draw symbols for both columns. Each word should have a different symbol. If a word is repeated, the same symbol should be used.
   c. Label the rows with symbols in numerical order.
   d. Cut out the rows of symbols.
   e. Paste the symbols in order on construction paper.
10. Have the students rotate through the classroom and test the devices and instructions.

Checking for Understanding

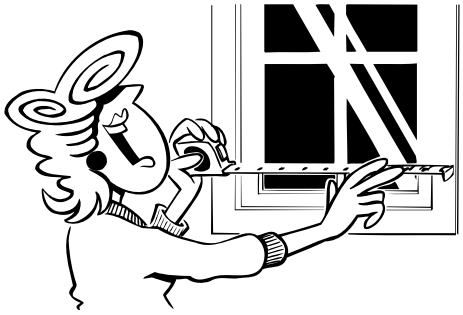
While the students are testing the procedures developed by other students, rotate through the room and check the symbols and procedures to ensure they are understandable. Conduct a class discussion on symbols they use every day and the importance of symbols.

Procedure Sheet

Sample Procedure

Playing a CD

1. Open the CD player
2. Select a CD
3. Place the CD in the CD player
4. Close the CD player
5. Turn on the CD player
6. Press play
7. Listen to the music



Your Procedure

In the space provided write your procedure.

Title of the procedure: _____

Steps:

1.

2.

3.

4.

5.

6.

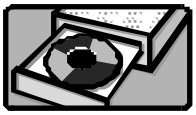
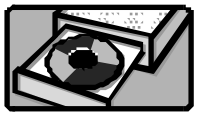
7.

8.

9.

10.

Sample Instruction Sheet

 Press the	 Open Button
 Select a	 CD
 Place it in the	 CD Player
 Close the	 CD Player
 Press the	 Power Button
 Press	 Play
 Listen to the	 Music

Your Instruction Sheet

Extending the Activity
Stories Through Symbols

Symbols can be used for many types of communication. They can even be used to tell stories.

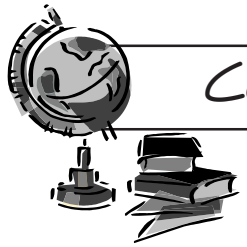
Have your students:

- ✔ Write a story explaining a day in their lives using only symbols and pictures.
- ✔ Recopy a fairy tale or nursery rhyme using symbols.

Evidence of Attainment

Students who have developed the ability to use and maintain technological products and systems can:

1. Identify symbols used in everyday life.
2. Create symbols.
3. Relay information using symbols.



Connections to Other Subjects

Science — Examine symbols used in science.

Mathematics — Identify symbols used in mathematics.

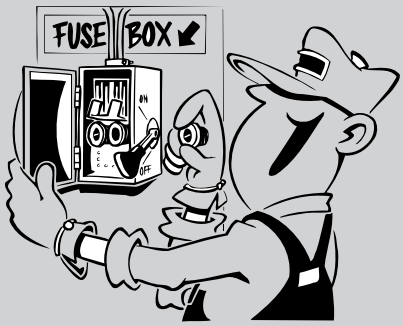
Social Studies — Study symbols used by states and countries around the world.

Language Arts — Write stories using symbols; identify how nouns and verbs are used in procedures.

Art — Research the design and use of symbols and icons in art and decoration.

Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
Symbols	Objects that are used to represent other things.
Communication	Sending a message from one person to another.



Resources

Books

Ventura, P. (1994). *Communication: Means and Technologies for Exchanging Information*. Boston: Houghton Mifflin. ISBN: 0-395-66789-5.

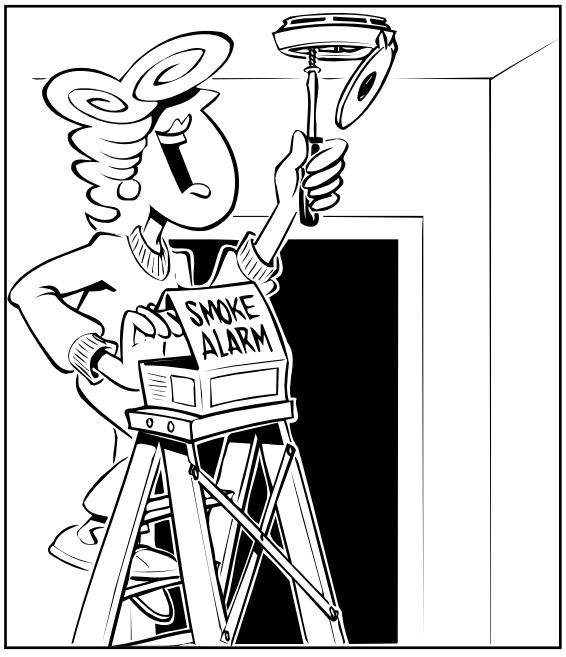
Wilkinson, P. and Dineen, J. (1994). *Scrolls to Computer Screens*. Surry, Great Britain: Dragons' World. ISBN: 1-85028-282-X.

Web resources

Hand Speak.
URL:http://www.handspeak.com

Name in Hieroglyphic.
URL:http://www.torstar.com/rom/egypt/

Encyclopedia of Symbols.
URL:http://www.symbols.com



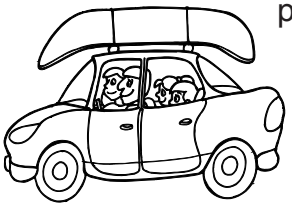
Can you use symbols to show how to do this technological action?

Kids Inventing Technology Series

Using Technological Devices

Introduction

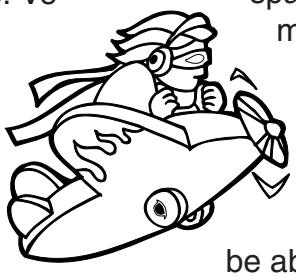
Have you ever ridden in a car for a long period of time? What if you had to walk the distance instead of using a car? Automobiles are a tool (technological device or artifact) used to move people and cargo from place to place. Automobiles are used all over the world on a daily basis. Automobiles were designed to meet a need to travel more quickly and comfortably. Like any technological development, an automobile must be designed properly and used and maintained correctly.



When designing an artifact, such as an automobile, designers must look at the tools and machines used to produce the vehicle. Vehicles are engineered to be able to be built by people working in a factory with tools and materials. Automobile designers also develop these vehicles so they can be maintained by mechanics working in garages miles from the factory. These mechanics use appropriate tools to maintain and repair the vehicles.

Without proper maintenance, an automobile becomes unreliable and ineffective. The tires must be checked, fluid levels monitored, and engine performance must be observed. We must also use the vehicle correctly on maintained roads and highways by going an appropriate speed and observing accepted driving rules. All of these steps are important in maintaining a safe and reliable vehicle.

The automobile is just one example of a tool. A tool is any device that humans use to complete a task. A tool can be as simple as a pencil or a hammer. Both of these devices allow humans to complete specific tasks. Tools can also be complex. The robotic arm on the space shuttle and an electron microscope are both complex tools. However, they are still used to complete specified tasks.



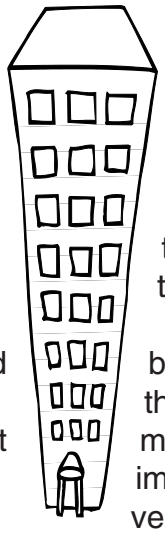
As users of modern technologies, we must first be able to select the proper tool for a given situation or task. For example, it would be difficult to tighten a bolt by using a baseball bat. This may seem like a ridiculous example but selecting the correct tool is a part of being technologically literate. Once a

Technological Literacy Standard #12

Students will develop the abilities to use and maintain technological products and systems.

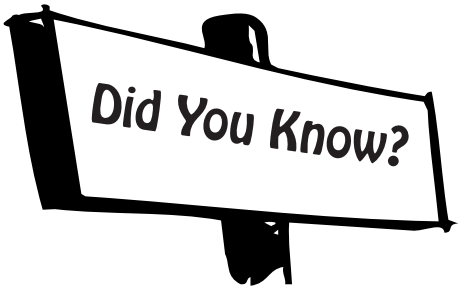
tool has been selected, the person must be able to use the tool properly and maintain its condition for proper use and effectiveness. By using tools properly, we can optimize their effectiveness. By learning to use a variety of tools effectively, we can create solutions to many of the challenges in our daily lives.

We use tools to meet our wants and needs. When we design and build an office building 25 floors tall, it is to meet a need. People need to optimize the number of offices available on a small piece of land. When designers develop

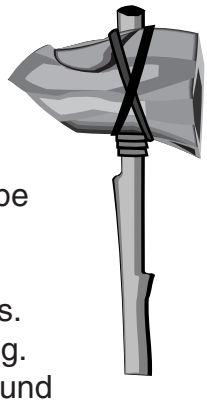


an airplane to fly at record-breaking speeds, it is to meet a need. People and cargo need to be able to reach a location at a quicker speed than is currently available. Whether you are building an office building or an airplane, tools must be used to develop and build the product.

As society advances, the tools we use become more complex and efficient. In the future, we will continue to produce more efficient and helpful tools. It will be important for humans to be able to develop, use, and maintain these more complex tools.



Tools have been used for thousands of years. The first tools were found objects like rocks and sticks. As humans became more advanced, they needed better tools. They began to shape tools from the objects they had found. Native Americans, for example, shaped pieces of rock and bone into arrowheads. These arrowheads were used for hunting. Arrowheads can still be found in the ground in many parts of the United States.



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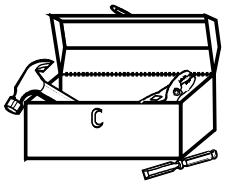
Grades K-2

Using Tools Correctly

Introduction

All people use tools. People use toothbrushes to brush their teeth, pencils to write on paper, and scissors to cut a piece of string. Using tools correctly is important in unlocking the potential of humans and tools working together. Along with using tools correctly, they must be used in a safe and efficient manner. All tools have different safety guidelines that help people use tools without injuring themselves. For example, construction workers wear safety glasses when they work with machinery, and cooks use oven mitts when handling hot pans. By using tools correctly and safely, people are able to accomplish their goals in an efficient manner.



Teacher Preparation

To prepare to introduce this activity, you should:

- Gather examples of different tools used in the classroom.
- Consider the safety issue for using scissors, paper punches, and needles.
- Duplicate the worksheets included in this activity.
- Make a sample photo or drawing tablet.
- Gather the supplies needed.

Benchmark

This activity will help students reach the following benchmark:

Use hand tools correctly and safely and be able to name them correctly.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Blank sheets of 5 1/2" x 8 1/2" bond paper (tablet body)
- Blank sheets of 5 1/2" x 8 1/2" thin posterboard (tablet back)
- Crayons or colored markers
- Index paper (tablet cover)
- Yarn
- Scissors
- Adjustable three-hole punch
- Plastic yarn needle

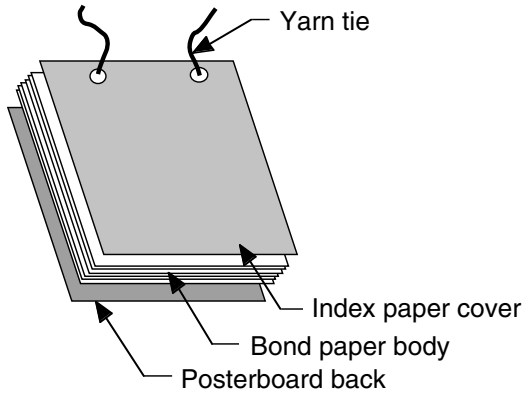
Preparing the Students

Set the stage for the this activity about tools and tool safety by:

- Explaining:
  a. The function of tools.
  b. That tools must be used correctly.
  c. The importance of tool safety.
- Giving examples of tools used in the classroom, such as pencils, staplers, rulers, markers, etc.
- Discussing the different tools students use on a daily basis.

Conducting the Activity

1. Show the students a completed drawing, journal, or photograph tablet.
2. Challenge the students to design a cover for their own personal tablet.

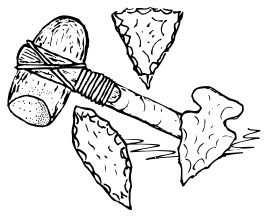


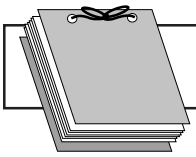
3. Distribute the *Tablet Cover Design* worksheet to the students. Note: This should be run on index paper.
4. Have each student sketch a cover for his or her tablet on the worksheet.
5. Explain that the cover and the blank sheet must be made (manufactured).
6. Through discussion, have the students identify the steps in making the tablet such as:
   a. Design a cover.
   b. Color the cover.
   c. Cut the cover to size.
   d. Gather the inside sheets.
   e. Punch holes in the cover and sheets.
   f. Place the cover on the sheets.
   g. Bind the cover to the sheets with yarn using a needle.
7. Through discussion, have the students:
   a. List the tools they would use for each step using the *Tablet Tools* worksheet.
   b. Identify safety rules for the important tools they will use. These may include scissors, paper punch, yarn needle, markers, and rulers.
8. Have the students write the major rules on their *Tool Safety* worksheet.
9. Demonstrate and explain the use of the following tools:
   a. Scissors
   b. Paper punch
   c. Yarn needle
10. Hand out sheets of paper, crayons, markers, and colored pencils.
11. Have the students:
   a. Cut the paper to size.
   b. Punch holes in the top of the tablet.
   c. Decorate the cover.
   d. Assemble the tablet with yarn.

Checking for Understanding

As your students work on their projects, ask questions about the tools they are using. Make sure they are using the tools properly and safely. Check to see if they understand they are using tools to develop a product.

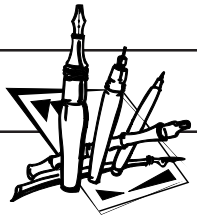
Humans are tool makers and tool users. What tools do you use? How often do you use tools on a daily basis? Are there different uses for common tools you use?





Tablet Cover Design

Design your cover in the box below. Draw it carefully with light pencil lines. You will color and cut out the design to become the cover for your tablet.



Tablet Tools

What tools would you use to do the following tasks on your tablet?

Design cover

Cut out cover

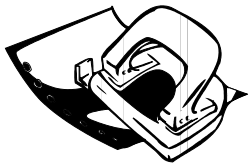
Punch holes in cover, back, and body sheets

Hold papers and cover together

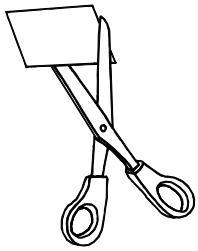
Tool Safety

Write two or three important safety rules for each tool listed below.

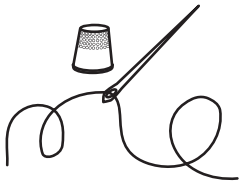
Paper Punch



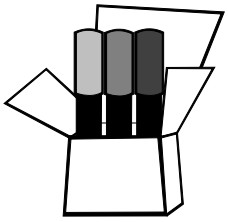
Scissors



Needle



Markers



Grades 3-5

Selecting and Using Tools Wisely

Introduction

The tools we use have changed every year as new tools are designed. Many of the new tools make tasks easier to do. Using tools has improved efficiency and productivity in all fields of design and production.

Many tools are used in designing a product. Tools such as rulers, pencils, paper, compasses, and triangles are used in designing products by hand. Computers and design software are used in computer-aided design. Advances in software and computer hardware have allowed designers to create more complex designs, while improving efficiency.

Tools are also used in producing an object. Manual tools such as screwdrivers, drills, hammers, and saws have been used in production for many years. Currently, advanced tools such as robots and computer numerical control devices are improving productivity in manufacturing. These tools increase speed and reduce costs needed to create a product.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Build one or two sample picture frames using easy-to-find materials.
- Prepare a bulletin board showing advancements in current tools.

Benchmark

This activity will help students reach the following benchmark:

Select and safely use tools, products, and systems for specific tasks.

- Gather different tools used in design and production to show the students.
- Gather the supplies and tools needed.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Paper
- Soda straws
- Craft sticks
- Glue
- Craft magnets
- Frame decorating materials such as sea shells, colored rocks, dried flowers, moss, etc.
- Crayons, markers, and colored pencils
- Stencils
- Scissors
- Rulers
- Paper cutter
- Worksheets included in this activity

Preparing the Students

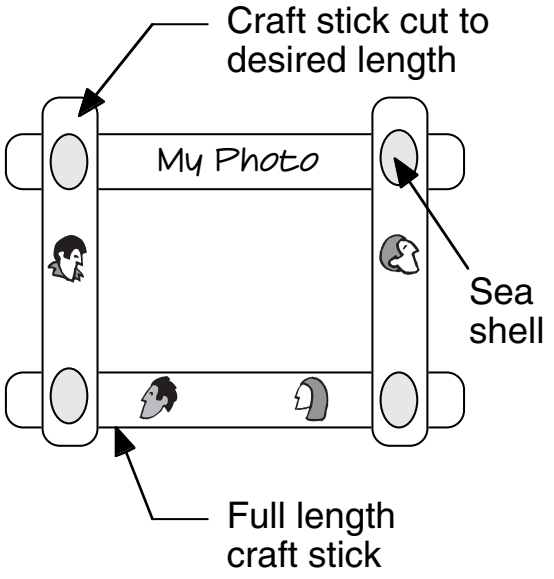
Set the stage for this activity about selecting and using tools by:

- Discussing tool use and safety.

- Explaining that technology involves using tools and materials.
- Describing the different types of tools used by people. (See transparency #1)
- Discussing the importance of selecting an appropriate tool to complete a task.
- Describing the activity and the expectations of the students.

Conducting the Activity

1. Show the students the product they are making.



A sample picture frame

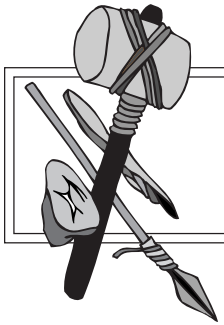
2. Distribute the *Picture Frame Design* worksheet.
3. Give the students a theme to design a picture frame.
4. Discuss and demonstrate each step in the process of designing the picture frame. (See Transparency #2)
5. Have the students identify each material used and the tools that will be used to process them using the bottom of the *Picture Frame Design* worksheet.
6. Work with the students while they complete each step of the process.
7. Have the students show their designs to the rest of the class.

Steps for creating the picture frame:

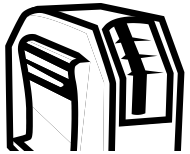
1. Draw a sketch of the frame on the *Picture Frame Design* worksheet.
2. Determine the materials needed and list them on the bottom of the *Frame Design* worksheet.
3. Measure the appropriate amount of materials using a ruler.
4. Cut the materials using a variety of cutting tools such as:
   a. Paper cutter
   b. Scissors
   c. Small craft saw
5. Create the basic frame layout.
6. Attach the frame pieces with glue.
7. Decorate the frame with a variety of materials such as:
   a. Markers
   b. Crayons
   c. Straws
   d. Sea shells
   e. Dried flowers
   f. Colored rocks
   g. Colored paper
   h. Glitter
   i. Pipe cleaners
8. Attach the magnets to the back of the frame.

Checking for Understanding

To check for understanding, ask questions about the tools they are using. As the students complete their worksheets, lead a discussion on the results.



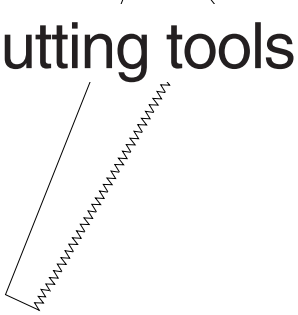
Types of tools

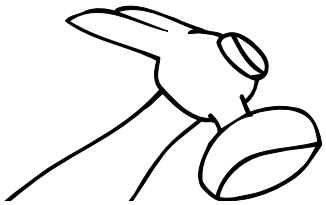


Measuring tools

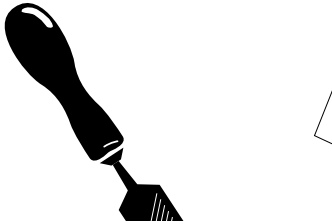
Drilling tools

Cutting tools

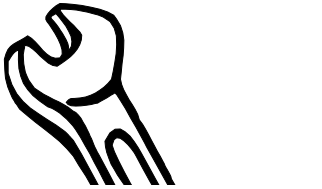




Pounding tools



Polishing tools



Gripping tools

Transparency #1

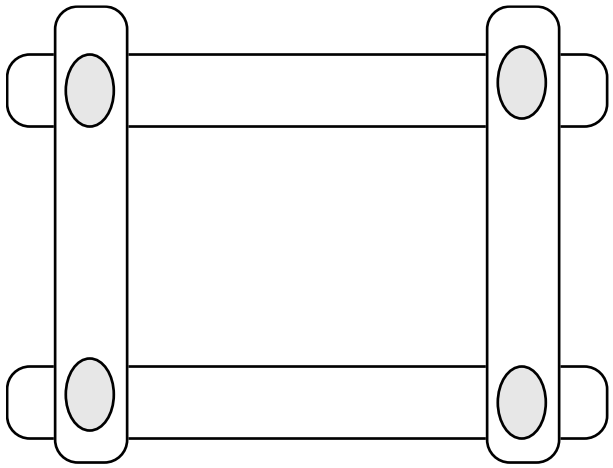
Arrange the steps for making the frame.

Cut out the materials

Decorate the frame

Attach the magnets to the back of the frame.

Determine the materials needed.



Create the basic frame layout

Attach the frame pieces

Measure the appropriate amount of materials

Draw a sketch of the frame

Picture Frame Design

In the space below, sketch the picture frame you are planning to make.

List the materials you will use and the tools that are used to cut and shape them.

MATERIALS	TOOLS

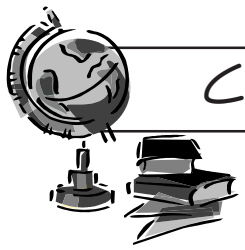
Extending the Activity

- ✔ Students use tools on a daily basis. Have the students bring in a tool from home and show the other students in the class how to use the tool, and explain the need the tool meets.
- ✔ Have a local mechanic, electrician, or construction worker visit the class and discuss the tools they use on a daily basis.
- ✔ Individually or as a class, create a list of different tools and how they are used.

Evidence of Attainment

Students who have developed the abilities to use and maintain technological products and systems can:

- Create a product using many different tools.
- Explain the importance of tools.
- Describe how tools affect materials.
- Select appropriate tools to complete a task.



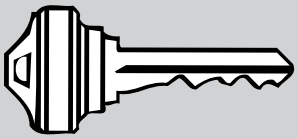
Connections to Other Subjects

Science: Scientific advancements that have been used to develop improved tools and technology.

Mathematics: Measurement and fractions.

Social Studies: How tools affect our lives and lives of other cultures.

Art: Design of tools and use of color and sketching in product design.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.	Materials	Objects that are changing in shape and value with tools.
Maintain	To keep an object in good working condition.	Tool	A device used to perform manual or mechanical work.

Resources

Books

Bloomfield, Louis A. (2001). *How Things Work*. New York: John Wiley and Sons, Inc. ISBN: 0471381519.

Wright and Brown. (2004). *Technology: Design and Applications.* Tinley Park, IL: Goodheart-Willcox. ISBN: 1-59070-165-8.

Wright. (2004). *Technology.* Tinley Park, IL: Goodheart-Willcox. ISBN: 1-59074-159-3.

Wulffson, Don L. (1999). *The Kid Who Invented the Popsicle: And Other Surprising Stories About Inventions*. Strand, London: Puffin. ISBN: 0141302046.

Web resources

Education World.
URL*: http://www.educationworld.com/*

How Stuff Works.
URL: *http://www.howstuffworks.com/*

National Kids Construction Club.
URL: *http://www.kidconstructclub.org/index.html*

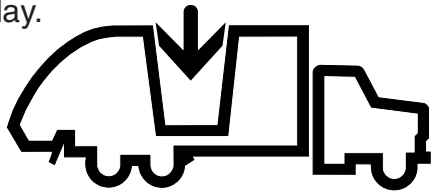
Kids Inventing Technology Series

Technology and Waste

Introduction

To most people technology is seen as beneficial to modern society. Technology enables us to view world events while sitting in our living rooms, travel at great speeds, build comfortable homes, lift great weights, and complete a thousand other tasks. However, technology can also be very damaging because as quickly as new technologies evolve, old technologies become obsolete. Once obsolete, we are faced with disposing of the remains of that technology. As televisions and automobiles wear out they are replaced, which causes many problems. For example, Americans get rid of about 25,000 vehicles every day. It is not hard to see the problem we are facing. Where do you put the junk vehicles? How can we use the scrap materials that are in these vehicles. How do we shield acres covered with old cars from view?

However, this example is only a small part of a much larger problem. The average American throws out four pounds of trash a day. This may not seem like that much until you consider that there are over 276 million people in the United States. Simple arithmetic tells us that we generate nearly one billion (1,000,000,000) pounds of trash each day.



What is in all this trash? Between 35 and 40 percent of America's trash is paper products, including newspapers, magazines, paper bags, and mail. Another 17 percent is leaves and grass clippings. Metal makes up around 10 percent of the trash. Glass and food waste are each between seven and nine percent. Plastics, including milk jugs and packaging, are around seven percent of the waste. The remaining portion is comprised of wood, leather, textiles and other miscellaneous items. Currently, most of that trash (about 73%) is collected and sent to landfills. It is buried and loses its productive value as a material.

Technological Literacy Standard #5

Students will develop an understanding of the effects of technology on the environment.

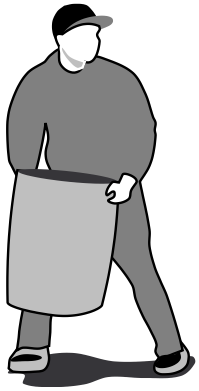
Landfills are large pits dug into the earth. They are lined with clay to keep the waste from contaminating the soil and water around it. Waste is hauled to the landfill and dumped in sections. When a section is full, soil is placed over the trash and more garbage is placed on top. All landfills have a maximum volume that they can hold. When that limit is reached, the landfill is shut down and a layer of clay is placed on top. Grass and trees can then be planted on top of the landfill and it can be used for recreation purposes. Landfills are becoming parks, golf courses, and even ski slopes. Denver's Mile-high Stadium, the home of the Broncos football team, is on an old landfill.

As the garbage in landfills decomposes, methane gas is produced. Most landfills collect this gas, which can be used to heat homes.

Landfills may seem like a great idea because our trash is out of sight, while a completed landfill can be used for recreation and a very useful gas can be collected as the garbage in it decomposes. However, that is not the whole story. Landfills take up a large amount of land and they can smell very bad. They can also leak pollution into the ground water and lose their effectiveness over time.

The key element to a landfill is bacteria. The bacteria eats the garbage, which causes it to decompose. Most bacteria need oxygen to survive and, after a few years, the oxygen in the landfill is used up and the bacteria die. Once the bacteria die, the garbage in the landfill stops decomposing and remains intact. Landfills are not the answer to the garbage problem that people had hoped for back in the early 1980s when they started to be opened up in large numbers.

The real answer will not be found by looking at how to get rid of the trash, but by figuring out how to reduce the amount of trash generated and recycling as much of that trash as possible. The best way to decrease the amount of trash is by following what is known as the 3 Rs: reduce, reuse, and recycle. All three of these principles are needed to control the problem of waste facing not only the U.S., but the entire world. By following the three Rs, we can reduce the amount of natural resources that we use and save



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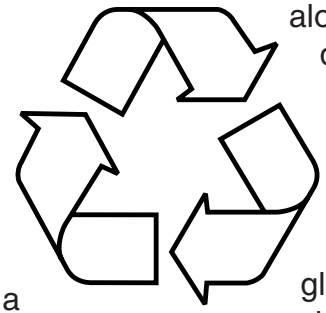
some of them for generations to come.

The first principle is ***reducing***. To reduce means to cut back on the amount of things that we buy that contain items we throw away. Many products are packaged in materials that eventually end up in a landfill. By reducing the wasteful products that we buy, we are decreasing the trash that we throw away. When purchasing an item, consider if that product will last a while or if it is a disposable item. If it is disposable, pay a little extra and get a product that won't need to be replaced as often. For example, instead of bringing your lunch in a paper bag buy a lunch box and reduce the number of paper bags bought and thrown away. Pack the items in the lunch in reusable containers instead of plastic bags.

The second principle is ***reuse*** which is closely related to reducing. Reusing products also helps to decrease the amount of trash we throw away. Instead of using a Styrofoam cup for the morning coffee, use a mug that can be washed and reused. When you are done using something, consider whether or not someone else can use it. If so, you can donate it to a school, church, a resale shop, or hold your own yard sale. If you get a new computer, donate the old one to a charitable organization, give unwanted toys to a local day care center, etc.

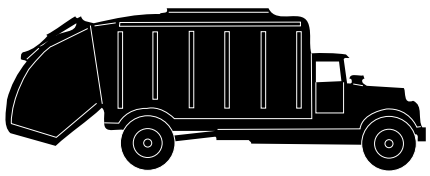
The last principle is ***recycling***. Recycling is the process in which old products go through a process and are made into new products. The first step in recycling is the collection of the materials. Different cities and locales have their own collection process. Some places pick up recyclables



along the curb with the trash, some do it on a different day than trash pick-up, and in some places the consumers must take the items to a recycling center. After the items are collected, they are sorted by material types such as glass, plastics, paper, aluminum, and steel. Some materials, like glass, are sorted again according to color; all of the brown glass is separated from the green and clear glass.

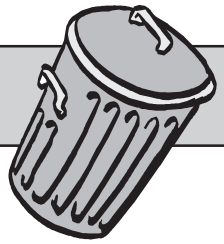
Once separated, the materials are sent to be reprocessed. Aluminum, steel, and plastic are broken into small pieces and melted down. The melted material can be processed into basic materials like sheets, bars, pellets, and rods. Glass is also broken into pieces, heated, and poured into a mold to make products like bottles and jars. The process for paper is a little different. The old paper is chopped into small pieces and added to water to form pulp. The pulp is washed and bleached to the desired color and becomes the basic ingredient for new paper. All of these processes have the same outcome, new products with less effect on natural resources.

Currently, reducing, reusing, and recycling seem to be the only solid answer to the waste problem. New technology is being developed to aid in these processes. More and more types of materials are able to be recycled. New techniques for packaging are being used to create less waste from packaging materials, and products are being produced using more and more recycled materials. When you buy products, look for the recycle symbol and do your part to help the problem.



Grades K-2

Reusing Materials



Introduction

Controlling waste requires the three-prong effort: reduce, recycle, and reuse. This activity is a look at the reuse and recycling of materials as a way to deal with waste created by technological activities. The students will examine the amount of waste that is thrown out by the average American. They will then try to find as many ways to reuse the trash as they can. They will separate clean trash into what can be recycled and what cannot.

Teacher Preparation

In order to introduce the concept of the three Rs of waste management (Reduce, Reuse, Recycle) complete the following:

- Find a children's story about waste management or recycling.
- Prepare a bulletin board explaining the three Rs.
- Gather four plastic bins or cardboard boxes to be used for recycling collection boxes. Label the boxes: glass, paper, plastic, and aluminum.
- Collect the tools and supplies listed.
- Fill five garbage bags with four pounds of "clean" trash (paper, colored paper, cardboard, clean glass and plastic bottles, clean aluminum cans, foam cups, Styrofoam pieces, file folders, etc.)

Benchmark

This activity will help students reach the following benchmark:

Some materials can be recycled and reused.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

- Paper
- Colored paper
- Cardboard
- Clean glass and plastic bottles
- Clean aluminum cans
- Foam cups
- Styrofoam pieces
- File folders
- Garbage bags
- Markers
- Tape
- Glue

Preparing the Students

Get the students started thinking about the problem of waste by explaining how much trash is produced in the U.S. and the world.

- Explain that each person in the United States throws away four pounds of trash every day.
- Explain that most of that trash gets buried in landfills or burned. Both of these approaches are causing pollution.

Conducting the Activity

After preparing the students:

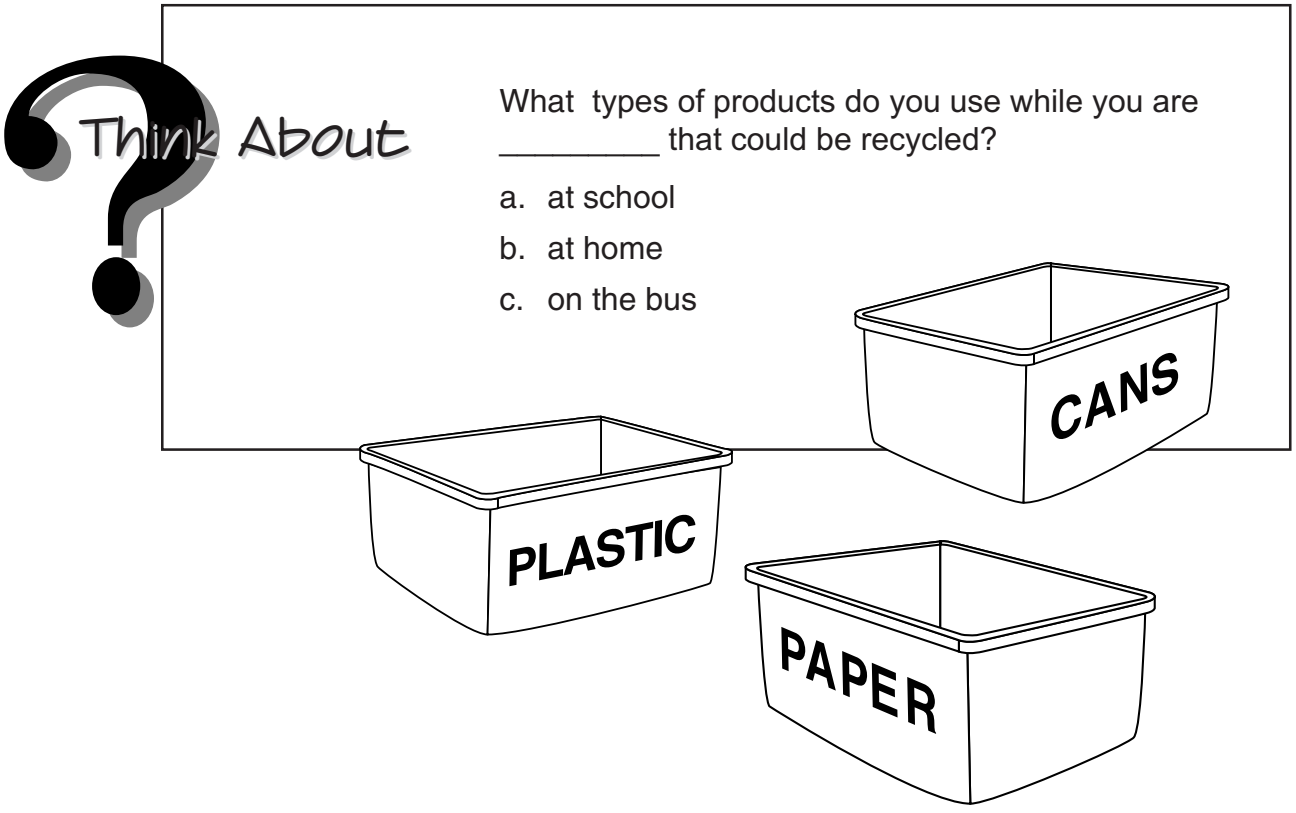
1. Divide the class into five groups.

2. Give each group a trash bag you have prepared with four pounds of “clean” trash.
3. Have each group open their bag.
4. Explain that they are to find a way to reuse as much of the trash as possible. They can make craft type items or develop new uses for the trash.
5. Have markers, glue, and tape available to the groups.
6. When the groups are done, have them collect their leftover items.
7. Discuss what types of items can and cannot be recycled.
8. Have them divide the leftovers into the recycling bins you labeled.
9. If they have any items that cannot be recycled, have them place the items into the garbage bags.
10. Collect all the garbage bags and dump them into a single trash bag.
11. Place all other bags into the plastic recycling bin.
12. Show the class the leftover trash.
13. Discuss the size difference between the amount of trash before and after the activity.
14. Examine what would happen if everyone in the world reused and recycled.
15. Display the products the students created around the room.

Checking for Understanding

To check for understanding have the students complete the Reuse and Recycle handout like the one found on page 6.

Discuss their answers as a class.



Reuse and Recycle Handout

List ways that you could reuse the following items

Piece of paper

Soda can

Cardboard tube

Milk carton

Newspaper

Light bulb

Colored marker

Which of these items can be recycled?

What Can Be Recycled

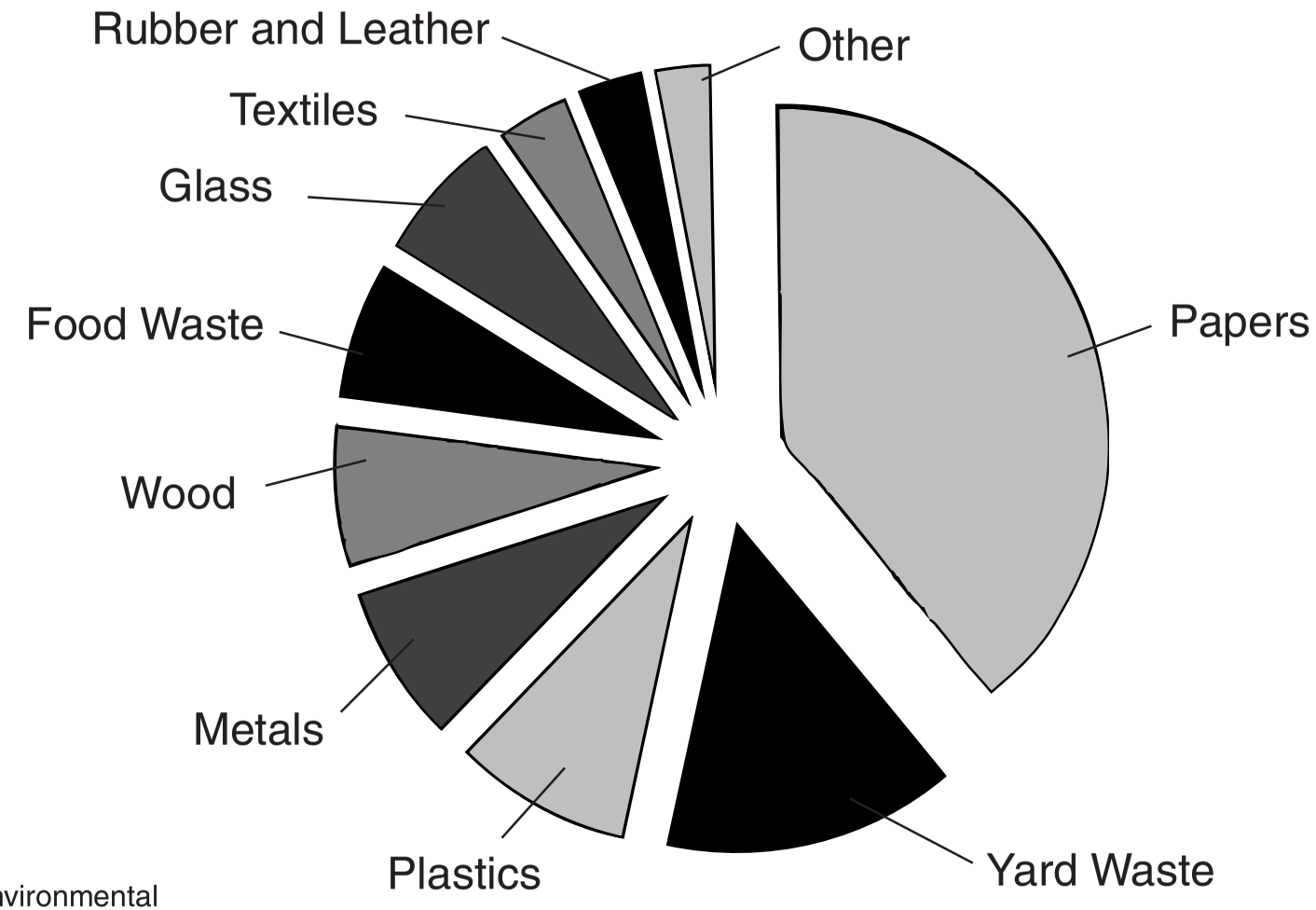
Can Be Recycled

- Cardboard
- Newspapers
- Glass containers
- Aluminum cans
- Tin-coated steel cans
- Plastics marked #1 & # 2
- Milk Jugs

Cannot Be Recycled

- Paper coated with plastic
- Paper soiled with food
- Light bulbs
- Dishes
- Plastics marked #3, #4, #5, #6, & # 7
- Most spray cans

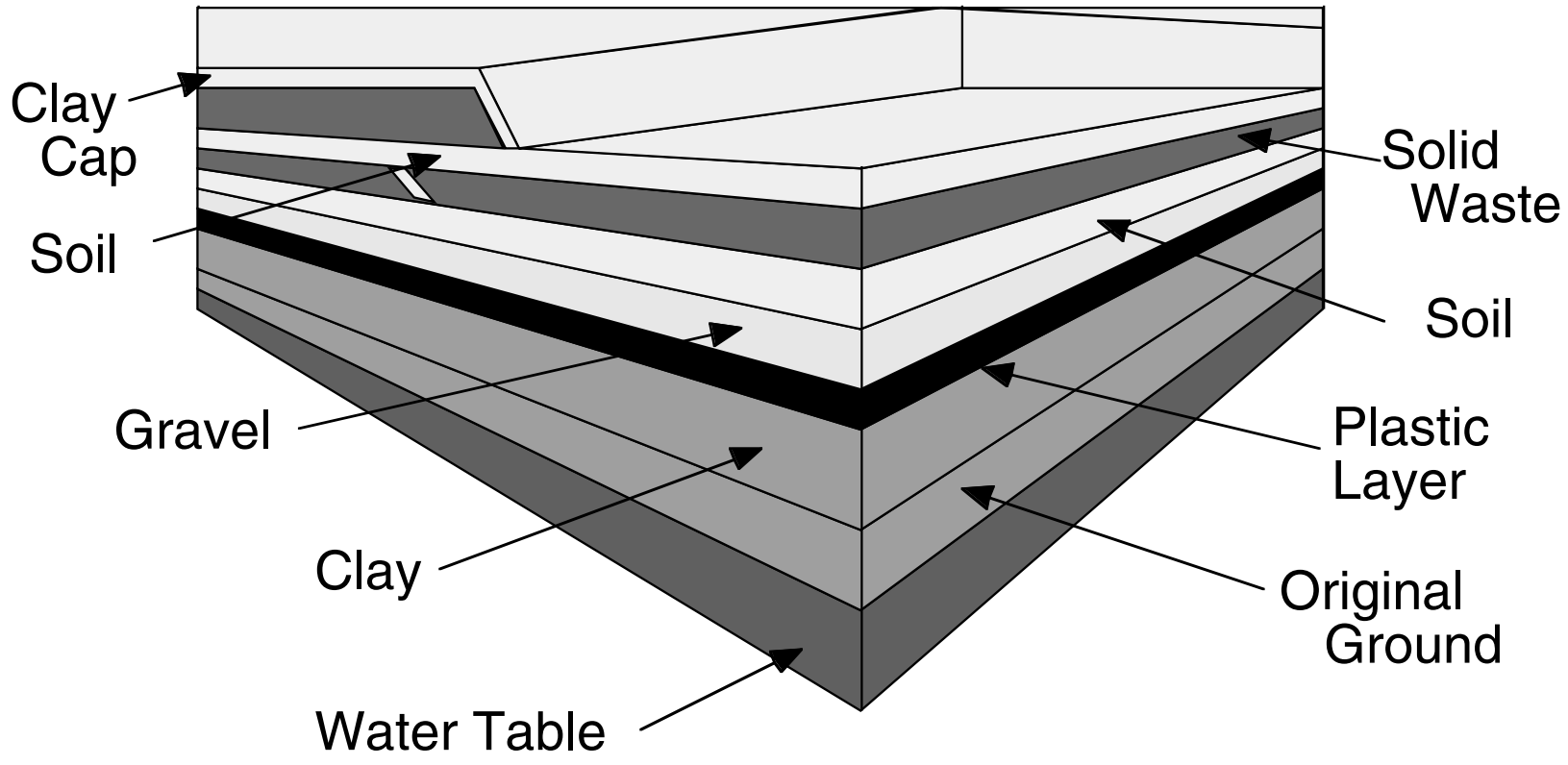
Typical Household Solid Waste



Source: Environmental Protection Agency

Transparency #2

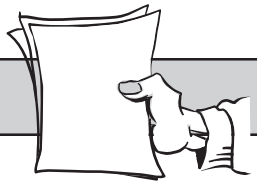
Diagram of a Landfill



Transparency #3

Grades 3-5

Making Paper



Introduction

This activity is an experience in recycling. The students will have the opportunity to go through a process that is very similar to the process of industrial paper recycling. The students will collect paper products, make it into pulp, dye it, form it, and dry it. At the end of this activity, the student will have produced recycled paper.

Teacher Preparation

To prepare to introduce the students to this activity, you should:

- Collect books, magazines, newspaper articles, and web resources that discuss the need for recycling.
- Prepare a display on types of materials that can be recycled and how that process works.
- Gather the supplies and tools listed for this activity.

Supplies and Tools Needed

The following tools and supplies are needed to complete this activity:

For the class:

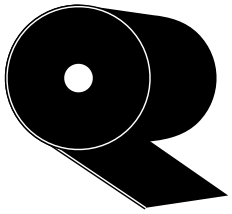
- Paper products (notebook paper, newspaper, construction paper, etc.)
- 5 large buckets, at least 10” x 12” wide
- Duct tape
- Blender or eggbeater
- 4 - Wooden spoons
- 4 - Rolling pins
- 8 – 10”x12” pieces of felt
- Stack of newspaper

Benchmark

This activity will help students reach the following benchmarks:

Wastes should be appropriately recycled or disposed of to prevent unnecessary harm to the environment.

The use of technology affects the environment in good and bad ways.



- Towels
- Roll of wax paper
- Wood Stapler

For each student:

- 8” x 10” piece of window screen
- 2 – 1/2” x 1” piece of wood, 10” long
- 2 – 1/2” x 1” piece of wood, 7” long

Preparing the Students

Begin the activity by discussing how much waste is produced every year and what types of materials are in that waste.

Discuss current means of waste removal, landfill, and incineration. Explain that both types cause pollution and hurt the environment. Discuss that the pollution caused by waste is a negative aspect of technology.

Introduce recycling as a positive use of technology. Instead of the waste harming the environment, recycling helps by reducing both the need for natural resources and the amount of waste that goes into landfills and incinerators.

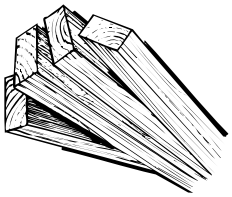
Explain your community's recycling process and how the students can help recycle.

Conducting the Activity

Preparing the Paper Scraps

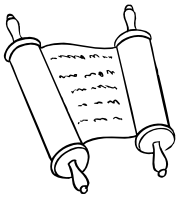
1. Have each student tear up pieces of different types of paper. The pieces should be about 1 to 2-inch squares. They should each tear a large handful of scraps.
2. Place the scraps in a bucket of water.
3. Let the scraps sit for two hours.

While waiting, the students can build the frames. The wood will be used to keep the screen tight.

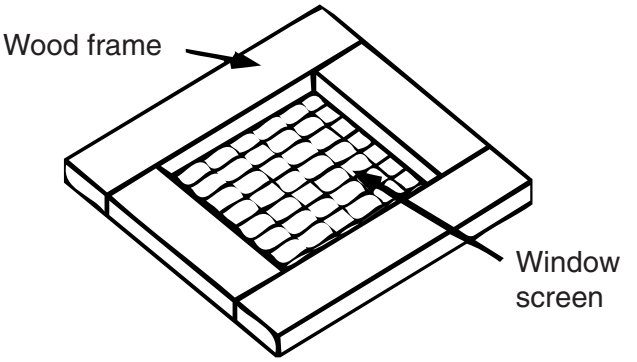


Building the Frames

1. Give each student:
   - ✔ 2 – 1/2" x 1" pieces of wood 10" long,
   - ✔ 2 – 1/2" x 1" pieces of wood 7" long,
   - ✔ 1 – 8"x10" piece of window screen
   - ✔ 3 feet of duct tape.
2. Each student should:
   a. Lay the 1/2" x 1" piece of wood 10" long along the edge of the long side of the screen.
   b. Run a 10" piece of tape down the one edge of the screen and tape it to the wood strip.
   c. Do the same with the other 1/2" x 1" piece of wood 10" long
   d. Tape the 1/2" x 1" piece of wood 7" long to the ends of the screen the same way.
   e. Staple the screen to the wood.



After the frames are built and the scraps have soaked for two hours, make the pulp.



Making the Pulp

1. Fill the other four buckets 1/2 full of clean water and set them aside.
2. Using a blender or eggbeater, blend the soggy scraps until smooth. If you use a blender, add one part scraps to four parts water.
3. When all scraps have been blended, divide the mixture between the four buckets.
4. Divide the class into four groups, one for each bucket.
5. Have each group:
   a. Add 10 to 12 drops of glue to each bucket.
   b. Add food coloring or dye to their mixture, if desired.
   c. Use a wooden spoon and stir the mixture.

The students are now ready to make their paper.

Making Paper

1. Next to each bucket, place a small stack of newspaper, a couple of towels, a roll of wax paper, two pieces of felt, and a rolling pin.
2. Have each student gather his or her frame.
3. Have the students line up behind their bucket.

4. Have the first student:
   a. Place a couple of sheets of newspaper and a towel on the table and one piece of felt on top of it.
   b. Dip his or her frame into the bucket, with the dowel rod side up, making sure that it is completely covered.
   c. Slowly lift the frame.
   d. Hold the screen above the bucket and let the excess water drain.
   e. Carefully flip the screen over onto the felt.
   f. Place a piece of wax paper on top of the pulp and run the rolling pin over the sheet to force the water into the felt. Get rid of as much water as possible.
   g. Once the water is removed, gently peel up the paper.
   h. Place the piece of paper in the window or outside in the sun to dry completely.
5. The next student in line can now repeat the same process.
6. Repeat the process until all students have made a sheet of paper. During the process the newspapers, towel, and felt may need to be changed.

When all the students have made a sheet of paper, you can move on to the finishing touches.

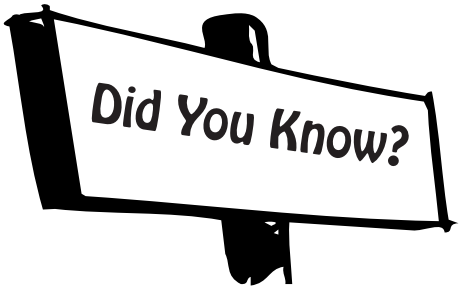
Finishing the Activity

1. Have the students clean up the activity.
2. Each student should allow his or her paper to dry.
3. Once it is dry, have each student write a short story about making paper on it.

Checking for Understanding

To make sure that the students understand the need for recycling and that technology can be both good and bad, ask the students the following questions.

1. What are some good things that come about because of technology?
2. Does technology create bad things also?
3. What types of bad things?
4. What can we do to fight the bad things?
5. Should we recycle? Why?
6. What will happen if we do not recycle?



- It takes 90% less energy to make aluminum by recycling than it does to produce new aluminum.
- Every ton of recycled steel saves 2,500 pounds of iron ore and 1,000 pounds of coal.
- New York City throws out enough garbage every day to fill the Empire State Building.
- Only about one tenth of all solid garbage in the United States gets recycled.

Extending the Activity

Composting

Discuss composting as a form of recycling. Explain how it works and the benefits of it.

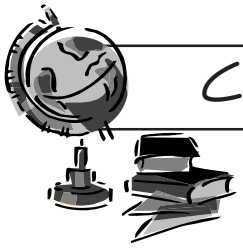
Have the students list all the things that they use in a day that could be composted.

As a class, develop a compost station for the school.

Evidence of Attainment

Students who have developed an understanding of the effects of technology on the environment can:

- Describe the three Rs of waste management.
- Choose materials that can be recycled.
- Explain the process of recycling.
- Make a product out of reused or recycled materials



Connections to Other Subjects

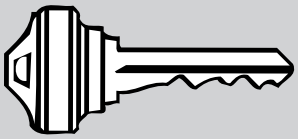
Science: The process of biodegrading. Chemical reactions and the products of biodegrading organic materials.

Mathematics: Calculating the amount of trash produced. Using percentages.

Social Studies: Examine how other civilizations dealt with trash.

Language Arts: Write lawmakers or a local waste collection company regarding recycling in your community.

Art: Design and make crafts out of used materials. Make a poster encouraging recycling.



Key Terms

Technology	Using tools, materials, and knowledge (know-how) to extend the human potential.
Biodegradable	A material that can be broken down by bacteria and natural processes into compounds such as carbon dioxide and water.
Compost	A recycling technique, which decomposes food matter into a product that can be used to fertilize the soil.
Decompose	To break down, change form.
Incinerator	A building designed to burn solid waste.
Landfill	A site where solid waste is buried.
Reduce	Not buying as many disposable goods or goods with extra packaging.
Reuse	Repairing a product or finding a different use for it.
Recycle	Use a waste product to make a new product.
Household Solid Waste	All trash, garbage, and yard waste that a household disposes of.

Resources

Books

Blashfield, Jean F. and Wallace B. Black. (1991). *Recycling*. Chicago: Childrens Press. ISBN: 0-516-05502-X.

Foster, Joanna. (1991). *Cartons, Cans, and Orange Peels*. New York: Clarion Books. ISBN: 0-395-56436-0.

Gibbons, Gail. (1992). *Recycle: A Handbook for Kids*. New York: Little, Brown and Company. ISBN: 0-316-30971-0.

Owen, Oliver S. (1993). *Eco-solutions: It's in your Hands*. Edina, MN: Abdo & Daughters. ISBN: 1-56239-203-4.

Showers, Paul. (1994). *Where Does Garbage Go?* New York: HarperCollins Publishers. ISBN: 0-06-021057-5.

Web resources

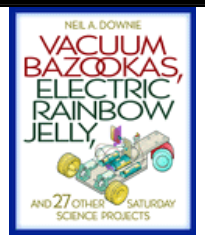
The Environmental Protection Agency.
http://www.epa.gov

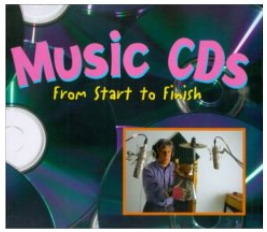
The Environmental Protection Agency's Recycle City.
http://www.epa.gov/recyclecity

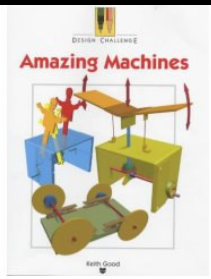
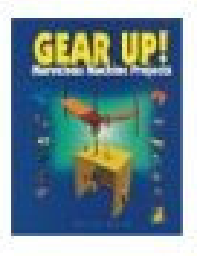
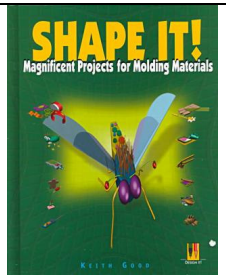
The Steel Recycling Institute.
http://www.recycleroom.org

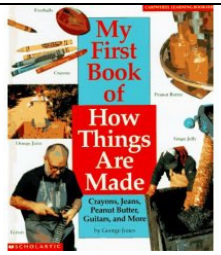
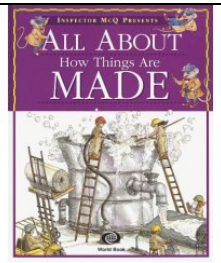
The Glass Packaging Institute.
*http://www.gpi.or*g

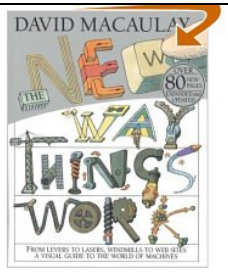
Book List

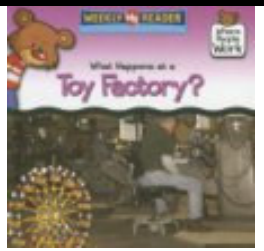
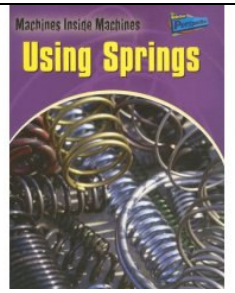
Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Downie, Neil A.	**Vacuum Bazookas, Electric Rainbow Jelly, and 27 Other Saturday Science Projects.** • 256 pages • 9.6 x 8.1 x 1 inches • Hard cover • Paperback	Downie, Neil A. Vacuum Bazookas, Electric Rainbow Jelly, and 27 Other Saturday Science Projects. Princeton, New Jersey: Princeton University Press, 2001.	Amazone.com ($8.31 – $16.91 + shipping and handling)	 ISBN: 0-691-00986-4
Charles, OZ	**How Is a Crayon Made?** • 28 pages • Paper Bag • Hard cover	Charles, Oz. How is a Crayon Made? Scholastic, 1998.	Amazone.com ($0.01 – $16.95 + shipping and handling)	0-590-45997-X
Cook, Janet (Author) G. Smith (Illustrator) T. Gower (Illustrator)	**How Things Are Made** • 24 pages • Paper Back • Finding Out About Things series • 8 x 7.6 x 0.1 inches	Cook, Jan et How Things Are Made. Educational Development Corporation Tulsa, OK, 1989.	Amazone.com ($0.19 – $10.00 + shipping and handling)	 ISBN-10: 0746002769 ISBN-13: 978-0746002766
Currie, Stephen Kathy McLaughlin (Photographer)	**Pianos From Start to Finish** • 32 pages • Contains: Illustrations • Made in the U.S.a. • For a juvenile audience. • Hard cover	Currie, Stephen. Pianos From Start to Finish. 2006. Blackbirch Press, Farmington Hills MI , 2001.	Alibris.com ($16.95 – $25.97 + shipping and handling)	 ISBN: 1-4103-0721-2

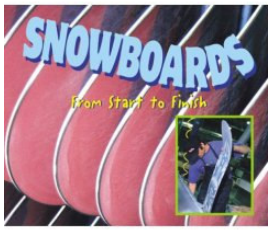
Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Englart, Mindi Rose (Author) Peter Casolino (Illustrator), Peter Casolino (Photographer)	**Music Cds: From Start to Finish** • 32 pages • Hardcover • 1 ED • Age Range: 8 to 11	Englart, Mindi Rose. Music Cds: From Start to Finish (Made in the USA). 1st. Thomson Gale, 2001.	Amazone.com ($0.42 – $14.73 + shipping and handling) **Or** Barnes & Noble.com, for $ 22.45 **Or** Biblio.com Books, for $ 22.95 **Or** Papamedia.com, for $22.95	 ISBN: 1-56711-485-7
Englart, Mindi Rose	**Pens From Start to Finish** • 33 pages • Reinforced Hardcover • Edition: 1 • Glossary • Full-color photographs • Age Range: 8 to 11	Englart, Mindi Rose. Pens From Start to Finish (Made in the USA). 1st. Blackbirch Pr Inc, Farmington Hills MI, 2001.	Amazone.com ($4.99 – $15.27 + shipping and handling) **Or** Valorebooks.com ($ 4.98 – $ 22.45)	 ISBN: 1-56711-487-3
Fredrick, Dawn Photographs by Bob and Diane Wolfe	**How It Happens at the Boat Factory** (How It Happens, 1) (Hardcover) • 32 pages • Full-color photographs • 10" x 8" • Reinforced library binding • Glossary • Grades 2-5	Frederick, Dawn. How It Happens at the Boat Factory. Minneapolis, MN: The Oliver Press, Inc., 2002.	Amazone.com ($2.45 – $19.95 + shipping and handling) **Or** Order Toll Free: 1-800-8-OLIVER (1-800-865-4837) from orders@oliverpress.com For $ 19.95 Tel: (952) 926-8981 Fax: (952) 926-8965	 ISBN # 1-881508-90-0

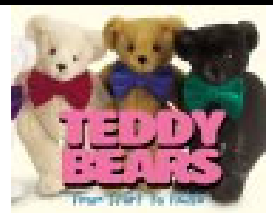
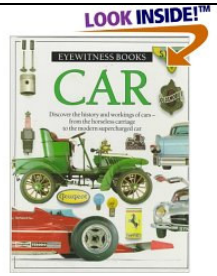
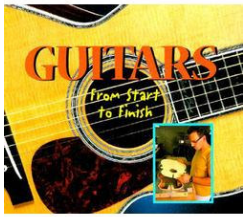
Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Good, Keith	**Design Challenge Amazing Machines** • 32 pages • 10.2 x 8 x 0.2 inches • Hard cover • Ages 9-12	Good, Keith. Design Challenge Amazing Machines. Evans Brothers Ltd, 2003.	Amazone.com ($10.05 - $31..19 + shipping and handling)	 ISBN: 0-237-51986-0
Good, Keith	**Gear Up!: Marvelous Machine Projects** • 30 pages • Hardcover • Design Challenge Series • 10.7 x 8.4 x 0.4 inches • Ages 9 - 12	Good , Keith. Gear Up!: Marvelous Machine Projects. Learner Publications, 2000.	Amazone.com ($15.95 - $37.75 + shipping and handling)	 ISBN-10: 0822535661 ISBN-13: 978-0822535669
Good, Keith	**Shape it Magnificent Projects for Molding Materials** • 20 pages • Hard cover • 10.6 x 8.4 x 0.3 inches • Ages 9-12	Good, Keith. Shape It! Magnificent Projects for Molding Materials. Minneapolis, MN: Lerner Publications Co., 2000.	Amazone.com ($2.08 – $24.85 + shipping and handling) BAMM.com Booksamillion.com, for $23.40 1800-201-3550	 ISBN: 0-825-3568-8

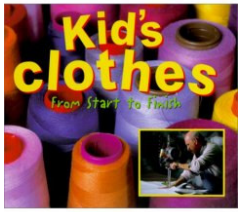
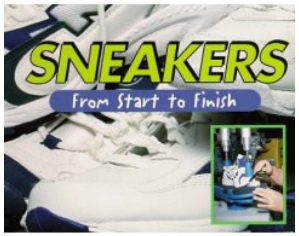
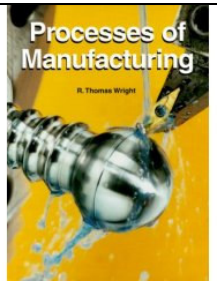
Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Devon Howard	**Skateboards: From Start to Finish** • 32 pages • Illustrated • Technical & Manufacturing Trades • 7.84x9.02x.33 in. • Children's 9-12	Howard, Devon. Skateboards: From Start to Finish. Blackbirch Press, Farmington Hills MI , 2005.	Amazone.com ($10.27 - $31..87 + shipping and handling) **OR** Powells.com, for $22.45	 ISBN: 1-4103-0658-5
Jones, George	**My First Book of How Things Are Made: Crayons, Jeans, Guitars, Peanut Butter, and More** 64 pages Hardcover Cartwheel Learning Bookshelf Series 10.4 x 9.1 x 0.4 inches Ages 4 - 8	Jones, George. My First Book of How Things Are Made: Crayons, Jeans, Guitars, Peanut Butter, and More. Scholastic, 1995.	Amazone.com ($0.39 - $49.19 + shipping and handling)	 ISBN-10: 0590480049 ISBN-13: 978-0590480048
Kain, Kathleen Robert Byrd (Illustrator)	**All About How Things Are Made** • 32 pages • Hard cover • 10.2 x 8.2 x 0.2 inches • Science & Nature • Illustrated • Ages 9-12	Kain, Kathleen. All About How Things Are Made. World Book, 1995.	Amazone.com ($1.40 - $11.95 + shipping and handling)	 ISBN: 0-7166-1634-3

Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Kreger, Claire	**Homes: From Start to Finish (Made in the USA)** • 32 pages • Hardcover • 9 x 7.5 x 0.5 inches • Glossary • Ages: 4 to 8 years	Kreger, Claire. Homes: From Start to Finish (Made in the USA). Blackbirch Pr Inc, Farmington Hills MI , 2003.	Amazone.com ($2.38 - $17.51 + shipping and handling)	 ISBN: 1-41030-169-9
Leokum, Arkady	**How things are made: How they work ... where they come from** • 63 pages • Elephant books Series	Leokum, Arkady. How Things Are Made . Toronto, Ontario: Grosset & Dunlap, 1976.	Amazone.com ($0.95 - $25.00 + shipping and handling)	**ISBN-10:** 0448125013 **ISBN-13:** 978-0448125015
Macaulay, David and Ardley, Neil	**The New Way Things Work** • 400 pages • 8.50 X 10.88 in • Grades 7+ • Ages 12+	Macaulay, David and Ardley, Neil. The New Way Things Work. Houghton Mifflin/Walter Lorraine Books; Rev Sub edition, 1998.	Amazone.com ($9.95 - $22.05 + shipping and handling)	 ISBN: 0-395-93847-3
National Geographic Society Arnold B. Ajello (Editor), Barbara Gibson (Illustrator)	**How Things Are Made** • Hard Cover • Baby - Preschool	National Geographic Society (U.S.) Special Publications Division, How Things Are Made. National Geographic Society, 1981.	Amazone.com ($1.25 - $11.50 + shipping and handling)	ISBN-10: 0-8704-4334-8 ISBN-13: 978-0870443343
Parker, Steve	**How Things Work** • 160 pages • Paperback	Parker, Steve. How Things Work . Kingfisher Books, 1990.	Amazone.com ($8.13 - $21.38 + shipping and handling)	ISBN-10: 0-8627-2573-9 ISBN-13: 978-0862725730

Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Pohl, Kathleen	**What Happens at a Toy Factory? (Where People Work)** • 24 pages • Paperback • 7 x 6.7 x 0.1 inches • Ages 4-8	Pohl, Kathleen. What Happens at a Toy Factory? (Where People Work). Weekly Reader Early Learning Library , 2006.	Amazone.com ($15.95 - $18.62 + shipping and handling)	 ISBN-10: 0-8368-6889-7 ISBN-13: 978-0836868890
Sadler, Wendy	**Using Springs (Machines Inside Machines)** • 32 pages • Reinforced Hardcover • Made in the USA Series • 10.25 x 8.25 x 0.25 • Grades 2-3	Sadler, Wendy. Using Springs (Machines Inside Machines). 1st. Chicago, IL: Heinemann/Raintree, 2005.	Amazone.com ($15.95 - $48.36 + shipping and handling) **Or** Shop.com for $27.50	 ISBN: 1-4109-1446-1
Sadler, Wendy	**Using Screws (Machines Inside Machines)** • 32 pages • Library Binding • 10.4 x 8.4 x 0.4 inches • Ages 4 - 8	Sadler, Wendy, Sadler, Wendy. Using Screws (Machines Inside Machines). Raintree, 2005.	Amazone.com ($0.62 - $48.36 + shipping and handling)	 ISBN-10: 1-4109-1443-7 ISBN-13: 978-1410914439

Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Smith, Ryan A. Gary Tolle (Illustrator)	**Golf Balls From Start to Finish** • 32 pages • Reinforced Hardcover • Made in the USA Series • 7.5 x 9 x 0.5 in • Grades 2 - 3	Smith, Ryan. Golf Balls From Start to Finish . 1st. Farmington Hills MI : Blackbirch Press, 2005.	Amazone.com ($9.59 - $23.70 + shipping and handling) **OR** Shop.com for $15.99	 ISBN-10: 1-4103-0657-7 ISBN-13**:** 978-1410306579
Smith, Ryan A	**Trading Cards From Start to Finish** • 32 pages • Hardcover • Made in the USA Series • 9.1 x 7.6 x 0.3 inches • Ages 4 - 8	Smith, Ryan. Trqding Cards From Start to Finish . 1st. Farmington Hills MI : Blackbirch Press, 2005.	Amazone.com ($9.57 - $23.82 + shipping and handling) **OR** Shop.com for $22.45 **OR** ValoreBooks.com for $16.53	 ISBN-10: 1-4103-0374-8 ISBN-13: 978-1410303745
Stone, Tanya Lee Gale Zucker (Illustrator)	**Snowboards: From Start to Finish** • Hard cover • Illustrated • Made in the USA Series • 9.3 x 7.8 x 0.4 inches • Ages 4-8	Stone, Tanya Lee. Snowboards From Start to Finish. 1st.. Farmington Hills MI : Blackbirch Press, 2000.	Amazone.com ($1.14 - $15.27 + shipping and handling)	 ISBN-10: 1-5671-1480-6 ISBN-13: 978-1567114805

Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Stone, Tanya Lee	**Teddy Bears (Made in the USA)** • 31 pages • Board book • Made in the USA Series • 9.2 x 7.8 x 0.3 inches • Ages 4-8	Stone, Tanya Lee. Teddy Bears (Made in the USA. 1st.. Farmington Hills MI : Blackbirch Press, 2000.	Amazone.com ($1.02 - $17.10 + shipping and handling)	 ISBN-10: 1-5671-1479-2 ISBN-13: 978-1567114799
Sutton, Richard	**Car (Eyewitness Book, No 21)** • 63 pages • Hard cover • Eyewitness Book No. 21 • 11.3 x 8.8 x 0.5 inches • Ages 9 -12	Sutton, Richard. Car (Eyewitness Book). 1st.. Knopf Books for Young Readers, 1990.	Amazone.com ($0.09 - $3.89 + shipping and handling)	 ISBN-10: 0-6798-0743-8 ISBN-13: 978-0679807438
Woods, Samuel G.	**Guitars From Start to Finish** • 32 pages • Board Book • Made in the USA Series • 9.3 x 7.8 x 0.4 inches • Ages 4 – 8	Woods, Samuel G. Guitars From Start to Finish. 1st.. Farmington Hills MI : Blackbirch Press, 1999.	Amazone.com ($0.92 - $43.33 + shipping and handling)	 ISBN-10: 1-5671-1392-3 ISBN-13: 978-1567113921

Author(s)	Book Name & Description	Book Reference	Where Can We Get It?	Front Cover and ISBN #
Woods, Sammuel G. Peter Casolino (Photographer)	**Kids Clothes: From Start to Finish** • 31 pages • Hard Cover • Made in the USA Series • 8.7 x 7.5 x 0.3 inches • Ages 4-8	Woods, Samuel G. Kids Clothes From Start to Finish. 1st.. Farmington Hills MI : Blackbirch Press, 2001.	Amazone.com ($7.91 - $43.33 + shipping and handling)	 ISBN-10: 1-5671-1483-0 ISBN-13: 978-1567114836
Woods, Samuel G.	**Sneakers: From Start to Finish** • 32 pages • Hard Cover • Made in the USA Series • 9.3 x 7.8 x 0.4 inches • Ages 4-8	Woods, Samuel G. Sneakers From Start to Finish. 1st.. Farmington Hills MI : Blackbirch Press, 1999.	Amazone.com ($0.01 - $23.70 + shipping and handling)	 ISBN-10: 1-5671-1393-1 ISBN-13: 978-1567113938
Wright, Thomas	**Processes of Manufacturing** • 464 pages • Hard cover • 10.5 x 7.6 x 1.1 inches	Wright, Thomas. Processes of Manufacturing. New edition . Tinley Park, IL : Goodheart-Wilcox Publisher, 2004.	Amazone.com ($28.65 - $56.00 + shipping and handling)	 **ISBN-10:** 1590703626 **ISBN-13:** 978-1590703625

NSF Exhibit Component Terminology

Additive: produced by addition - the act or process of adding; direct chemical combination of substances into a single product. *www.m-w.com*

Assembly: the fitting together of manufactured parts into a complete machine, structure, or unit of a machine; a collection of parts so assembled. *www.m-w.com*

Deformation: a change in shape due to an applied force. *en.wikipedia.org*

Design: the creative art of executing aesthetic or functional designs; to create, fashion, execute, or construct according to a plan. *www.m-w.com*

Fastener: a hardware device that mechanically joins or affixes two or more objects together.

Industrial design: an applied art whereby the aesthetics and usability of products may be improved. Design aspects specified by the industrial designer may include the overall shape of the object, the location of details with respect to one another, colors, texture, sounds, and aspects concerning the use of the product ergonomics. *en.wikipedia.org*

Join: to put or bring together so as to form a unit. *www.m-w.com*

Manufacture: to make into a product suitable for use; to make from raw materials by hand or by machinery. *www.m-w.com*
The transformation of raw materials into finished goods for sale. *en.wikipedia.org*

Plastic: capable of being molded or modeled; applies to substances soft enough to be molded yet capable of hardening into the desired fixed form. *www.m-w.com*

Product: anything that can be offered to a market that might satisfy a want or need. *en.wikipedia.org*

Subtractive: constituting or involving subtraction; to take away by or as if by deducting; to take away (an amount) from a total. *www.m-w.com*

Die: (additive, deform, subtractive) a metal block that is used for forming materials like sheet plastic and sheet metal.
en.wikipedia.org

Extrusion: (deform) manufacturing process where a material is pushed and/or drawn through a profile die to create long objects of a fixed cross-section. Hollow sections are usually extruded by placing a pin or mandrel in the die. Extrusion may be continuous (producing indefinitely long material) or semi-continuous (repeatedly producing many shorter pieces). *en.wikipedia.org*

Injection Molding: (additive) a manufacturing technique for making parts from plastic material. Molten plastic is injected at high pressure into a mold, which is the inverse of the desired shape. The mould is made from metal, usually either steel or aluminum, and precision-machined to form the features of the desired part. *en.wikipedia.org*
The process of forcing melted plastic in to a mold cavity. *www.what-is-injection-molding.com*

Mold: (additive) a hollowed-out block that is filled with a liquid like plastic, glass or metal. The liquid hardens or sets inside the mold, adopting its shape. *en.wikipedia.org*

Vacuum Forming: (deform) a sheet of plastic is heated to a forming temperature, stretched onto or into a single-surface mold, and held against the mold by applying vacuum between the mold surface and the sheet. *en.wikipedia.org*

ITEA Standards for Technology Literacy

Relevant Standards and Benchmarks for HPMT Exhibit

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

In order to comprehend the scope of technology, students should learn that:

K thru 2:

a) The natural world and human-made world are different.

b) All people use tools and techniques to help them do things.

c) Things that are found in nature differ from things that are human-made in how they are produced and used.

d) Tools, materials and skills are used to make things and carry out tasks.

3 thru 5:

e) Creative thinking and economic and cultural influences shape technological development.

Standard 2: Students will develop an understanding of the core concepts of technology.

In order to comprehend the core concepts of technology, students should learn that:

K thru 2:

a) Some systems are found in nature, and some are made by humans.

b) Systems have parts or components that work together to accomplish a goal.

c) Tools are simple objects that help humans complete tasks.

d) Different materials are used in making things.

e) People plan in order to get things done.

3 thru 5:

f) A subsystem is a system that operates as a part of another system.

g) When parts of a system are missing, it may not work as planned.

h) Resources are the things needed to get a job done, such as tools, machines, materials, information, energy, people, capital and time.

i) Tools are used to design, make, use and assess technology.

j) Materials have many different properties.

k) Tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating and computing.

l) Requirements are the limits to designing or making a product or system.

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

In order to appreciate the relationships among technologies and other fields of study, students should learn that:

K thru 2: a) The study of technology uses many of the same ideas and skills as other subjects.

3 thru 5: b) Technologies are often combined.

c) Various relationships exist between technology and other fields of study.

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

In order to recognize the changes in society caused by the use of technology, students should learn that:

K thru 2: a) The use of tools and machines can be helpful or harmful.

3 thru 5: b) When using technology, results can be good or bad.

C) The use of technology can have unintended consequences.

Standard 5: Students will develop an understanding of the effects of technology on the environment.

In order to discern the effects of technology on the environment, students should learn that:

K thru 2: a) Some materials can be reused and/or recycled.

b) Waste must be appropriately recycled or disposed of to prevent unnecessary harm to the environment.

3 thru 5: c) The use of technology affects the environment in good and bad ways.

Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

In order to realize the impact of society on technology, students should learn that:

K thru 2: a) Products are made to meet individual needs and wants.

3 thru 5: b) Because people's needs and wants change, new technologies are developed and old ones are improved to meet those changes.

c) Individual, family, community and economic concerns may expand or limit the development of technologies.

Standard 12: Students will develop the abilities to use and maintain technological products and systems.

As part of learning how to use and maintain technological products and systems, students should learn that:

K thru 12: a) Discover how things work.

b) Use hand tools correctly and safely, and be able to name them correctly.

c) Recognize and use everyday symbols.

3 thru 5: d) Follow step-by-step directions to assemble a product.

e) Select and safely use tools, products and systems for specific tasks.

f) Use computers to access and organize information.

g) Use common symbols, such as numbers and words, to communicate key ideas.

Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

In order to select, use and understand manufacturing technologies, students should learn that:

K thru 2: a) Manufacturing systems produce products in quantity.

b) Manufactured products are designed.

3 thru 5: c) Processing systems convert natural materials into products.

d) Manufacturing processes include designing products, gathering resources and using tools to separate, form and combine materials in order to produce products.

e) Manufacturing enterprises exist because of a consumption of goods.