TECHNOLOGY AND DESIGN

Teacher's Guide

PITSCO EDUCATION

42212

Technology and Design

Written by Tammy Pankey.

Cover design by Jason Kellogg

Document design and graphics by Crista Cunningham.

Summary

In *Technology and Design*, you learn about how people create new things to solve problems. You make connections to math applications of decimals, conversions, calculating speed, and the coordinate system. You design, build, and test several creations.

Interval 1

- Understand the importance of technology and how it evolves.
- Construct a simple robot that creates art.

Interval 2

- Identify the categories of technology.
- Design and build a Fold-N-Roll vehicle.

Interval 3

- Investigate the design process.
- Test and improve your Fold-N-Roll vehicle.

Interval 4

- Explore the input, process, and output of systems.
- Use code to create a structure.

Interval 5

- Recognize the relationship between technology and science.
- Design a sail and evaluate its efficiency.

Technology

Technology is all around us. *Technology* is defined as knowledge that helps humans solve problems. People use the knowledge to supply needs and wants. Scientists study technology to learn how people look for a **solution** to a problem in their lives. Humans change the world as they solve problems.

Our world is in a constant state of change. Some changes are the result of natural causes such as weather. Other changes are the result of human activities. Some changes are necessary and good whereas others are not. Technology can improve our daily lives. Technology can create problems. It can affect the environment.

The automobile is a great example. It has made our lives better. It is a good way to travel. It also causes problems. The fumes cause problems in our atmosphere and the environment. Accidents cause death and destruction. Decisions regarding technology can both benefit us and hurt us.

Technological solutions are never perfect. Solutions have trade-offs such as safety, cost, efficiency, and appearance. Our world is filled with all kinds of objects that people need or want. Each of these things is the result of someone seeing a problem and solving it.

Technology has changed slowly over history until the beginning of the Industrial Revolution. Since then, technology has changed rapidly. New technology replaces old. Many technologies become obsolete after only a few years. Each year, new technologies for personal use and entertainment become available.

Society often drives the development of new technology and our use of it. This can be because of cultural, social, economic, or political reasons. Social media and networking didn't really start until around the year 2000. Because of society's demand for more energy-efficient vehicles, there's been a large increase in hybrid and electric cars.

Briefing | Technology and Design

Technology touches every aspect of our lives. Think about one example of something in your life that isn't technological. Even natural foods that we eat involve technology. Tools are used to gather these foods, and technology is used to transport them to you.

Humans like to **invent**. The development of something completely new is called an invention. However, design work does not stop after a new invention has been produced. The invention of something new is rare compared to the many improvements made to things over time.

Technological solutions have constraints. The effects of weather and friction and the properties of materials limit the choices engineers make in designs. An invention might be a useful idea, but if it is dangerous or looks bad, people will not use it.

Briefing Questions

1. What is technology?

   Technology is the knowledge that helps humans solve problems.

2. What is design?

   Design is a planned process of change.

Vocabulary

solution:

the act or process of solving a problem; an answer or explanation

invent:

to create, think up, or make for the first time

Top 10 List **Answers below will vary.**

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Giant Artie Bot

1. Area of arena (cm^2) =
   Answers will vary.
2. 22.56 m = **2,256** cm 12.8 m = **1,280** cm
3. Area of basketball court (cm^2) = **2,887,680 cm^2**
4. How much bigger than the arena is the court?
   Answers will vary.
5. Diameter of Artie Bot (cm) =
   Answers will vary.
6. Diameter of giant Artie Bot (cm) =
   Answers will vary.

Conclusion Questions

List any adjustments you made.

Answers will vary.

How did the changes affect the movement of the Artie Bot?

Answers will vary.

Mission Log | Technology and Design

Technology Categories

Technologies help people solve problems. There are seven main categories of **technologies**. These different categories can overlap with each other.

- Agriculture and biotechnology
- Construction
- Energy and power
- Information and communication
- Manufacturing
- Medical
- Transportation

Agriculture technologies include farm equipment, irrigation systems, and even robotics to plant seeds and harvest plants. Agricultural waste can be composted or even turned into biofuel such as ethanol to power vehicles. Artificial ecosystems like Biosphere 2 have been created.

Biotechnologies involve changing living organisms to better suit our purposes. Nanotechnology provides opportunities to work at a microscopic level. Gene therapies are being developed to prevent and treat diseases. Some of the produce, meat, and dairy you eat might have come from genetically modified organisms (GMOs).

Construction technologies include structures, buildings, and their internal systems. Construction is more than just buildings. This can include roads, dams, pipelines, and bridges. Maintenance of these different structures is important. Systems used within structures can include plumbing, heating and air, and electrical.

Energy and power technologies are essential in our lives. Energy comes in many forms, including light, sound, and electricity. The goal of machines that run on energy is to use it efficiently. A large emphasis has been placed on using renewable energy resources instead of fossil fuels.

Information and **communication** technologies provide ways for us to gain knowledge, be productive, and communicate with each other. These technologies also provide us with entertainment. They provide a way for us to process information. We can receive this information through print or digital sources.

Briefing | Technology and Design

Manufacturing is a huge industry that produces most of the products you see in stores and use in your home. Manufacturing is usually done in factories around the world. Many factories use technologies like robotics and machines to make goods. Even people create products in factories.

Medical technologies include medical equipment, tools, and medicine. Vaccines protect you from chickenpox and measles. Advances in artificial limbs provide mobility and function for people. Thermometers, monitors, and stethoscopes are just a few examples of medical tools.

Transportation technologies move people and things from place to place. These include moving things via water, roads, and air. Transportation systems like subways and mass transit provide ways to transport large amounts of people. The safety and cost of these systems have to be considered.

Briefing Questions

1. What are the different categories of technologies?
   The seven main categories of technologies are agriculture and biotechnology, construction, energy and power, information and communication, manufacturing, medical, and transportation.
2. How are these different categories of technologies related?
   Answers will vary.

Vocabulary

technologies:
knowledge that helps humans solve problems

communication:
ways for us to gain knowledge and receive information

Design Brief:

Answers will vary. Answer should include the problem, constraints, and target audience.

Plan

Wheel Types **Answers will vary.**

Sketch

Sketches will vary.

Mission Log | Technology and Design

Design Process

Problem solving is a valuable skill. Problem solving can follow specific steps. When you put these steps together, it is called a **process**. Design is a planned process of change. A well-designed product must work. The product must also look pleasing.

The design process is a series of steps that guides someone to a solution. However, designing something is not always orderly. The creative process of designing is more like switching back and forth between thinking and doing.

Below is a list of the steps and a description of what can be done during each step.

Step 1 – Problem

Identify and describe the problem. State what problem your solution needs to solve. This is sometimes called a design **brief**. Describe the problem in writing. This step will get the design process started right.

Step 2 – Research

Gather information. What have others done? What is already known about the problem? Use different resources to look for solutions.

Step 3 – Brainstorm

Think of solutions for the problem. Sketch or describe the ideas and possible solutions. One idea often leads to other ideas. Sometimes, combining two ideas will create a new idea.

Step 4 – Select

Select the best idea from the possible solutions. Make a list of the pros and cons. Select the idea that solves the problem.

Briefing | Technology and Design

Step 5 – Plan

Decide the size and shape of the solution and make a sketch of it. List the materials and tools needed to build a solution. Determine how much the project will cost.

Step 6 – Build

Build a model of the idea. Make the solution. Create a working prototype. Keep a log of the steps needed to build the solution.

Step 7 – Test

Test the model. Does it work? Design a test to produce observations and data. Charts and tables are a good way to organize test results.

Step 8 – Improve

Evaluate your design. Change and improve the model. Make changes and test the solution again. Keep a log of the changes.

Briefing Questions

1. Why is the design process not always orderly?

   The design process switches back and forth between thinking and doing.

2. What do you call it when a group of people work together to come up with ideas to solve a problem?

   Brainstorming is when a group of people work together to come up with ideas to solve a problem.

Vocabulary

process:

a series of steps, actions, motions, or operations that bring about or lead to a result

brief:

a short statement or summary of facts related to a topic

Race Day

	Distance (m)	Time (s)	Speed (m/s)
Trial 1			
Trial 2	Answers for table will vary.		
Trial 3			

Redesign 1 Sketch:

Sketches will vary.

Differences

Answers will vary.

	Distance (m)	Time (s)	Speed (m/s)
Trial 1			
Trial 2	Answers for table will vary.		
Trial 3			

Redesign 2 Sketch:

Sketches will vary.

Differences

Answers will vary.

	Distance (m)	Time (s)	Speed (m/s)
Trial 1			
Trial 2	**Answers for table will vary.**		
Trial 3			

Conclusion Questions

What were your reasons for making the changes in your redesign?

Answers will vary.

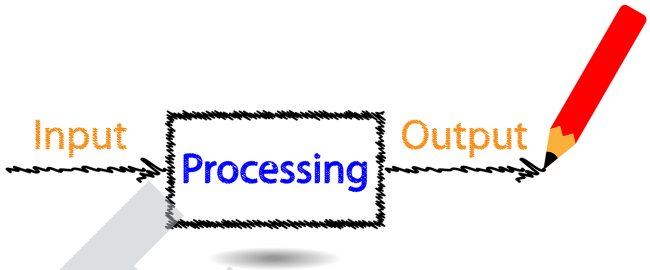
Were they successful changes? Why or why not?

Answers will vary.

Briefing | Technology and Design

Technological Systems

Solutions to problems often take the form of a **system**. Systems operate because of three parts: input, process, and output. Inputs in a system are called resources. These resources might include materials, energy, information, people, tools, machines, and money. These inputs are all necessary for the system to work.



In a system, three things can be processed. These are materials, energy, and information. Material is processed to change its size; shape; or physical, chemical, or electrical characteristics. When materials are processed, you are usually making a product. It could be a pencil, or it could be a computer.

Energy is processed to change material from one form to another. Technology creates devices that convert one form of energy into another form. For example, chemicals in a battery are converted into electrical energy. The electrical energy can be converted by an electric motor into mechanical energy. Energy processing is a part of every system.

Information is processed to change its form in order to send, receive, store, or retrieve a message or signal. Today, computers play a large role in our ability to process information. A phone, radio, and television all have the ability to process information.

Outputs from systems take a number of forms. The most obvious output is the reason the system was created. For example, a lightbulb in a house has an output of light. The lightbulb also produces heat, which is not always desirable.

Patterns can be used to transmit information. Morse code is a series of long and short sounds or lights. It was the first form of telegraph communication. Computers were originally built on binary code, which is a series of zeros and ones.

Technology and Design | Briefing

Computers and computing are everywhere in our daily lives. You might have a personal device to play games, download apps, or watch movies. Your home might even be have an app that controls the alarm system or thermostat. At the basic level of all these devices are different types of coding and **programming**.

Programmers take the English language and convert it into code that the computer understands. They essentially have to learn a new language. This coding can be very simple, such as telling a computer to add and subtract numbers, or it can be very complex. There are different levels of programming that serve different purposes.

Briefing Questions

1. What three parts do systems need to operate?

   Systems need an input, a process, and an output to operate.

2. What are three things a system can process?

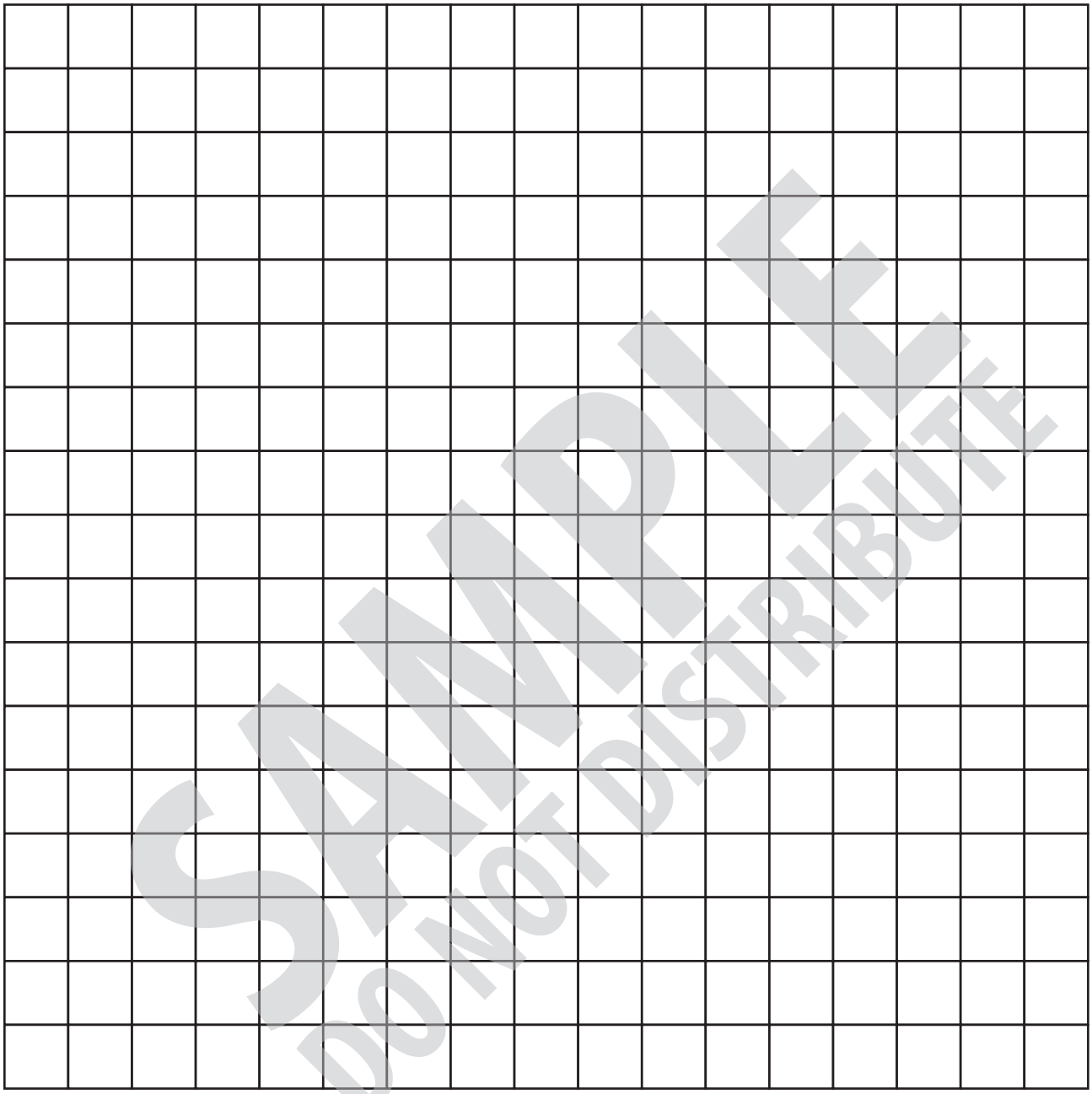
   Answers will vary. A system can process materials, energy, and information.

Vocabulary

system:
a group of parts that work together to achieve a goal

programming:
changing the English language into computer code

Your Shape



Mystery Shape

Use the graph in the back of this Mission Journal.

Three-Dimensional Structure Drawing

Drawings will vary.

Conclusion Questions

When you wrote the binary instructions, how were you thinking like a computer?

Answers will vary.

Propose an alternative building material for your structure. Justify your answer.

Answers will vary.

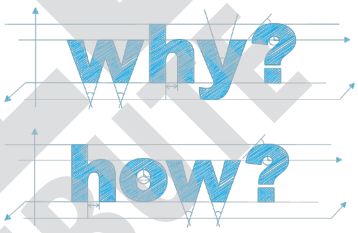
Mission Log | Technology and Design

Science and Technology

Science and technology have an interesting relationship. Science can drive technology. As scientists develop better understanding of a topic, they often need better instruments to take measurements. New, high-tech instruments take more accurate measurements.

Technology is essential to science. It provides instruments that enable observation of objects and other things that are otherwise unobservable. Science and technology are not the same thing.

Science tries to answer questions about the natural world. Science asks the question, “Why?” Technology tries to answer a different kind of question. It asks the question, “How?” The solution to this type of problem is the work of technology.



High-tech instruments measure things such as quantity, distance, location, size, and speed. Technology also provides tools that help investigations, inquiry, and analysis. Technology uses knowledge from all areas of study. Knowledge and techniques from art and design can help solve problems.

Scientific inquiry and technology design have similarities and differences. Scientists propose explanations for questions about the natural world. Engineers propose solutions relating to human problems, needs, and wants. Technological solutions are temporary. New technology replaces old technology.

When humans build something or try something new, they should think about how it affects other people. New technology often leads to new discoveries in science.

With new technologies, the **ethics** of whether something should be done or used have been raised. This could include privacy, security, copyright, or moral values. Cloning is the ability to create a duplicate of an organism. There isn’t a federal law banning human cloning. Most states in the United States ban human cloning, although animal cloning isn’t as limited.

Briefing | Technology and Design

The use of drones is continuing to grow. Packages can even be delivered to your house by a drone. The military often uses drones for surveillance. The recreational use of drones by people raises privacy and safety concerns. The aviation industry is struggling with their use in national airspace.

Google has created self-driving cars that are being tested in different states. Their goal is to create a completely automated vehicle that doesn't require a human operator. They want to reduce the number of traffic accidents and provide accessibility to all people.

Briefing Questions

1. What does science answer questions about?
   Science tries to answers questions about the natural world.

2. What does technology try to answer?
   Technology tries to answer how to solve problems.

Vocabulary

science:
tries to answer questions about the natural world

ethics:
whether something should be done or used

Mag Sailer

No. of sails:

Sail Design 1

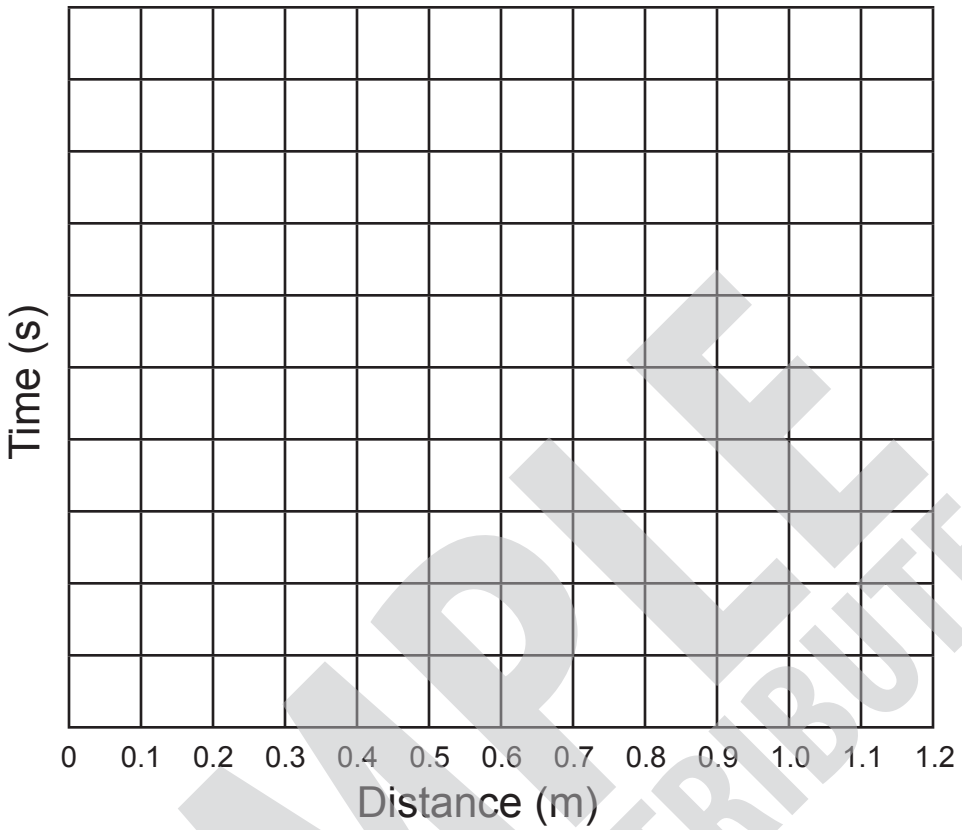
Draw shape of sail below.
Drawings will vary.

	Distance (m)	Time (s)	Speed (m/s)
Trial 1	Answers for table will vary.		
Trial 2			
Trial 3			
Trial 4			

Sail Design 2

Draw shape of sail below.
Drawings will vary.

	Distance (m)	Time (s)	Speed (m/s)
Trial 1	Answers for table will vary.		
Trial 2			
Trial 3			
Trial 4			



Graphs will vary. They should show an upward trend.

Conclusion Questions

What conclusions can you make about how the wind speed affected the Mag Sailer speed?

Answers will vary.

How did changing the shape, curve, or number of sails affect the sailer speed?

Answers will vary.

Career Connection | Technology and Design

Find the *Children's Dictionary of Occupations* book. Read the job descriptions. Use the information on these jobs when completing Activities A, B, or C. Any career can be used to complete Activities D and E.

Graphic Designer **Mechanical Engineer**

Interior Designer **Product Designer**

A. Select a job. Write five qualities a person would need to be successful at the job. Qualities could include communicates clearly, enjoys math, works well with his or her hands, and so forth.

B. Select a job. Decide if you would like to do that job. Write a paragraph that explains what parts of the job you would enjoy. If there are parts that you would not like to do, explain why you would not like to do them.

C. Select a job. What type of training or education would you need? List four skills the job requires. Explain how you would get those skills.

D. Find other jobs that would include work with technology and design. List three jobs and tell how they relate technology and design. The jobs do not need to be listed in the book.

E. Think of a person you know or someone famous who works with technology and design. Tell about this person and the job he or she does.

Note: Complete this Connection on a separate sheet of paper or on the blank Mission Log pages.

Graphs and How to Use Them

Tables are used to organize exact amounts of data and display information. Tables show numerical specifics rather than visual comparisons and, therefore, take longer to read and understand.

Bar graphs are used to compare data and show trends. They provide a display that enables the reader to quickly examine these trends visually. Bar graphs can be difficult to read accurately.

Circle graphs are used to compare parts to a whole. Constructing an accurate circle graph is difficult, particularly when the parts-to-whole relationship must be calculated and graphed without a computer.

A **line graph** uses data points connected with line segments to represent data collected over time. A line graph is often used to show a trend or general direction in data. The appearance of the graph indicates whether the data numbers are increasing or decreasing.

Answer the questions below. Write your answers on notebook paper.What type of graph would you use to display the following types of data?

1. The daily high temperatures recorded in your city for a year
2. Average amount of milk drunk in a year by different age groups
3. Monthly sales of school supplies sold at the student store
4. How your allowance is spent
5. The monthly total of TV sets sold at the local department store
6. The average age of children that learn to ride a bicycle

Note: Complete this Connection on a separate sheet of paper or on the blank Mission Log pages.

Rubber Band Power

Background

Temperature affects the elasticity of materials. You might be surprised at the results you get when you experiment with changing the temperature of a rubber band.

Materials

- Adult helper
- Rubber band
- Dish of ice water
- Hair dryer
- Coffee cup
- Carabiner
- Ruler

Hypothesis

Predict what will happen. Write your hypothesis on the lines below.

_____

_____

Procedure

In order to make a real test, you will need to keep most things the same. You will need to hold these things constant: the weight (coffee cup) and the rubber band. The variable you will test will be the temperature of the rubber band.

- Constants: weight, rubber band
- Variable: temperature of the rubber band

1. Hang the coffee cup on the rubber band using the carabiner. Measure the length from the top of the rubber band to the bottom.

2. Place the rubber band in ice water for several minutes. Hang the cup on the rubber band. Measure the length of the rubber band from the top to the bottom.

3. Heat the rubber band with a hair dryer for several minutes. Hang the cup on the rubber band. Measure the length of the rubber band from the top to the bottom.

4. Perform the experiment several times to ensure the results.

Observations

Write what you saw during the experiment.

Data Analysis

Create a table and record your data.

Draw a picture of the experiment.

Conclusion

Compare your prediction with what you saw. What did you learn? Was your hypothesis correct?

Time Line Activity

Create a time line that represents the years 1800 to 2025. Each interval of time should represent a period of 25 years. The year 1800 would be at the far left of the line. The year 2025 would be at the far right of the line. Place the dates and events listed below at the correct location on the time line.

1839 – Charles Goodyear invented vulcanized rubber, which is used in tires.

1881 – Thomas Edison developed the first commercial power utility and the first electric meter.

1886 – Josephine Garis Cochran built a dishwasher that worked and started the KitchenAid company.

2015 – The first solar aircraft started its trip around the globe.

1959 – Jack Kilby of Texas Instruments invented the microchip, a complex device that makes computers possible.

1821 – Michael Faraday built the first electric motor, which would eventually replace steam power.

1947 – Three researchers at Bell Laboratories developed the first transistor, making smaller and more efficient electronics possible.

2006 – Facebook was launched into the mainstream.

1989 – The World Wide Web was invented by Tim Berners-Lee.

1998 – Google was first launched as a search engine.

Note: Complete this Connection on a separate sheet of paper or on the blank Mission Log pages.

Vocabulary

1. solution
2. invent
3. technologies
4. communication
5. process
6. brief
7. system
8. programming
9. science
10. ethics

Activities

A. Write three paragraphs about technology. Correctly use as many vocabulary words as you can.

B. Create three questions and answers using at least five of the words from the list above.

C. Create a word search puzzle using graph paper. Use the definitions as clues for what words to find.

D. Create cards for each word and definition. Make sure you have 10 cards with words and 10 cards with definitions. Place the cards facedown. Play Concentration by taking turns trying to match the word with the correct definition.

E. Draw a picture of an invention. Label the picture using the vocabulary words. You may use phrases or sentences to make your graphic clear.

Note: Complete this Connection on a separate sheet of paper or on the blank Mission Log pages.

Research Connection | Technology and Design

Discuss the following questions as a Crew. Then, each person will write his or her own answers. You may illustrate your written answers.

1. How can technology be both good and bad?

2. What is the relationship between science and technology?

Charles Goodyear was born in 1800. Charles' father was an inventor and manufacturer. Charles went to public school. Charles became his father's partner in business. Charles took a trip to New York City. He visited a store that sold objects made of India rubber.

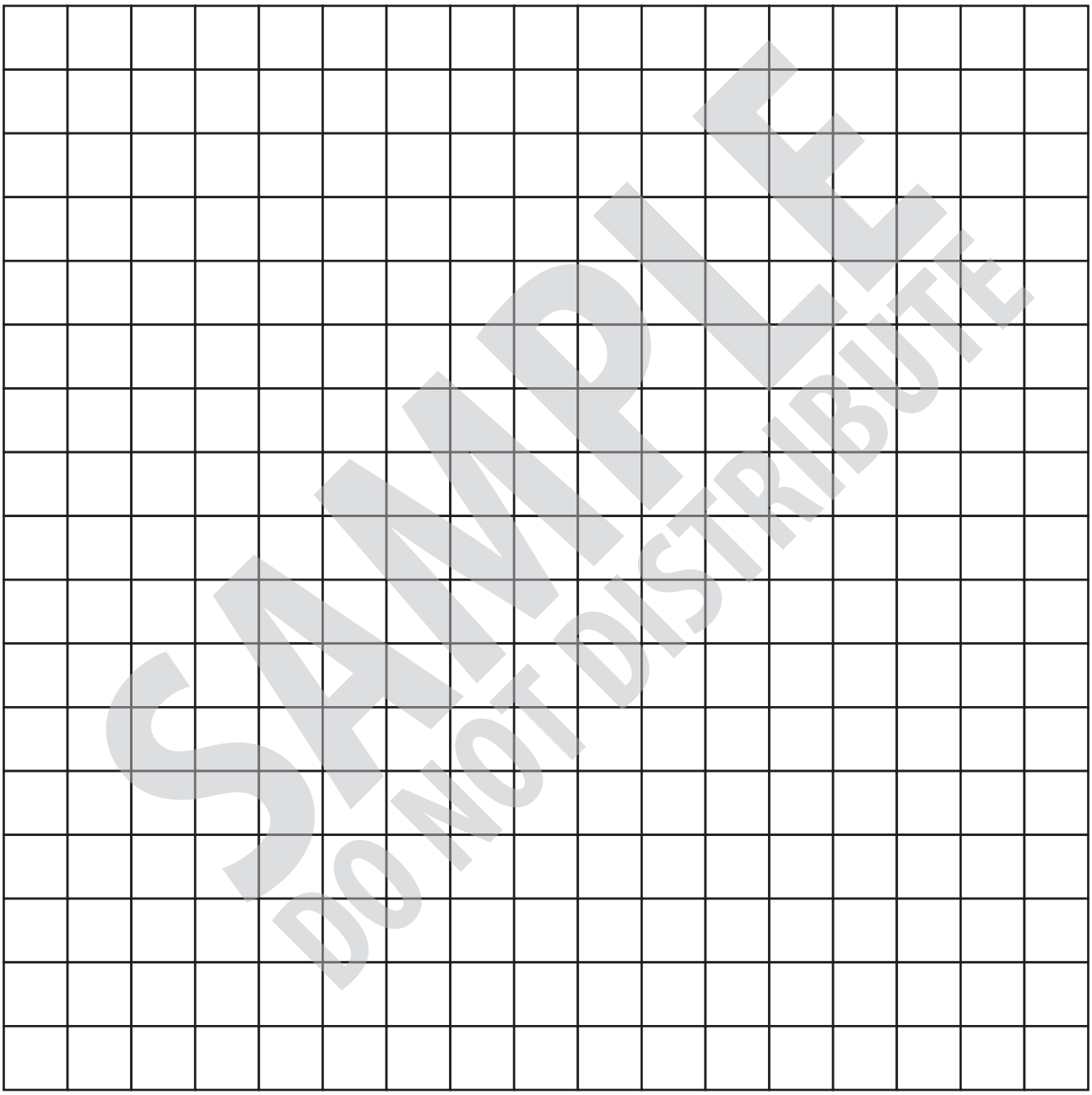
Rubber was new in America. Goodyear was fascinated by the possibilities of the material. He set out to improve its characteristics. Goodyear received his first patent for a process that made rubber easier to work with. In 1839, Charles discovered that if you removed the sulfur from rubber and heated it, it would retain its elasticity. This is called vulcanization. This made the rubber waterproof and winter-proof. In 1844, Goodyear was granted a patent for vulcanized rubber.

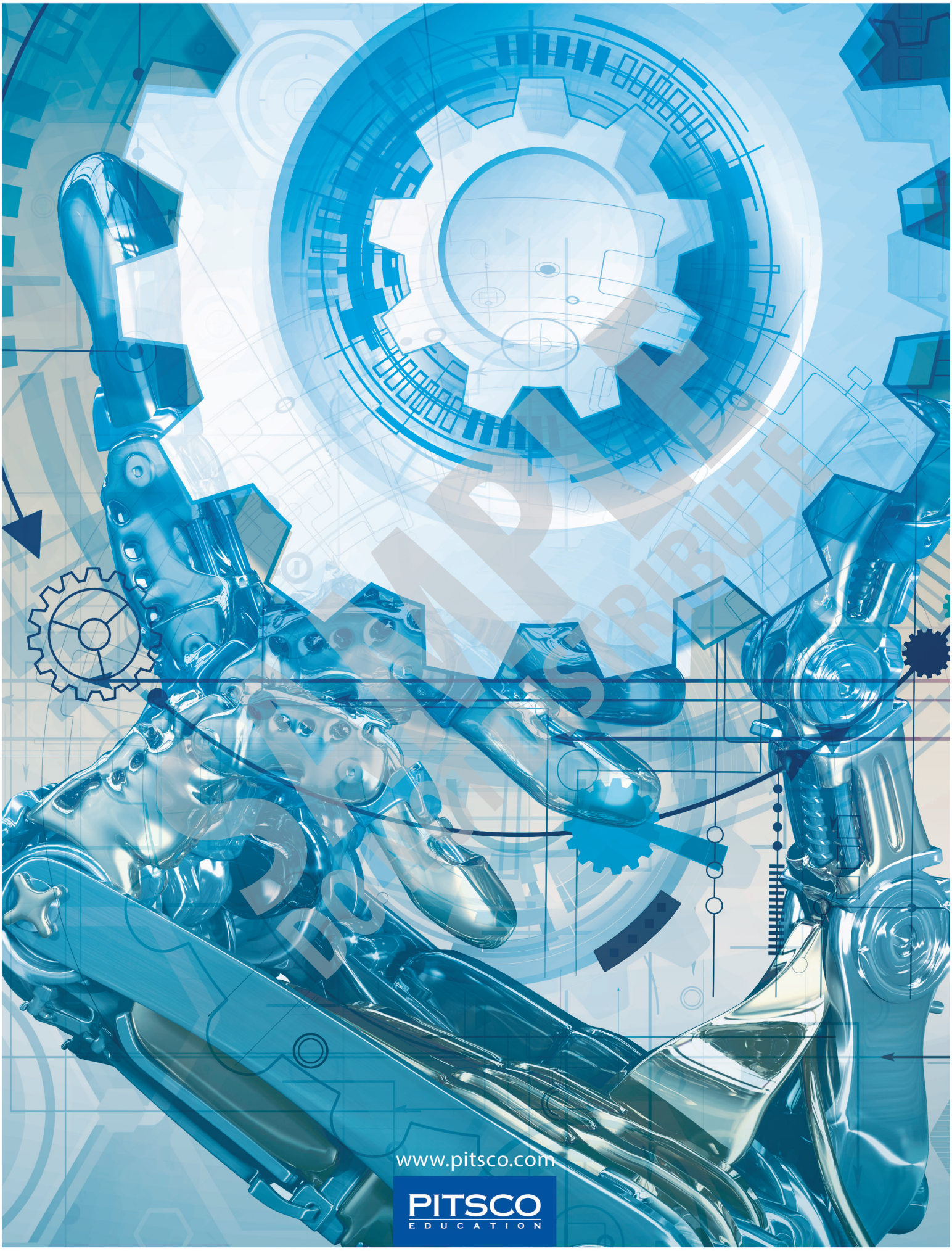
Select one of the following topics. Research the topic. Write a paragraph and draw at least one picture to illustrate what you have learned. If time permits, choose another topic.

- ergonomics
- synthetic
- prototype
- function
- recycling
- 3-D printing
- proportion
- designer

Note: Complete this Connection on a separate sheet of paper or on the blank Mission Log pages.

Mystery Shape




www.pitsco.com
PITSCO
EDUCATION