
MSPAP
RUBRIC

PART 3 Motion

LESSON 17

Introduction to the Anchor Activity

CORBIS/BETTMANN

This shoe-testing machine is designed to test leather soles.

INTRODUCTION

In this lesson, you will begin the Anchor Activity, a research project that will give you the opportunity to apply what you have learned in this module to a new situation. You and your partner will select a single device to study. Or, if you wish, you may design and build your own device. Whichever option you choose, you will do research to obtain as much information as you can about this device during the next few weeks. You will focus on how this device demonstrates the concepts and principles of energy, machines, and motion that you have studied. During the last lesson of this module, you will demonstrate to the class how your device works and share what you have learned about it.

OBJECTIVES FOR THIS LESSON

Understand the goals of the Anchor Activity.

Select a device to research or build.

Develop a plan to research or build the selected device.

Getting Started

1. Read “Civil Engineering: Danelle Bernard’s Bridge to the Future,” on pages 168–170.

2. Participate in a class discussion about what you have read.

3. Discuss with the class the importance of working together as a team.

Inquiry 17.1
Beginning the Anchor Activity

PROCEDURE

1. Participate in a class discussion of the purpose and goals of the Anchor Activity.

2. To get started, you need to come up with some ideas for devices that you can research. With the class, brainstorm the kind of devices you could investigate. You may suggest existing devices or devices you could design and build. Suggest any ideas that come to mind. Do not judge an idea right now. Do not worry if it is a good or bad idea. You will decide that later. You want to make a list of as many ideas as you can.

MATERIALS FOR LESSON 17

For you

1 copy of Student Sheet 17.1a: Guidelines for the Anchor Activity: Investigating a Device That Is Already Made
1 copy of Student Sheet 17.1b: Guidelines for the Anchor Activity: Making a Device of Your Own
1 copy of Student Sheet 17.1c: Getting Started on the Anchor Activity
1 copy of Inquiry Master 17.1c: Calendar for the Anchor Activity

3. With the class, evaluate each device on the list. Some devices will be reasonable to research; others will not. Your teacher will delete from the list any devices that will not work.

4. With your partner, decide on the device you would like to investigate or build. If you would like to investigate or build a device that is not on the list, check with your teacher to be sure that it is acceptable. Remember, it should be something that you can use. It must also be safe to use and demonstrate at school.

5. In your science notebook, record the device you choose.

6. Your teacher will give you a student sheet that lists Anchor Activity guidelines for your chosen device. Follow along as your teacher reviews each part of the project. Make sure you understand what is expected for each part. Ask questions about anything that is not clear.

7. Now review the calendar on Inquiry Master 17.1c. It tells you the dates by which each part of your project should be completed. Put the Anchor Activity guidelines and the calendar in the front of your science notebook so you can refer to them later. Be sure to follow the calendar so that you complete everything on time and receive full credit for your work.

8. Discuss with your lab partner where you think you can find information about your device. Share your ideas with the rest of the class.

9. Complete Student Sheet 17.1c: Getting Started on the Anchor Activity.

10. Read "How To Succeed With Your Project," on the next page.

HOW TO SUCCEED WITH YOUR PROJECT

Research takes time and succeeds with steady, continuous effort. Your final grade for the Anchor Activity will be the sum of all the scores earned throughout the project, not a single grade given at the end. To earn the most credit, complete each part on time and follow directions.

You will complete the Anchor Activity over the next few weeks. You will do most of the work for it outside the classroom. Sometimes you will work on your own. At other times you will work with your lab partner at home, at school, or at the library. If you live near your lab partner, you will have opportunities to meet outside of school time to complete your research and design your presentation. Some class time will be given for working on the project. Make good use of it. It gives you a chance to ask any questions you may have.

A good plan of action will also help you complete the project. Your plan should include not only what you and your partner will do, but also when and where you will meet to complete your research and design your presentation. In addition to a plan, you will need a calendar with a schedule for completion of the project. Setting deadlines for different parts of the Anchor Activity makes it less likely that you will have to do a lot of work at the last minute.

Keep a log or journal of your work in your science notebook. The log should tell what you did to contribute to the group effort and when you did it. Record your thoughts and ideas as you work. You may want to have your parents sign your log. This shows you have been working steadily on the project.

Information comes in many forms. Learn to use all the different resources at your school or local library. Your teacher may arrange for you to go to your school library or computer lab to do some of your research. Librarians and computer resource teachers can help you find information and plan your presentation.

Think of different ways you can share what you learned. Putting the information on a poster is one way; using computers is another. Your teacher will give you information about how to plan your presentation. Choose the format that best fits the resources in your school.

Plan and practice your oral presentation. A well-organized presentation is the best way to get your information across. It will earn you the most credit.

CIVIL ENGINEERING:

Danelle Bernard's Bridge to the Future

PHOTO BY MARVIN D. BLIMLINE/MARYLAND STATE HIGHWAY ADMINISTRATION

Danelle Bernard

"When I was in high school," recalls Danelle Bernard, "I really liked math, science, and physics. I also was interested in architecture. For a while I thought about becoming an architect. But then I decided I wasn't 'artsy' enough."

Danelle's guidance counselor gave her a good idea. "Why not think about becoming a civil engineer?" he asked.

Danelle looked into civil engineering and soon decided that it was the career for her. She graduated from college with a bachelor of science degree in civil engineering. Her courses covered topics such as design of steel structures, design of concrete structures, soil mechanics, surveying, structural analysis, and construction cost estimating. After working for 4 years, Danelle took a test that qualifies those who pass it as licensed professional engineers. Many employers require licensing, which is like a degree.

Today, about 15 years after graduation, Danelle is a project engineer for the Bridge Design Division, which is part of the State Highway Administration in Maryland. Danelle and her coworkers have a big responsibility: to oversee the design of bridges throughout the state. The group is responsible for designs aimed at repairing old bridges (some of which are almost 100 years old) as well as building new ones. Some of the bridges are quite small. "They're out in the middle of a cornfield," she says with a smile. Many others, however, are large, concrete-and-steel structures located in urban areas. Thousands of vehicles pass over them every day. At any moment, Danelle and her group are working on about a dozen projects. Each takes about 1 to 2 years to complete.

Teamwork

One thing Danelle likes best about her job is that it involves teamwork. Several different groups of people, composed mainly of engineers, work on Maryland's bridges. One group, for example, is in charge of inspecting all of the state's bridges. Maryland has more than 2400 bridges, and federal law requires that each bridge be inspected every 2 years.

PHOTO BY MARVIN D. BLIMLINE/MARYLAND STATE HIGHWAY ADMINISTRATION

Bridge maintenance is the job of civil engineers.

The inspection teams examine the bridge carefully. If they see cracks or other signs of deterioration, the bridges are slated for repair work. The bridge inspection group has several teams of engineers who do the design for minor bridge repairs. If a bridge requires major repairs or has to be replaced because it is severely deteriorated, however, it is turned over to the Bridge Design Division, which includes Danelle's team.

The bridge design team carefully analyzes the forces acting on the bridge. Their objective is to determine how strong the structural members of the bridge have to be to carry the weight of the vehicles that will pass over it. They must make sure that the bridge meets national and state design codes, but at the same time they have to think about cost constraints. When you've got more than 2400 bridges to think about, saving money is important!

Protecting the environment is also a concern. When a new bridge is being designed or an existing bridge is being repaired, Danelle and her team often meet with local citizens, elected officials, and members of environmental groups to discuss the effect that the bridge will have on the local community and the environment.

After Danelle and her colleagues have figured out all the details related to the bridge design, it's time to bring in the drafters, who transfer the designs into plans that will be used to build the bridge. In the past, drafting was much more painstaking. A lot of time was spent drawing, erasing, and drawing again! Today's draftspersons use CADD, short for "computer-aided drafting and design," to create the bridge plans. Changes can be made much more easily. In fact, using CADD, the drafters can even superimpose a drawing of a bridge onto a photograph

PHOTO BY MARVIN D. BLIMLINE/MARYLAND STATE HIGHWAY ADMINISTRATION

Using computer technology to redesign bridges

to show how a new bridge will look in a certain area. That comes in handy when the bridge design team is working with local residents who are concerned that the bridge will destroy the appearance of their neighborhood.

Always Something Different

Why is Danelle so enthusiastic about her work? There are many reasons. The first is simple—it's a job that is definitely needed. "Bridges help people get to work, get around, and do what they need to do!" she exclaims. Another big advantage is that you can see the results of your work. "Every time I drive on the highway," she says, "I can say to myself, 'I helped design that bridge.' "

The third reason is that every day brings new challenges. "Every bridge is different," she says. "Every project goes differently. We don't just sit at a desk and 'crunch numbers.' We get involved with local citizens and people from diverse backgrounds. And when the bridge is under construction, we go out and meet with the construction crews. You're gaining new experience all the time. It's something that you could never learn from a textbook." □

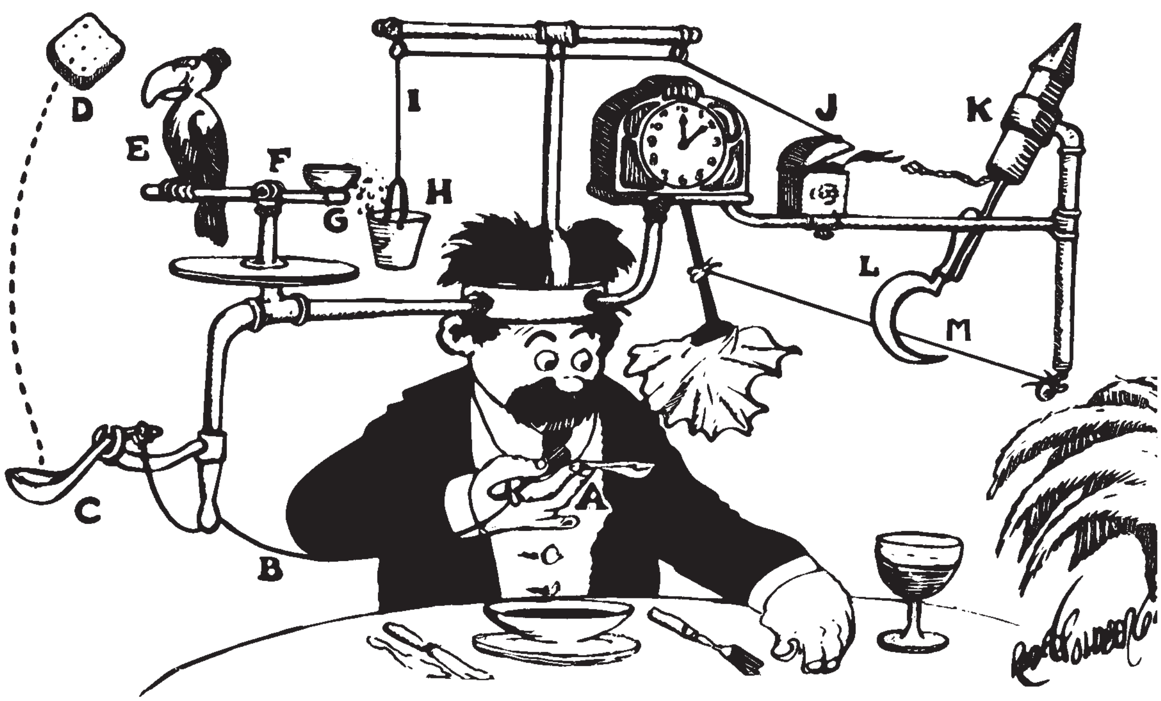
HOW TO DO A SIMPLE TASK—IN JUST 13 STEPS

Rube Goldberg began his career as a cartoonist in 1904.

Imagine making a pencil sharpener that also peels oranges. Sounds pretty weird, doesn't it? But that's the kind of thing that happens across the country each year in the Rube Goldberg Machine Contest™ held at various high schools, colleges, and universities. Teams of students compete to make machines that combine multiple steps and assorted gadgets to complete simple tasks such as sharpening pencils, toasting bread, and wiping chins.

Who was Rube Goldberg? He was an American cartoonist whose specialty was poking fun at the unnecessary complications of modern technology. He was born in San Francisco, California, in 1883. His cartoons showed complicated devices for doing a simple job. The "chin-wiper" pictured here is a typical Rube Goldberg machine. It takes 13 steps for the self-operating napkin to work. Why would anyone think of a machine like this?

During the decades that Rube Goldberg's work was featured in the nation's media, technological inventions were changing life dramatically. New devices, such as the telephone and washing machine, allowed people to use services for which they formerly needed to hire someone. In the early part of this century, these devices made people a little nervous (just like comput-



This Rube Goldberg™ device—The Self-Operating Napkin—combines practical and whimsical elements.

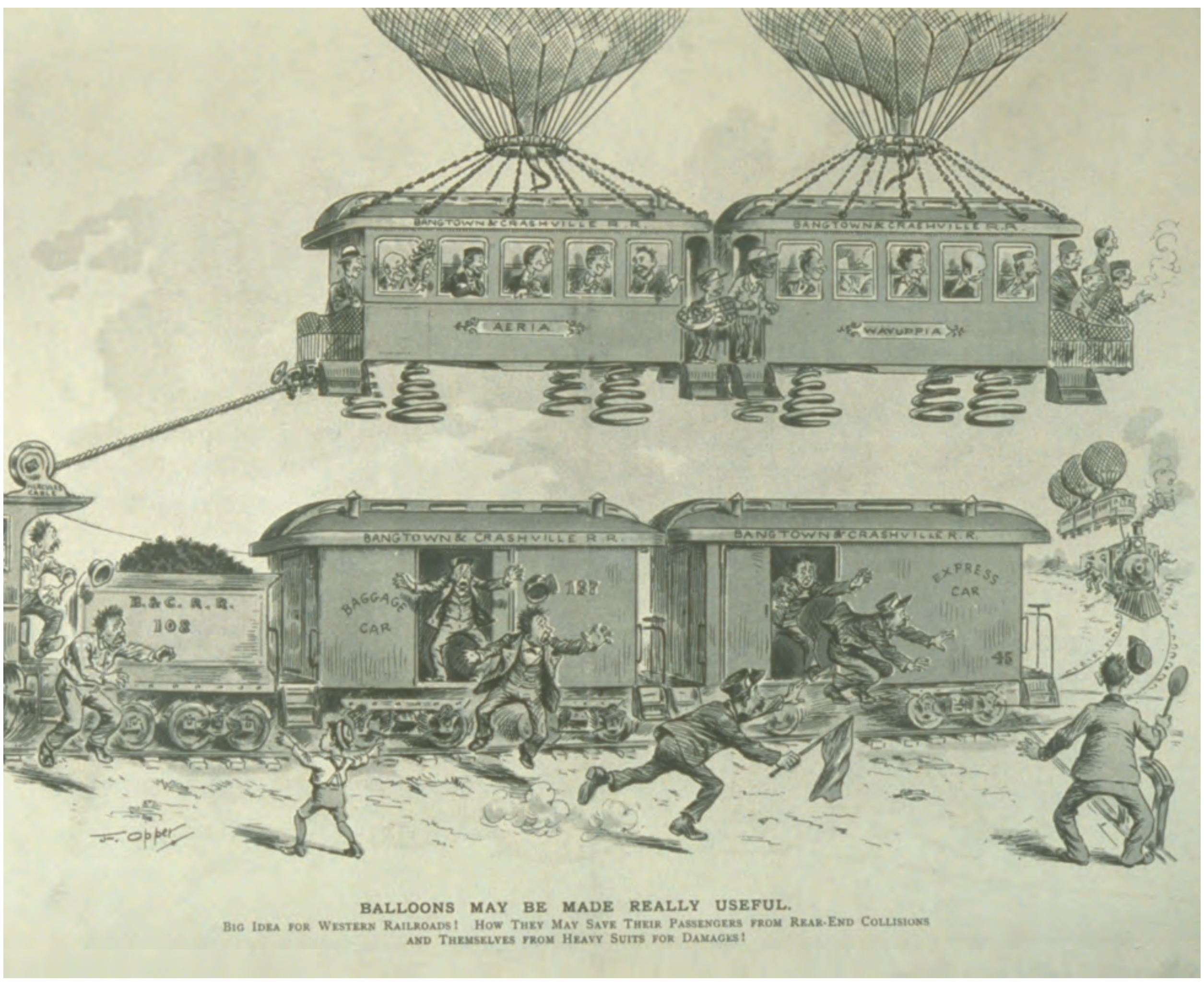
ers and pagers make some people nervous today!). Rube Goldberg's drawings of far-fetched machines completing easy tasks became so popular that Americans now associate the phrase "Rube Goldberg machine" with any system that seems too complicated.

Pails, Paddles, and Scientific Principles

Rube's machines used everything from false arms to wheels, cups, rods, paddles, pails, kitchen tools, and old shoes. But these devices, no matter how extravagant, did demonstrate a keen knowledge of physics. Rube's father insisted that his son earn a technical degree before embarking on a career as an artist. While a graduate engineering student, Rube learned most of the principles that make his creations tick. It's no wonder that his designs are popular with engineering students—and they were the ones who began hosting the Rube Goldberg Machine Contest in the 1930s.

Today, the Rube Goldberg Machine Contest is held all over the United States. The largest and oldest is hosted by Pi Theta Tau, the engineering society at Purdue University in Lafayette, Indiana. Student finalists have appeared with their machines on late-night television talk shows and in many magazine and newspaper articles.

HAGLEY MUSEUM AND LIBRARY



Rube Goldberg was not the only artist of his time to poke fun at modern technology. This railroad car is designed to protect passengers from train collisions.

AP/WIDE WORLD PHOTOS

The 1999 Rube Goldberg Machine Contest winners with their Rube Goldberg devices

The Contest Rules

All competitions have rules, and the Rube Goldberg Machine Contest is no exception. Some of the rules that usually apply to high school competitions are the following:

- Machines must operate within the following dimensions: 5 feet high, 6 feet wide, and 5 feet deep.
- Machines must complete one cycle of all steps within 9 minutes.
- Machines cannot have any loose or flying objects (for example, drops of water, confetti, and feathers) fall outside their established boundaries.

Once judges have determined that an entry passes these guidelines, the machine is judged for creativity, efficiency, and "Rube Goldberg" spirit. Every machine must have a theme—these range from *Star Wars* to the everyday (for example, junk food and housekeeping).

The 1998 competition prize was captured by a team from the University of Texas at Austin, whose "Mission to Mars/Spaceship Goldberg" took a combination of 40 steps—mechanical, electrical, and chemical—to turn off an alarm clock. It began with a solar-powered clock knocking down a weight and ended with a miniature model of the Mars Sojourner Rover roaring down a track, dropping a curtain over the clock, and turning it off. It's complex—but it works! ☐