Learn Through Experience

FUDGE FACTORY

A simulation solving a scientific mystery while learning about electricity and magnetism

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Revised 2010 edition
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10200 Jefferson Boulevard
P.O. Box 802
Culver City, CA 90232-0802
ISBN# 978-1-57336-339-6
www.teachinteract.com

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Your students become true scientists as they work to solve a scientific mystery. After arriving at a fudge factory, they discover that operations are shut down due to a mysterious electrical failure. As students work to solve the mystery, they become better prepared to conduct and understand scientific investigations. Through using the scientific method during this simulation, they learn to hypothesize, observe, draw conclusions from factual information, and carefully record their endeavors—just as scientists do. Specifically, your students will gain the following:

Knowledge

- Steps of the scientific method
- How electricity works
- Characteristics of static electricity and current electricity
- Characteristics of electricity as it exists in nature
- Types of circuits
- Meanings of electricity-related vocabulary
- Safety precautions necessary for electricity management
- Historical background of famous scientists in the field of electricity and magnetism
- Relationships among electricity, magnetism, and motors

Skills

- Working as a team with classmates
- Conducting experiments according to the scientific method
- Enhancing language arts and problem-solving skills by accurately collecting and recording scientific data, observations, and questions
- Analyzing clues to determine their usefulness in solving a problem
- Reading for information
- Sharing and discussing information in meaningful ways

Feelings and Attitudes

- Developing and valuing a sense of teamwork
- Appreciating the value and usefulness of electricity
- Appreciating accurate record keeping
- Increasing confidence in applying the scientific method
- Developing healthy respect for the dangers posed by natural and artificially generated electricity

PURPOSE

OVERVIEW

Most students are fascinated by mysteries because they are able to take pieces of information and see how they fit together as they attempt to solve a problem. Unfortunately, some students are under the impression that all mysteries are connected with murder and suffering, because that is what they see on television and in the movies. Students need to recognize that real people investigate and solve mysteries of the non-violent kind daily in science, history, health, engineering, and many other disciplines. FUDGE FACTORY exposes your students to a scientific mystery. As they use the scientific method, they work as scientists do to solve a real mystery. This simulation will engage, excite, and challenge students as they actively increase their understanding of the scientific process. Students are motivated and excited as they uncover clues and gain information, much like a detective does. FUDGE FACTORY is part of Interact's Science Mystery Series, stressing the scientific method and discovery.

FUDGE FACTORY consists of three distinct phases.

- Phase 1 covers the basics of the characteristics of electricity and magnetism through brief written histories and basic science experiments and activities.
- Phase 2 explores more details and offers further examples of electricity and magnetism and related concepts as students work to solve the mystery.
- Phase 3 provides several options for extending this simulation, including ideas for culminating events and challenging independent study projects.

Phase 1: Momentous History (Optional)
In this phase, students learn about some of the major historical people and moments related to discoveries in the field of electricity and magnetism. Then they conduct experiments to illustrate these discoveries using the scientific method.

The EUREKA! MOMENTS provide teachable opportunities to explore the following: Benjamin Franklin and static electricity; Luigi Galvani and Alessandro Volta and generating electricity; Hans Christian Oersted and Andre-Marie Ampère turning electricity into magnetism; Michael Faraday and turning magnetism into electricity; Thomas Edison (his influence on the field of electricity) and controlling experimental design.

The EUREKA! ACTIVITIES re-enact and illustrate the moments in scientific history discussed in the EUREKA! MOMENTS, demonstrating the principles discovered and showing how scientists expanded on and sometimes corrected previous work done by others. These activities lay the groundwork for the scientific study in Phase 2.

If your students are already familiar with the scientific method and the concepts underlying the principles of electricity and magnetism, you may simply opt to have them read and discuss the contents of the Student Guide: Phase 1, then proceed to Phase 2.

Phase 2: Faraday's Fudge Factory
This phase, the main portion of the simulation, guides students through a scientific mystery set in a fudge factory where the components are not working because of problems with electricity. Divided into teams, students explore Faraday's Fudge Factory with "Ms. Faraday," the factory's owner, searching for clues and participating in a variety of laboratory explorations. Students apply what they have learned about electricity and magnetism to solve the mystery.

OVERVIEW

OVERVIEW

Students participate in daily group problem-solving sessions, called T.E.A.M. ACTIVITIES (**T**ogether **E**veryone **A**ccomplishes **M**ore), which provide additional information about science, electricity, and magnetism. Students receive information about the problems plaguing the factory's various operations in the form of CLUE SEARCH information sheets, written as narratives of students' experiences at the factory. Students then explore the questions raised by the CLUE SEARCH information and gain additional practice in using the scientific method as they complete six ELECTRICITY EXPLORATION activities.

At the end of each day, during a short debriefing session, students discuss what they have learned that day. Room by room, students report their recommendations to Ms. Faraday on a SCIENTIFIC DETECTIVE FORM. After working on the five mystery sessions in Phase 2 and going through a final debriefing session, students give Ms. Faraday their overall recommendations and suggestions.

Phase 3: Extensions (Optional)
Based on the interests and abilities of your students and the time available, decide whether you will extend the learning of this simulation with one or more of these activities.

- Oral presentations of group recommendations to a person acting as Ms. Faraday
- Challenge Projects
- Electrified Inventions Day
- Women Inventors Research Projects
- Eureka! Moment Re-enactments

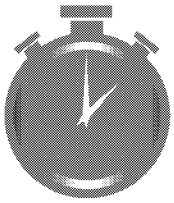
1. **Preparation Reading**
   Carefully and thoroughly read this Teacher Guide and both Student Guides *before* beginning this simulation. This will help you plan your time and adjust this simulation to meet your students' needs and abilities.

2. **Science Journals**
   Each student in your class needs a Science Journal. Plan time every day during class for students to write their observations and conclusions in their journals. FUDGE FACTORY includes a duplicable MY SCIENCE JOURNAL master to use as a cover.
   a. Students make these journals by gluing their copy of MY SCIENCE JOURNAL to:
      - a composition book or notebook
      - folded construction paper (11" x 17")
   b. Each student's Science Journal should include:
      - GLOSSARY
      - SCIENTIFIC METHOD handout
      - pockets for additional handouts
      - at least 10 sheets of lined paper

3. **Schedule**
   The schedule of this simulation is flexible. Study the Unit Time Chart. It is organized by investigations, not by days. If you plan 45 to 60 minutes per day, Phase 1 activities will take approximately five to seven days to complete. If you choose to have your students create their own inventions as an extension activity, schedule additional time. Students can complete these inventions in class or as homework. Using the same amount of daily class time, Phase 2 will take approximately eight days.
   a. Be sure to look carefully through each phase to determine how you can best use this simulation in your class.
   b. If your students need background knowledge of electricity and magnetism and related concepts, Phase 1 prepares them for Phase 2.
   c. Even if your students have some knowledge of electricity and magnetism concepts, consider reading and discussing the EUREKA! MOMENTS in the Student Guide: Phase 1.
   d. If you decide to have your students take what they have learned in this simulation one step further, add the time you think they will need to complete the optional Phase 3.

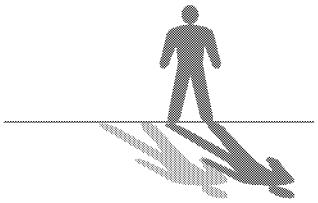
If you do not have enough class time for journal writing, assign this as homework.

The GLOSSARY provides an excellent reference for the terminology used throughout this unit. Encourage your students to use this tool!

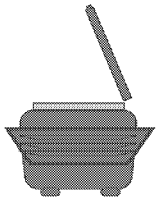


See the Unit Time Chart on page 15 to plan your time.

SETUP DIRECTIONS



You may allow your students to continue in the same group throughout the simulation or regroup them for Phase 2.



4. **Grouping Students**
Divide your students into groups of four to six, to remain together throughout the simulation. If the number of students does not divide evenly, some students must be responsible for sharing more than one set of T.E.A.M. ACTIVITY strips during Phase 2.

5. **Duplication**
Make copies of the following pages in the quantity indicated in *italics*. The duplication master pages begin on page 61.

Phase 1
YOUR SCIENCE JOURNAL* — *class set*
MY SCIENCE JOURNAL* — *class set*
SCIENTIFIC METHOD* — *class set*
PROTONS AND ELECTRONS — *class set*
EUREKA! ACTIVITY 1 — *class set*
ELECTRIC SPIDER — *class set*
EUREKA! ACTIVITY 2 — *class set*
EUREKA! ACTIVITY 3 — *class set*
EUREKA! ACTIVITY 4 — *class set*
EUREKA! ACTIVITY 5 — *class set*
* Denotes reproducibles needed in Phase 2, even if you opt to not do Phase 1.

Phase 2
CLUE SEARCH 1 - The Office Room — *class set*
CLUE SEARCH 2 - The Cooking Room — *class set*
CLUE SEARCH 3 - The Refrigeration Room — *class set*
CLUE SEARCH 4 - The Packaging Room — *class set*
CLUE SEARCH 5 - The Boiler Room — *class set*
WHAT ARE T.E.A.M. ACTIVITIES? — *class set*
INTRO. T.E.A.M. ACTIVITY — *one set of strips per group*
INTRO. T.E.A.M. ACTIVITY RECORD — *one per group*
T.E.A.M. ACTIVITY 1 — *one set of boxes per group*
T.E.A.M. ACTIVITY 1 RECORD — *one per group*
T.E.A.M. ACTIVITY 2 — *one set of boxes per group*
T.E.A.M. ACTIVITY 2 RECORD — *one per group*
T.E.A.M. ACTIVITY 3 — *one set of strips per group*
T.E.A.M. ACTIVITY 3 RECORD — *one per group*
ELECTRICITY EXPLORATION 1 — *class set*
ELECTRICITY EXPLORATION 2 — *class set*
ELECTRICITY EXPLORATION 3 — *class set*

ELECTRICITY EXPLORATION 4A — *class set*
ELECTRICITY EXPLORATION 4B — *class set*
ELECTRICITY EXPLORATION 5 — *class set*
SCIENTIFIC DETECTIVE RECORD FORM — five per group

6. **Materials**
   Carefully note the materials you will need in this simulation. Note, too, the separate listings for Phase 1 (which is optional), Phase 2, and Phase 3 (also optional). Gathering these materials ahead of time will help you run this simulation smoothly. Check the Daily Directions for additional details.

Get Wired
Use solid not stranded wire, 18 to 24 gauge. Using wire strippers or scissors, strip one-half inch (1 cm) of insulation from each end of the wires ahead of time. You should be able to reuse your wires. You will need:

- *8–inch wires — six per group*
- *8–inch insulated copper wires — four per group*
- *12–inch insulated copper wire— one per group*
- *24–inch insulated copper wire— one per group*
- *30–inch insulated copper wire— one per group*
- *12–inch magnet wire (enamel coated, 32 gauge) — one per group*
- *2 to 3–inch nichrome wire (#32) — one per group*

Phase 1
EUREKA! MOMENT 1
- Science Journals* — *class set* (see Setup Directions #2)
- Group Science Folders
  - Construction paper (11" x 17") — *one per group*
  - Pencils — *class set*
  - Stapler — *one per group*
- Eureka! Activity 1
  - Balloon (inflated) — *one per group*
  - Paper spider (found on ELECTRIC SPIDER handout) — *one cutout per group*
  - Scissors — *one per group*
  - Stopwatch or clock with a second hand — *one per group*
  - String or yarn, 12"–14" long — *one per group*
  - Wool cloth (any size) — *one per group*

* Denotes items needed in Phase 2, even if you opt to not do Phase 1.

Electronics stores and science supply houses will most likely have all of the materials you will need for these investigations. Basic electricity or magnetism kits will also have most items.

To obtain insulated copper wire, consider asking a local telephone company for surplus 25–pair interior telephone cable. Each cable contains 50 wires of an appropriate gauge. A cable about 12' long should supply plenty of wire for your class.

You may locate a semiconductor diode (Electricity Exploration 4b) at a local electronics store or through mail order resources. Request a small signal rectifier diode series #IN400–. Request a final digit of 3 or higher (e.g., IN4003).

***CAUTION!** Do not allow students to strip wires. This is potentially hazardous and demands too much class time.*

Fabric stores often give free samples.

SETUP DIRECTIONS

- Protons and Electrons Activity
  - 6" x 6" (15 cm x 15 cm) positive (+) signs (protons) — *half class set*
  - 6" x 6" (15 cm x 15 cm) negative (-) signs (electrons) — *half class set*

EUREKA! MOMENT 2

- Eureka! Activity 2
  - Bowl of liquid (e.g., salt water, lemon juice) — *one per group*
  - Dimes or aluminum foil folded to dime-size — *five per group*
  - Paper towel (two-inch squares) — *nine per group*
  - Pennies — *five per group*

EUREKA! MOMENT 3

- Eureka! Activity 3
  - Battery (D or lantern) — *one per group*
  - Compass — *one per group*
  - Insulated copper wire, 24-inch (61-cm) or longer with half-inch (1-cm) insulation stripped from each end — *one per group*
  - Insulated copper wire, 12-inch (30-cm) with half-inch (1-cm) insulation stripped from each end — *one per group*
  - Iron filings or small paper clips — *several per group*
  - Lightbulb — *one per group*
  - Lightbulb holder — *one per group*
  - Nail (long) — *one per group*
  - Tape (electrical or duct) — *one per group*

EUREKA! MOMENT 4

- Eureka! Activity 4
  - Bar magnet — *one per group*
  - Compass — *one per group*
  - Insulated copper wire, 30-inch (76-cm) or longer with half-inch (1-cm) insulation stripped from each end — *one per group*
  - Iron filings — *several per group*
  - Thin card (4" x 6" note card, large enough to cover force field bar magnet will create) — *one per group*

EUREKA! MOMENT 5

- Eureka! Activity 5
  - Art paper (12" x 18") — *for each group*
  - Markers, colored pencils or crayons — *class set*

Be sure to use electrical or duct tape when performing experiments. Masking tape can become a conductor and burn or catch on fire. Scotch tape can melt.

Phase 2

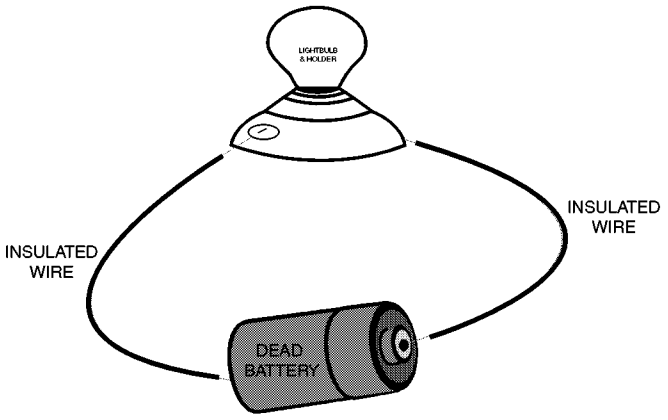
"Sparking Their Appetite" - Intro.

- Science Journals (if Phase 1 was not completed) — *class set* (see Setup Directions #2)
- Group Science Folders (if forming new groups)
  - Construction paper (11" x 17") — *one per group*
  - Pencils — *class set*
  - Stapler — *one per group*

Office Suite

- T.E.A.M. ACTIVITY
  - Battery (size D) — *one per group*
  - Wire, eight-inch (20-cm) with half-inch (1-cm) insulation stripped from each end — *one per group*
  - Lightbulb — *one per group*
- Electricity Exploration 1
  - Faulty circuit setup — *one per group*
    - Battery (dead, size D) — *one per setup*
    - Lightbulb — *one per setup*
    - Lightbulb holder — *one per setup*
    - Tape (electrical or duct) — *one per group*
    - Wires, eight-inch (20-cm) with half-inch (1-cm) insulation stripped from each end — *two per setup*

Set up materials as shown here, but use a dead battery. Cover all connections with electrical or duct tape (not shown) so that students will have to check these more closely.



TEACHING TIP

If you wish, you could include a poor wire connection instead of a dead battery. In such a case, adjust experiment answers accordingly.

You may find it helpful to mount these setups on a piece of cardboard, taping down the components as you tape over the connections.

SETUP DIRECTIONS

TEACHING TIP

It is OK to use fewer types of materials than 12, but be sure to include fudge.

Use electrical or duct tape when performing experiments. Masking tape can become a conductor and burn or catch on fire. Scotch tape can melt.

- Substitute circuit components:
  - Battery (working, size D) — *one per group*
  - Lightbulb — *one additional per group*
  - Lightbulb holder — *one additional per group*
  - Wires, eight-inch (20-cm) with half-inch (1-cm) insulation stripped from each end — *two additional per group*
- Stiff cardboard (optional) — *one piece per group*

The Cooking Room

- Electricity Exploration 2
  - Items made from rubber, plastic, paper, cotton, copper, wood, fudge, steel, wool, aluminum, leather, nickel — *one of each per group*
  - Battery (any size) — *one per group*
  - Lightbulb — *one per group*
  - Lightbulb holder — *one per group*
  - Paper towels — *one wet and one dry per group*
  - Tape (electrical or duct) — *one per group*
  - Wires, eight-inch (20-cm) with a half-inch (1-cm) of the insulation stripped from each end — *three per group*

The Refrigeration Room

- Electricity Exploration 3
  - Battery (C or larger) — *two per group*
  - Lightbulbs — *two per group*
  - Lightbulb holders — *two per group*
  - Tape (electrical or duct) — *one per group*
  - Wires, eight-inch (20-cm) with a half-inch (1-cm) of insulation stripped from each end — *six per group*

The Packaging Room

- Electricity Exploration 4A
  - Base (such as a plastic or Styrofoam cup) — *one per group*
  - Battery (D-cell) — *one per group*
  - Dowel, half-inch (1-cm) or other round object — *one per group*
  - Magnet (strong, but small) — *one per group*
  - Magnet wire, 12-inch (30-cm), enamel-coated, 32 gauge (or thinner) — *one per group*
  - Paper clips (uncoated) — *two per group*
  - Rubber band (thick) — *one per group*
  - Sandpaper — *one piece per group*
  - Tape (electrical or duct) — *one per group*

- Electricity Exploration 4B
  - Battery (D-cell) — *one per group*
  - Lightbulb — *one per group*
  - Lightbulb holder — *one per group*
  - Semiconductor diode (400v) — *one per group*
  - Tape (electrical or duct) — *one per group*
  - Wire, eight-inch (20-cm) with half-inch (1-cm) insulation stripped from each end — *three per group*

The Boiler Room

- Electricity Exploration 5
  - Battery (lantern) — *one per group*
  - Brads (one-inch or long enough to go through the cardboard) — *two per group*
  - Clay — *two lumps per group*
  - Corrugated cardboard, 2" x 3" (5 x 7 cm) — *one per group*
  - Insulated copper wire, eight-inch (20-cm) with half-inch (1-cm) insulation stripped from each end — *four per group*
  - Lightbulb — *one per group*
  - Lightbulb holder — *one per group*
  - Nichrome wire (#32) 2-3-inch (5-7.5-cm) — *one per group*
  - Paper clips (uncoated) — *three per group*

Phase 3 (Optional)

Challenge Projects

- Materials needed for various projects (e.g., poster, game, book)
- Supplies necessary for experiments as desired

Electrified Inventions

- Materials needed to make models of inventions
- Display boards for written information and photos, if desired

Women Inventors

- Research material/resources
- Display boards for written information and photos, if desired
- Materials needed to make models of invention

EUREKA! MOMENT Re-enactments

- Simple props as desired
- Supplies necessary to re-enact one of the Eureka! Activities

7. **Teaching Schedule Per Lesson**
   a. During Phase 1 the class reads a different EUREKA! MOMENT each day. Decide if you will read these short essays aloud with the class, or if students will read and discuss the information within their groups. The general daily format is:
      • Read EUREKA! MOMENT
      • Complete the related EUREKA! ACTIVITY
      • Debriefing discussion
      • Write in Science Journals
   b. During Phase 2 your students explore problems at the factory room by room. The general daily format is:
      • T.E.A.M. ACTIVITY
      • CLUE SEARCH
      • ELECTRICITY EXPLORATION
      • SCIENTIFIC DETECTIVE RECORD FORM

8. **Teaching Options: Phase 1**
   The following are suggestions for modifying Phase 1:
   a. EUREKA! ACTIVITIES
      You may read and discuss the EUREKA! MOMENTS as a class lesson by lesson, then when you have read all five, allow teams of students to rotate through Eureka! Activity stations set up to investigate the principles and re-enact the history.
   b. You may stop at Step 6 in EUREKA! ACTIVITY 5 and not have students make a model or other display materials for their Electrified Inventions.
   c. T.E.A.M. Activities
      For advanced students you may give necessary definitions and guidelines, then have groups design their own T.E.A.M. Activity information strips to be used with Phase 1. They then exchange and check strips between groups.

TEACHING TIP

Under this plan, you need only one or two sets of supplies for each of the five Eureka! Activities.

9. **Teaching Options: Phase 2**
   The following are suggestions for modifying Phase 2:
   a. Students complete all the T.E.A.M. ACTIVITIES, one by one, before doing any of the rest of Phase 2.
   b. Set up Electricity Exploration stations for all groups to rotate through the six activities. Allow two hours of class time for all six.
   c. Provide the five CLUE SEARCHES one at a time and have students fill out the corresponding SCIENTIFIC

DETECTIVE FORMS, keeping in mind the four T.E.A.M. ACTIVITIES and the six ELECTRICITY EXPLORATIONS they have completed.

The advantages of this variation include:

- Since groups rotate through the ELECTRICITY EXPLORATION stations, you need only one or two sets of supplies for each activity per class.
- You can easily use longer class periods if this works better in your schedule.
- Students must more fully assimilate the information they gathered in the T.E.A.M. ACTIVITIES and ELECTRICITY EXPLORATIONS, then apply this knowledge as they evaluate the CLUE SEARCH information.
- Students' conclusions on the SCIENTIFIC DETECTIVE RECORD FORMS serve as informal assessments of what they have learned during the simulation.

10. **Guest Speakers**

You can enhance this unit by inviting a physicist, electrical engineer, or electrician to speak to your class during or after this simulation. Local universities or businesses might have someone willing to spend time sparking scientific interest in your students.

11. **Culminating Event(s)**

You may conclude the FUDGE FACTORY unit with formal presentations or an open house where students demonstrate what they have learned to administrators, other classes, family, friends, and the larger community. Consider one or more of the following suggestions:

a. Oral Presentations—Have groups present their recommendations to "Ms. Faraday," the owner of Faraday's Fudge Factory (school principal, yourself, or other dignitary).
b. Challenge Projects—Students present their projects to Ms. Faraday and/or other visitors.
c. Electrified Inventions Day—Set a date, time, and venue for having guests view your students' work.
d. Women Inventors—Students research a specific female inventor and present their projects (including a model of the invention, if desired) to an audience.
e. Eureka! Moment Re-enactments—Students re-enact the moments in history explored in Phase 1.

UNIT TIME CHART

Phase 1: Momentous History (Optional)

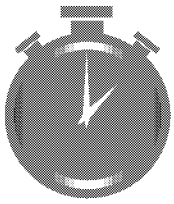
EUREKA! MOMENT 1	EUREKA! MOMENT 2	EUREKA! MOMENT 3	EUREKA! MOMENT 4	EUREKA! MOMENT 5	
Student Guide Phase 1 EUREKA! ACTIVITY 1 GLOSSARY MY SCIENCE JOURNAL YOUR SCIENCE JOURNAL SCIENTIFIC METHOD	Student Guide Phase 1 EUREKA! ACTIVITY 2 Science Journals	Student Guide Phase 1 EUREKA! ACTIVITY 3 Science Journals	Student Guide Phase 1 EUREKA! ACTIVITY 4 Science Journals	Student Guide Phase 1 EUREKA! ACTIVITY 5 Science Journals	

Phase 2: Faraday's Fudge Factory

INTRO	Office Suite	Cooking Room	Refrigeration Room	Packaging Room	Boiler Room
Student Guide Phase 2 INTRO. TEAM ACTIVITY GLOSSARY MY SCIENCE JOURNAL YOUR SCIENCE JOURNAL	Student Guide Phase 2 Science Journals T.E.A.M. ACTIVITY 1 CLUE SEARCH 1 ELECTRICITY EXPLORATION 1 SCIENTIFIC DETECTIVE RECORD FORM Debriefing	Student Guide Phase 2 Science Journals T.E.A.M. ACTIVITY 2 CLUE SEARCH 2 ELECTRICITY EXPLORATION 2 SCIENTIFIC DETECTIVE RECORD FORM Debriefing	Student Guide Phase 2 Science Journals T.E.A.M. ACTIVITY 3 CLUE SEARCH 3 ELECTRICITY EXPLORATION 3 SCIENTIFIC DETECTIVE RECORD FORM Debriefing	Student Guide Phase 2 Science Journals CLUE SEARCH 4 ELECTRICITY EXPLORATION 4A, 4B SCIENTIFIC DETECTIVE RECORD FORM Debriefing	Student Guide Phase 2 Science Journals CLUE SEARCH 5 ELECTRICITY EXPLORATION 5 SCIENTIFIC DETECTIVE RECORD FORM Final Debriefing Analysis of all clues Solving of mystery

Phase 3: Extensions (Optional)

EXTENSIONS					
You determine the content and timing of PHASE 3. Optional presentations of groups' conclusions Challenge Projects ELECTRIFIED INVENTIONS Women Inventors EUREKA! MOMENT Re-enactments					



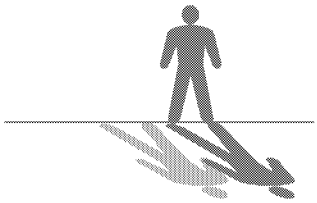
Estimated activity time 90 minutes

TEACHING TIP

If your students are familiar with the scientific method and basic electricity principles and experienced in doing electricity experiments, you may wish to simply read and discuss the Student Guide: Phase 1, then proceed to Phase 2.

TEACHING TIP

Prepare these signs ahead of time for an activity on electrical charges.



Groups of 4-6 students

EUREKA! MOMENT 1

Materials

- Student Guide: Phase 1 — *class set*
- YOUR SCIENCE JOURNAL — *class set*
- MY SCIENCE JOURNAL cover — *class set*
- GLOSSARY — *class set*
- SCIENTIFIC METHOD — *class set*
- PROTONS AND ELECTRONS (Optional) — *class set*
- EUREKA! ACTIVITY 1 — *class set*
- ELECTRIC SPIDER — *one cutout per group*
- Science Journals and Group Science Folders
  - Construction paper (11" x 17") — *class set + one per group*
  - Notebook paper — *10 sheets per student*
  - Pencils — *class set*
  - Stapler — *one per group*
- Eureka! Activity 1
  - Balloon (inflated) — *one per group*
  - Paper Spider (found on ELECTRIC SPIDER handout) — *one cutout per group*
  - Scissors — *one per group*
  - Stopwatch or clock with a secondhand — *one per group*
  - String or yarn, 12" -14" long — *one per group*
  - Wool cloth (any size) — *one per group*
- Protons and Electrons Activity
  - 6" x 6" (15 cm x 15 cm) positive (+) signs (protons) — *half class set*
  - 6" x 6" (15 cm x 15 cm) negative (-) signs (electrons) — *half class set*
- Chalkboard or overhead and transparency

Procedure

1. Divide students into groups of four to six students each. These students will work together throughout the simulation. See **Setup Directions #4, Grouping Students**, for more information.

2. Distribute, read and discuss YOUR SCIENCE JOURNAL.

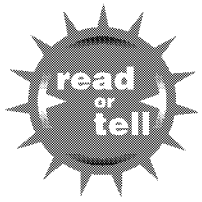
3. Distribute the MY SCIENCE JOURNAL cover and the GLOSSARY. Have students make their Science Journals. See **Setup Directions #2, Science Journals**, for more information. Have students place the handouts in their Science Journals when they have completed them.

4. Distribute one sheet of construction paper to each group and have each group make its own folder. Direct students to store within this folder all important information they gather in the simulation.

5. **Read or tell** the following information:

The Ancient Greeks found that if they rubbed amber it would attract light things such as feathers. The word ***electron*** *is the Greek word for amber. In 1600, William Gilbert (1544-1603), Queen Elizabeth I's doctor, published the earliest known writing on electricity. He studied natural magnets, called* ***lodestones****, and*

understood that the earth itself was a giant magnet with two poles. He also designed the first electrical instrument, which crudely measured the strength of an electric charge. In 1660, Otto von Guericke (1602-1686), a German, developed a machine that generated ***static electricity*** *charges. The ability to generate static electricity charges allowed scientists to study the properties of electricity more easily. Then, in 1745, Pieter van Musschenbroek (1692-1761), of the University of Holland in Leyden, found a way to store static electricity charges. This "Leyden jar" made it even easier for scientists to investigate electricity. Finally, in 1784 Dr. van Marum of Holland (1750-1837) created an "electrostatic" machine with glass plates 65 inches (165 cm) across.*



Draw a timeline like the one shown below to illustrate this information.