INTRODUCTION

The Energy kit contains

- Teacher Toolkit: Energy
- 1 Investigations Guide: Energy
- 1 Teacher Resources: Energy
- 1 FOSS Science Resources: Energy
- FOSS Science Resources: Energy (class set of student books)
- Permanent equipment for one class of 32 students
- Consumable equipment for three classes of 32 students

FOSS modules use central materials distribution. You organize all the materials for an investigation on a single table called the materials station. As the investigation progresses, one member of each group gets materials as they are needed, and another returns the materials when the investigation is completed. You place items at the station—students do the rest.

Individual photos of each piece of FOSS equipment are available online for printing. For updates to information on materials used in this module and access to the Safety Data Sheets (SDS), go to www.FOSSweb.com. Links to replacement-part lists and customer service are also available on FOSSweb.

NOTE
To see how all of the materials in the module are set up and used, view the teacher preparation video on FOSSweb.

NOTE
Delta Education Customer Service can be reached at 1-800-258-1302.
<table>
<thead>
<tr>
<th>Kit Inventory List</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drawer 1 of 3</strong></td>
</tr>
</tbody>
</table>

### Print Materials
- 1 Teacher Toolkit: Energy (1 Investigations Guide, 1 Teacher Resources, and 1 FOSS Science Resources: Energy*)
- 1 Poster set, Conservation, 4/set
- 2 Posters, Science Safety and Outdoor Safety

### Items for Investigation 1
- 16 FOSS® bulb holders
- 8 Cords
- 1 Flashlight, large (to accommodate 2 D-cells)
- 20 Lightbulbs, #222
- 50 Straws, jumbo
- 8 Test objects, bags, 38 objects/bag
  - 2 each of: Aluminum foil, Rubber bands
  - 2 each of: Aluminum nails, Sponges
  - 2 each of: Black rocks, Steel nails
  - 2 each of: Brass rings, Steel paper clips
  - 2 each of: Cardboard squares, Steel screens
  - 2 each of: Copper foil, Steel screws
  - 2 each of: Paper fasteners, Steel washers
  - 2 each of: Plastic chips, Wood sticks
  - 2 each of: Plastic straws, Wool yarn
  - 2 each of: River rocks

### Items for Investigation 2
- 8 FOSS® balances with pointers
- 2 Magnets, bar
- 8 Magnets-on-a-post
- 50 Spacers (plastic counters)
- 8 Washers, bags, large 25/bag

### Drawer 2 of 3

### Items for Investigation 3
- 2 Hand-crank generators with two bulbs
- 8 Rivets with rubber washers
- 8 Steel strips
- 8 Telegraph lines, 4 m
- 4 Vials of small washers, 100/vial
- 1 Wire, 24-gauge, insulated, 16 m/roll (53')

### Items for Investigation 4
- 2 9-volt batteries for tone generator
- 8 Basins, plastic
- 2 Containers, 1/2 L

* The student books, if included in your purchase, are shipped separately.

**NOTE**
The teacher toolkit is shipped separately. However, there is space in drawer 1 to store your toolkit.

These items might occasionally need replacement.
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**NOTE**
This module includes access to FOSSweb, which includes the streaming videos, interactive simulations, virtual investigations, and tutorials used throughout the module.

<table>
<thead>
<tr>
<th>Equipment Condition</th>
<th></th>
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### Items for Investigation 5

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>AA-cells, alkaline</td>
</tr>
<tr>
<td>1</td>
<td>Basin, plastic, clear</td>
</tr>
<tr>
<td>8</td>
<td>Flashlights, small (to accommodate 2 AA-cells)</td>
</tr>
<tr>
<td>100</td>
<td>Index cards, plain, 3&quot; × 5&quot;</td>
</tr>
<tr>
<td>32</td>
<td>Mirror clips, plastic</td>
</tr>
<tr>
<td>32</td>
<td>Mirrors</td>
</tr>
<tr>
<td>8</td>
<td>Ropes, 5 m</td>
</tr>
<tr>
<td>18</td>
<td>Solar cells with leads</td>
</tr>
<tr>
<td>1</td>
<td>Spring toy</td>
</tr>
<tr>
<td>1</td>
<td>Table-tennis ball</td>
</tr>
<tr>
<td>10</td>
<td>Zip bags, large, 4 L</td>
</tr>
</tbody>
</table>

### Drawer 3 of 3

#### Shared Items

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>FOSS® cell holders</td>
</tr>
<tr>
<td>8</td>
<td>FOSS® circuit bases</td>
</tr>
<tr>
<td>8</td>
<td>Compasses, magnetic</td>
</tr>
<tr>
<td>25</td>
<td>Cups, plastic, 250 mL (9 oz.)</td>
</tr>
<tr>
<td>36</td>
<td>Magnets, doughnut-shaped</td>
</tr>
<tr>
<td>16</td>
<td>Meter tapes</td>
</tr>
<tr>
<td>9</td>
<td>Motors</td>
</tr>
<tr>
<td>12</td>
<td>Springs, extras for replacement</td>
</tr>
<tr>
<td>8</td>
<td>FOSS® switches</td>
</tr>
<tr>
<td>1</td>
<td>Wire, 20-gauge, insulated, 16 m/roll (53')</td>
</tr>
<tr>
<td>1</td>
<td>Wire stripper</td>
</tr>
<tr>
<td>36</td>
<td>Zip bags, small, 7 × 12 cm (2.8&quot; × 3.5&quot;)</td>
</tr>
</tbody>
</table>

#### Consumable Items

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>D-cells, alkaline</td>
</tr>
<tr>
<td>1</td>
<td>Candles, birthday, box</td>
</tr>
<tr>
<td>1</td>
<td>Masking tape, 55 m (180')/roll</td>
</tr>
<tr>
<td>840</td>
<td>Recording dots, 1.3 cm (0.5&quot;)</td>
</tr>
</tbody>
</table>

#### Separate Shipper

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Runways, foam</td>
</tr>
</tbody>
</table>
MATERIALS Supplied by the Teacher

Each part of each investigation has a Materials section that describes the materials required for that part. It lists materials needed for each student or group of students and for the class.

Be aware that you must supply some items. These are indicated with an asterisk (*) in the materials list for each part of the investigation. Here is a summary list of those items by investigation.

For all investigations
- Chart paper and marking pen
- Computers with Internet connection
- Drawing utensils (pencils, crayons, colored pencils, marking pens)
- Glue sticks
- Projection system
- Science notebooks (composition books)
- Self-stick notes (for review sessions)

For outdoor investigations
1. Bag for carrying materials
2. Clipboards or cardboard pieces with binder clips (optional)

Investigation 1: Energy and Circuits
1. Bag, sturdy paper or plastic (optional)
2. Incandescent bulb (optional)
3. Screwdriver (optional)
- Scissors

Investigation 2: The Force of Magnetism
- Metal test objects, such as washers, machine screws, binder clips
2. Steel paper clips
2. Pieces of string, 20-30 cm

Investigation 3: Electromagnets
- Scissors

NOTE
Throughout the Investigations Guide, we refer to materials not provided in the kit as “teacher-supplied.” These materials are generally common or consumable items that schools and/or classrooms already have, such as rulers, paper towels, and computers. If your school/classroom does not have these items, they can be provided by teachers, schools, districts, or materials centers (if applicable). You can also borrow the items from other departments or classrooms, or request these items as community donations.
Investigation 4: Energy Transfer

- Balls for outdoor extension
- Calculator (optional)
- Ice cubes
- Safety matches
- Scissors
- Screwdriver, small, for installing battery in tone generator
- Clear-plastic sheet protectors (optional)

Investigation 5: Waves

- 8 Books
- Pitcher or 2 L bottle of water
- 1 Pencil for demonstration
- Rice grains
- Salt grains
- Water
PREPARING a New Kit

If you are preparing a new kit for classroom use, you can do several things initially that will save time during routine preparation for instruction.

1. **Prepare wires**
   - The kit contains a spool of 20-gauge wire and a spool of 24-gauge wire. Cut the wire and strip 1 centimeter (cm) of insulation off both ends. Use the wire stripper in the kit for both tasks. You will need to prepare
     - 20-gauge wire (thicker, usually red in the kit)
       - 16 pieces, 30 cm
       - 40 pieces, 15 cm
     - 24-gauge wire (thinner, usually yellow in the kit)
       - 8 pieces, 150 cm
   
   To strip insulation from the wires, set the screw on the wire stripper so that the stripper closes far enough to cut into the insulation, but not into the wire. Clamp the notched section of the tool onto the wire 1 cm from the end and slide the tool off the end of the wire. The insulation will come off without cutting the wire. Store all wires of a given length in a labeled plastic bag.

2. **Prepare flags on motor shafts**
   - The motor’s rotation is easier to observe if a masking-tape flag is attached. Cut a small piece of masking tape for each motor. Fold the piece of masking tape over the shaft of the motor.

3. **Prepare solar cells and mark the + terminal**
   - Prepare the solar cells for use by students. Look closely at the markings on the back of the solar cell by each screw. One screw is the + terminal and the other is the – terminal. Locate the + terminal and place a blue recording dot by it. This will help students easily locate the + terminal of the solar cell. You can use a permanent pen to label the dot “+.”

   Unscrew the wing nuts on the back of the solar cell and set them aside. Unwrap the lead wires and separate them so the ends are free. Notice that the wires have + and – markings in red along the white plastic. The markings are to remind the students about the terminals on the solar cell. (There is nothing different about the wires, just the markings.) Place the eye connectors over the threaded screws as shown with the + wire coming from the positive terminal. Screw the wing nuts down to hold the wires tightly in place. Make sure the wing nuts are snug. You can also use tape to flag the + terminal wire.
4. **Plan for energy stations**
   In Investigation 4, Part 1, students engage in four different activities at learning centers. Each center has a set of interactive materials and an instruction sheet. Print or make two copies of teacher masters 15–18, *Instruction Sheet for Energy Stations 1–4*. The instruction sheets will be more durable if you put them in clear-plastic sheet protectors.

5. **Prepare mirrors**
   The mirrors come with a protective plastic film covering the reflective surface. Remove and discard the plastic film before using the mirrors. Stack the mirrors carefully in the plastic storage bags so they don’t scratch each other.

6. **Prepare tone generator**
   Install a 9-V battery in each tone generator. You will need a small- or medium-sized Phillips-head screwdriver to remove the screw securing the cover of the battery compartment. Once you have the cover off, press the battery firmly into the plastic housing.

   Before replacing the battery compartment cover, plug in the speaker wire and turn on the tone generator to make sure the battery works. The battery-compartment cover is not essential to the functioning of the tone generator.

   Note that the Phillips-head screw can be very difficult to remove. It may be necessary to use a flat screwdriver to pry the compartment cover open. You can reclose the compartment cover with a small piece of tape. That might make it easier to change the battery when necessary.
PREPARING the Kit for Your Classroom

Some preparation is required each time you use the kit. Doing these things before beginning the module will make daily setup quicker and easier.

1. **Test D-cells**
   Sixteen alkaline D-cells are in the kit. A fresh set of cells should serve one complete teaching of the module. Sometimes, however, cells do need replacement. Check the cells before each investigation. For Investigations 1, simply connect a motor to each cell. If the motor runs, the cell will serve.

   For Investigation 3, test the cells by making an electromagnet and lifting a load of the tiny washers. Specifics for this process are in Investigation 3, Getting Ready, Part 1, Step 6. Replace cells that fail the test.

   **NOTE:** D-cells that fail the test for Investigation 3 often have enough energy to light the small bulbs and run the motors. Test each cell with a motor. If possible, use the old D-cells for the first two investigations the next time you teach the module, and start the last investigation with new cells.

   Although we wholeheartedly support conservation efforts, we have found that some rechargeable cells discharge too quickly and could burn fingers if students short-circuit the cell.

2. **Inventory test objects**
   Check the bags of test objects to make sure all the pieces are present. An inventory list comes in each bag when the kit is new. If the inventory sheets are missing, make more copies from the teacher master.

3. **Check wires**
   Check to make sure there are sixteen 30-cm wires and forty 15-cm wires of 20-gauge wire (thicker) and eight 150-cm wires of 24-gauge wire (thinner). Make sure both ends of each wire are stripped. If an end has broken off, use the wire stripper to remove about 1 cm of insulation from the end.

4. **Test the tone generator**
   Test the condition of the 9-volt battery in both tone generators to make sure that you can hear a pitch when it is turned on. Change the pitch and change the volume using the control knobs.
5. **Check the circuit components for Investigation 1**

Students will work with a circuit base and a switch in this investigation and in future investigations, with a bulb holder and a cell holder. Check these components (eight of each in the kit) to make sure they are in good condition, particularly the springs. The bulbs used in the holder are #222.

![8 circuit bases]

6. **Familiarize yourself with the spring connections**

The circuit base, switches, bulb holders, and cell holders have spring connectors. Wires are connected to contact points on components by inserting the stripped end of a wire between spring coils. To do this, place a finger on the end of the spring and bend the spring sideways. This action will open spaces between the coils on the outside curve of the bend. Insert the bare end of a wire between the coils, release the spring, and the spring will hold the wire securely. Connect the other end of the wire to the next component, using the same flex-and-insert technique. The tension of the springs holds the wires in place.

The best way to insert the D-cell in the cell holder is to insert the negative (flat) side in and use the cell to push back and compress the spring. While still holding the negative end of the cell against the spring, push the positive end of the D-cell the rest of the way into the holder. Take care not to deform the springs when inserting the D-cell.

If any springs become inoperable, simply pop them off the component and renew them with a replacement spring from the kit. Make sure the spring is pushed back as far as possible to allow room for the D-cell in the holder. Students should be discouraged from removing springs.

 Colombian_Spanish | #222以外の電球をフィルタリングする方法

### Energy Module—FOSS Next Generation

NOTE

Extra springs for repairing circuit components are provided in the kit.
7. **Become familiar with types of flashlights**

There are two types of flashlights in the kit used for different purposes. Become familiar with the cells that power each flashlight and test them ahead of time.

a. Large flashlight, used in Investigation 1, Part 1, for the introduction demonstration. This flashlight uses two D-cells.

b. Small flashlights, used in Investigation 5, Part 2. There are eight of these flashlights in the kit, one for each group. This flashlight uses two AA-cells, so 16 alkaline AA-cells are in the kit. A fresh set of cells should supply two class uses of the module. Sometimes, however, cells do fall victim to enthusiastic use by students and need replacement. Check the cells in the flashlight before Investigation 5.

8. **Check the hand-crank generators**

Check each of the hand-crank generators to verify the bulb is firmly attached and functioning. The bulb for the generator is larger than the #222 used in the circuit base. (There are two extra bulbs for the generators in the kit.) Connect a motor to the generator by attaching one motor wire to the red terminal clip and the other wire to the black terminal clip. Push the white plug-in connector into the socket on the front of the hand-crank generator (below the bulb).

9. **Test the solar cells for Investigation 5**

Test the solar cells to make sure they are powering the motors before you have your students work with them in Investigation 1. Refer to Investigation 5, Part 3, Steps 6–7 of Getting Ready for directions on how to do this.

We have found that when people are having trouble with the solar cells, the two most important things to do first are to get each motor going with a battery and to lubricate the motors using a light oil, such as sewing machine oil (be sure to keep all oils out of the reach of students). Here’s a good procedure.

- Test each motor with a D-cell. Make sure the shaft of the motor is spinning smoothly while you hold the connections.
- If a motor doesn’t run smoothly, lubricate the motor using a light oil, such as sewing machine oil (be sure to keep all oils out of the reach of students).
- Connect the ends of a motor’s wires to a solar cell. Make sure that no metal parts of the wires are touching each other (this would result in a short circuit and the motor won’t work).

10. **Check large washers**

Check to make sure there are 25 large washers in each bag.
11. Plan for recording dots
Recording dots are used in Investigation 2. You need seven dots per notebook sheet.

12. Check steel balls
The steel balls can rust if they are subjected to humidity. If your equipment is stored in a high humidity environment, keep the balls in a mesh bag or other container that allows for air flow. You can remove the rust with an appropriate and safe solvent before students handle the balls.

13. Acquire different-shaped magnets (optional)
Doughnut-shaped magnets are provided in the kit for each student. There are also four bar magnets for the class.

An extension you might want to try in Investigation 2 calls for other shapes of magnets. Your school may have some different magnets as resources. Check to see what is available.

14. Plan to review safety rules
Two safety posters are included in the kit, one for science indoors, *Science Safety*, and one for working outdoors, *Outdoor Safety*. You should review the guidelines with students and post the posters in the room as a reminder. *Getting Ready for Investigation 1, Part 1*, offers suggestions for this discussion. Also be aware of any allergies that students in your class might have. Students with latex allergies should not handle rubber bands.

15. Print or photocopy notebook sheets
You will need to print or make copies of science notebook sheets before each investigation. See *Getting Ready for Investigation 1, Part 1*, for ways to organize the science notebook sheets for this module. If you use a projection system, you can download electronic copies of the sheets from FOSSweb for projection.

16. Check FOSSweb for resources
Go to FOSSweb to review the print and digital resources available for this module.

17. Plan for word wall
As the module progresses, you will add new vocabulary words to a word wall or pocket chart and model writing and responding to focus questions. Plan how you will do this in your classroom.

You may also find it beneficial to use a pocket chart to display the equipment photo cards as reference for students as they gather needed items from the materials station for each part. Print the photo cards from FOSSweb.

Energy Module—FOSS Next Generation
18. Gather books from library
Check your local library for books. Visit FOSSweb for a list of appropriate trade books that relate to this module.

19. Plan for letter home and home/school connections
You will need to print or make copies of teacher master 1, Letter to Family, for the module and of the home/school connection teacher masters for each investigation. The Letter to Family and Home/School Connections are available electronically on FOSSweb.

20. Check FOSSweb for resources
Go to FOSSweb, register as a FOSS teacher, and review the print and digital resources available for this module, including the eGuide, eBook, Resources by Investigation, and Teacher Resources, including the grade-level Planning Guide.
CARE, Reuse, and Recycling

When you finish teaching the module, inventory the kit carefully. Note the items that were used up, lost, or broken, and immediately arrange to replace the items. Use a photocopy of the materials list (the Kit Inventory List), and put your marks in the “Equipment Condition” column. Refill packages and replacement parts are available for FOSS by calling Delta Education at 1-800-258-1302 or by using the online replacement-part catalog (www.DeltaEducation.com).

Standard refill packages of consumable items are available from Delta Education. A refill package for a module includes sufficient quantities of all consumable materials (except those provided by the teacher) to use the kit with three classes of 32 students.

Here are a few tips on storing the equipment after use.

• After using the kit, package the different lengths of cut wire in separate labeled bags.
• Check bags of test objects for all 38 items.
• Make sure all the small washers are in vials.
• Check for 25 large washers in each bag.
• Store steel strips and compasses away from magnets.
• Keep the bulbs in the bulb holders.
• Make sure flashlights are turned off (and you might want to remove the cells from the small flashlights).
• Store the foam runways in their box and make sure they are not twisted.
• Inventory and bag the small items.
• Check the packaging around the mirrors. These pieces of equipment need to be treated with extra care to avoid scratches.
• Check quantity of consumables, and order more if necessary.

The items in the kit have been selected for their ease of use and durability. Small items should be inventoried (a good job for students under your supervision) and put into zip bags for storage. Any items that are no longer useful for science (particularly cells) should be properly recycled. This is a good opportunity to get students involved in making decisions about what items can be recycled.