SUGGESTED ACTIVITIES

(*Energy*)

From *Invitations to Science Inquiry 2nd Edition* by Tik L. Liem:

Activity	Page Number	Concept
Which One is Heaver?	358	Inclined Plane
Tilt a Heavy Load with One Finger	355	Levers
Is a Hammer a Lever?	356	Levers
Does a Book Have Energy?	191	Potential and Kinetic Energy
Does Water in a Lake Have Energy?	192	Potential and Kinetic Energy

From *NSF/IERI Science IDEAS Project* (See following pages):

Activity	Page Number	Concept
Follow the Energy		Energy Transfer
Kinetic Energy Transfer		Energy Transfer

From *Harcourt Science* Teacher's Ed. Unit E: (For ALL grade levels)

Activity	Page Number	Concept
Measuring Work	F65(3rd grade text)	Work
Experimenting with a Lever	F37 (4th grade text)	Levers
How a Pulley Works	F45 (4th grade text)	Pulleys
Make an Archimedes Screw	F51 (4th grade text)	Inclined Plane
Make a Screw Using a Wedge	F61 (4th grade text)	Inclined Plane
How Stored Energy is Released	F97 (5th grade text)	Potential Energy, Transfer
Water Power	F103 (5th grade text)	Kinetic Energy, Transfer
A Steam-Powered Turbine	F109 (5th grade text)	Energy Transfer

WHICH ONE IS HEAVIER?

A. Question: *Do machines reduce the input of effort necessary to move a mass?*

B. Materials Needed:

1. A 200g and a 300g weight.
2. A spring scale (500g maximum).
3. A 30cm plastic ruler and a stack of books.

C: Procedure:

1. Place three or four textbooks on top of each other.
2. Place the two weights next to the stack of books and tell students that your task is to move the weights up on top of the stack.
3. Ask students: "Which one will take more effort to move?" Place the ruler on an incline (one end on top and the other end on the table), and pull the 300g weight over the ruler up on the stack of books with the spring scale (read the effort off this scale while moving the load).

D: Anticipated Results:

Students should experience that it takes more effort to move the 200g mass straight up, than it takes to move the 300g mass along the inclined plane.

E: Thought Questions for Class Discussion:

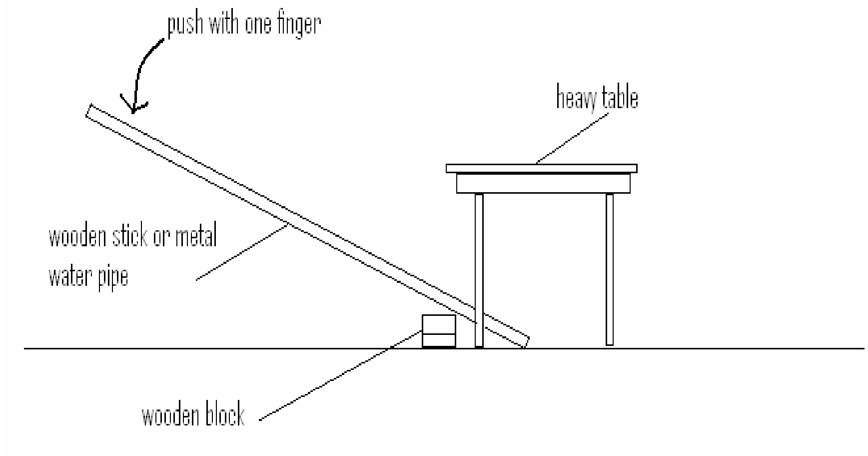
1. How much effort did it take to move the 200g weight straight up?
2. How much effort did it take to move the 300g weight over the incline on the top stack?
3. Why was the effort much less than the 300g on the incline?
4. How are the force components working on the incline?
5. What are other applications on the inclined plane?

F: Explanation:

It takes much less effort to move the 300g mass over the inclined ruler, than it takes to move the 200g mass straight up, as the incline component force (W') is much smaller. The less steep the slope of the incline, the smaller the effort. The weight on the incline (W) may be decomposed into a component perpendicular to the incline (W") and one along the incline (W'). The effort would be slightly larger than W' (to overcome friction). Other applications are: the screw, the wedge, axe, chisel, etc.

TILT A HEAVY LOAD WITH ONE FINGER

A. Question: *How can we lift heavy loads?*



B. Materials Needed:

1. A long wooden stick (shovel handle) or an iron water pipe (3-4m).
2. Two or three small wooden blocks.
3. A heavy piece of furniture.

C: Procedure:

1. Have students try to lift one side of the heavy piece of furniture to give then an idea of its weight.
2. Place the two or three wooden blocks close to the side of the table to be tilted, place the end on the long stick under the table rung and use the blocks as a fulcrum for the lever.
3. Now push the long end of the stick with one finger down (as a heavy load, a desk or a table, or a chair with a student sitting on it, may be used; make sure that a rung or horizontal bar is present, close to the bottom of the load to be lifted, to hook the lever on).

D: Anticipated Results:

Students should experience that with the lever it is possible to lift the heavy weight.

E: Thought Questions for Class Discussion:

1. What type or class of lever are we dealing with?
2. What functions as the resistance in this case?
3. What were the effort and the fulcrum in this lever?
4. What other examples can you name that are based on this class lever?

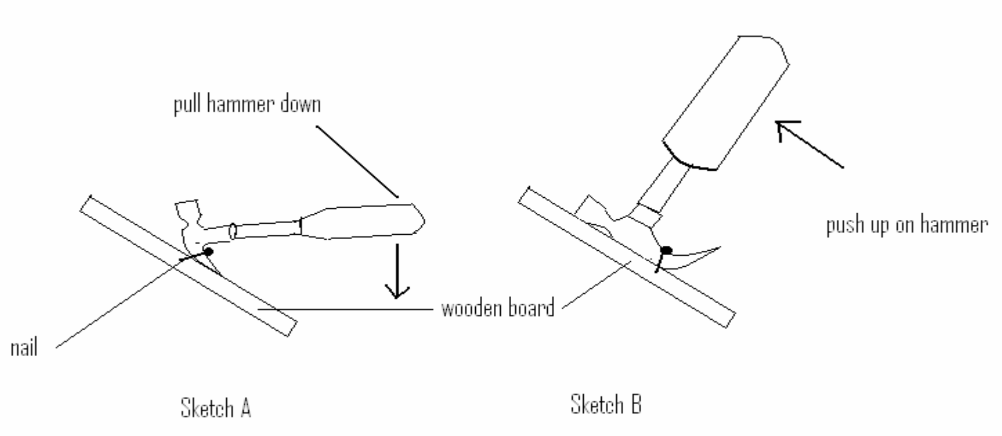
F: Explanation:

This **lever of the first class** has the **pivot or fulcrum** in between the **effort** and the **resistance.** The latter one being the heavy load (table, desk, or chair with someone seated on it) and the effort being the finger pushing on the long end of the lever, and the blocks of wood serve as the pivot or fulcrum.

Other examples applying the first class lever are: a pair of pliers, a pair of scissors, wire and chain cutters, most car jacks, teeter, totters, crowbars, etc.

IS THE HAMMER A LEVER?

A. Question: *What is the function of a lever?*



B. Materials Needed:

1. A hammer (which can be used to pull nails out).
2. A wooden board and small common nails.

C: Procedure:

1. Hammer a couple of nails into the wooden board (half way) and pull one nail out by pulling down on the hammer.
2. Pull the other nail out by pushing up on the hammer.
3. Ask students the questions listed.

D: Anticipated Results:

Students should be able to tell which method of pulling out the nail was an application of the second class lever.

E: Thought Questions for Class Discussion:

1. Which of the two methods of taking out the nails was an application of the second class lever?
2. What class lever was the other method applying?
3. Where is the fulcrum, effort and resistance located in the first method? Where are these in the second method?
4. What other examples can you name that apply the second class lever?

F: Explanation:

The best way to clarify where the forces are at work with the hammer pulling the nail, is to draw a sketch of both methods and the relationships and location of the force and fulcrum The fist method is applying the second class and the second method is applying the third class lever. Other examples of second class lever applications are: the wheelbarrow, crowbar, nutcrackers, paper cutters, two-hole punchers.

DOES A BOOK HAVE ENERGY?

A. Question: *Can energy be transferred?*

B. Materials Needed:

1. A heavy book (encyclopedia or dictionary).
2. A meter stick, pencil and eraser.
3. A high stool.

C: Procedure:

1. Place a stool on the table top and put a heavy book on the stool. Ask students: “Does the book have any energy at this position?”
2. Place the meter stick on the table top about 20-30cm in front of the stool, such that when the book is pushed off the stool, it will fall on the end ruler.
3. Insert a think pencil under the meter stick, about one-third from the end where the book will be falling on.
4. Place an eraser on the other end of the meter stick.
5. Push the book off the stool (and let it fall on the meter stick).Observe the eraser fly up!

D: Anticipated Results:

Students should observe the transfer of energy throughout the process.

E: Thought Questions for Class Discussion:

1. What kind of energy did the book have when it was lying on the stool? When it was falling on the ruler?
2. Does the book have any energy lying on the table top?
3. What type or energy did the book impart on the meter stick?
4. What kind of energy did the eraser obtain?
5. What was the original source of energy that triggered the flying eraser?

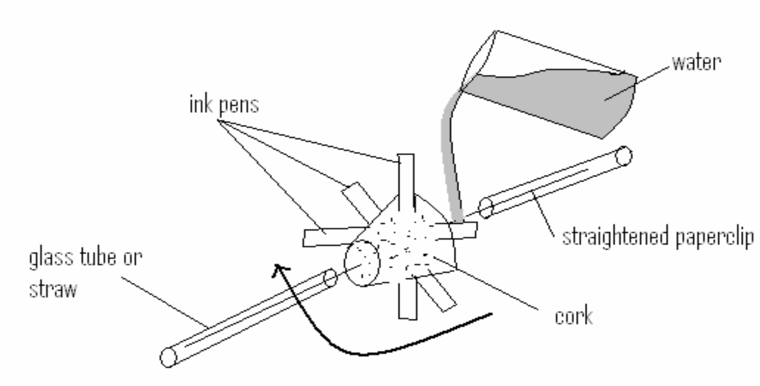
F: Explanation:

When the book was lying on the top of the stool, it had potential energy. As long as the book has the potential of falling towards the center of the earth, it has potential energy. Thus when it was lying on the table top after falling off the stool, it still possesses potential energy (to fall off the table and send another eraser flying). At the moment that the book was falling, this potential energy was transformed into kinetic energy, which was turned into mechanical energy of the moving meter stick, and this was imparted to the eraser, which obtained kinetic energy.

The original source of energy of this whole chain reaction was human muscle energy, which can be traced back to solar energy.

DOES WATER IN A LAKE HAVE ENERGY?

A. Question: *Can water be a source of energy?*



B. Materials Needed:

1. A large beaker, two short glass tubes.
2. A cork, 6 old ink pens, 2 paper clips.
3. Two clamps and two stands.

C: Procedure:

1. Push the six pens radially in the cork and set the materials up like in the sketch, so that the cork can rotate freely.
2. Hold the water-filled beaker above the cork and tell students: "This represents water in a lake up in the mountains."
3. Ask the students: "Does the water have energy? What kind?" Pour the water on one side of the cork on the protruding pens (do this over a sink of a container to catch the water).

D: Anticipated Results:

Students should observe that when water is poured on the cork, it will move it.

E: Thought Questions for Class Discussion:

1. What kind of energy does the water in the beaker have?
2. What kind of energy was moving the cork?
3. What is the resultant type of energy produced?
4. If the water in the beaker can be compared to the water in a lake, what can we compare the rotating cork with?
5. What kind of energy do we need to bring the water up in the beaker?
6. What type of energy is needed to fill up a lake with water?

F: Explanation:

The water in the beaker, held up high, is comparable to the water in a lake up high in the mountains, possessing potential energy. The energy may be released and transformed into kinetic energy by building a dam and controlling the flow of the water. By letting the flow of water pass the turbines, represented by the cork and protruding ink pens, the kinetic energy of the water is transformed into mechanical energy, which in turn is transformed into electrical energy. This last step takes place in the generators, being rotated by the turbines.

Follow the Energy

Goal: For students to see how the transfer of energy from one object to another and from one form to another is behind all motion and changes around us.

Materials:

- Energy Diagram Handouts
- PowerPoint of different scenes and objects (optional)

Procedure:

1. Distribute and discuss the energy diagram. Point out any forms of energy that students already have knowledge about, and answer questions about unfamiliar forms of energy.
2. Show images from books, videos, PowerPoint, or from any other source showing scenes where energy transfer is taking place. Images of nature, machines, and animals are all applicable.
3. For each scene, ask students to trace the energy transfers to any object from it's sources.

Journaling / Writing Extensions

1. Pick a new scene and ask students to identify and explain all energy transfers that take place.
2. Ask students to choose their favorite activity (playing sports, video games, riding a bike, etc...) and trace the energy transfers back to their origins.
3. Pick one type of energy from the diagram, and ask students to explain what the world might be like if that form of energy did not exist.

How Can Different Types of Energy Convert Between Each Other?

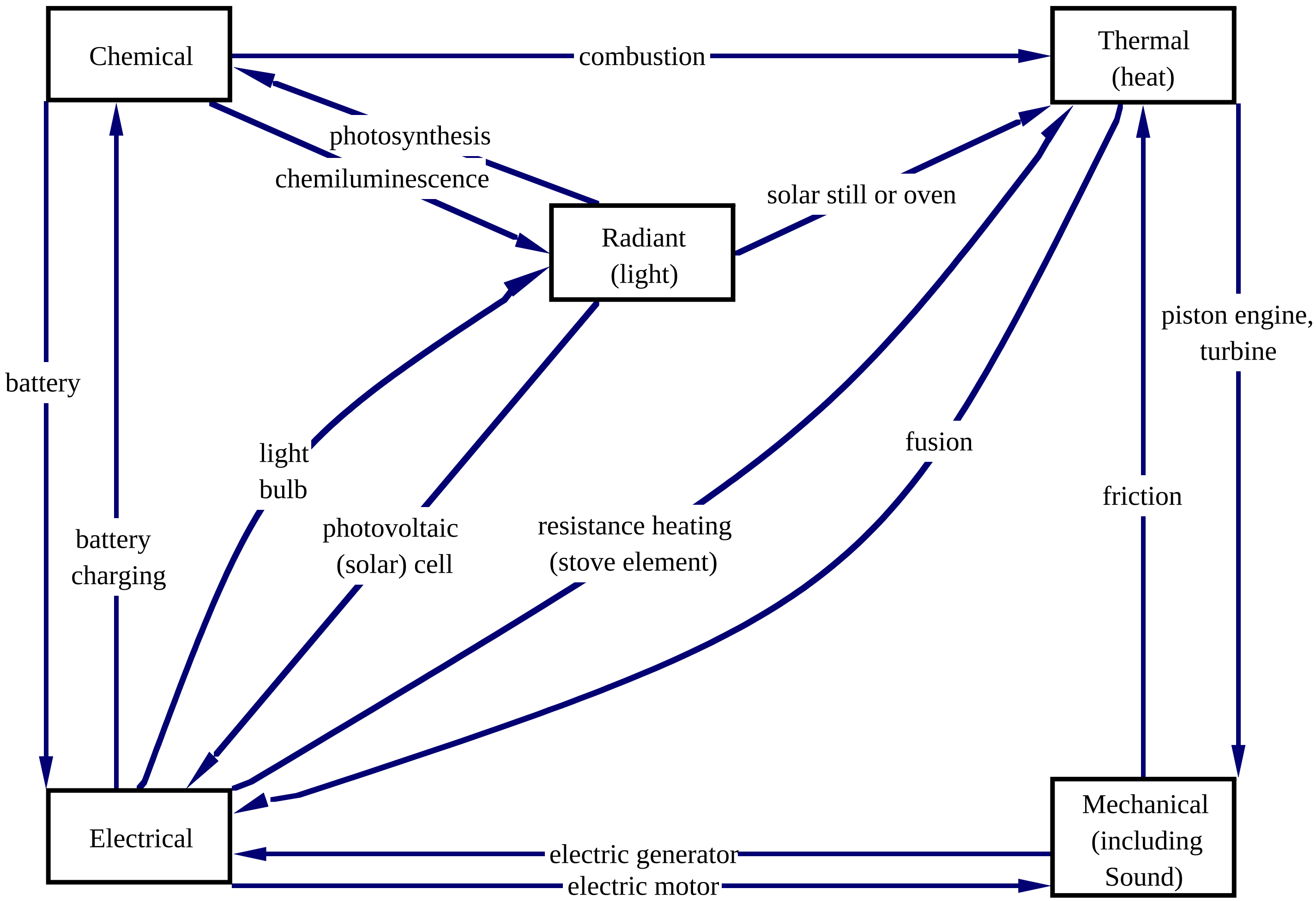


Figure 1 - Some forms of energy and their conversion pathways

NSF/IERI Science IDEAS Project Grant #0228353 v.1.0