

# Physical Science

## **DYNAMICS**

### **Newton's First Law of Motion**

Newton's first law states that every body remains in a state of constant velocity unless acted upon by an external unbalanced force. In other words, an object that is at rest will remain at rest unless another object with enough force sets it in motion. At the same time an object that is in motion, will continue to be in motion unless something acts to slow it down or stop it.

This experiment will ultimately help the children understand this concept. The washers that are stacked one on top of the other will not move. There is nothing around them that will set them in motion. If one of the children touches them or takes his finger and moves them they will not move.

On the other hand the washer that they will flick is set in motion by their finger. That washer now has no reason to stop moving unless some force around it causes it to stop. In an ideal environment where there is no such forces around then the washer would continue moving. On earth however, we have gravity, and friction. Both of these forces will ultimately take their toll and cause the washer to move.

When the washer moves towards the stack of washers it will encounter a force and that force being the washers that are not moving. The energy that is in the moving washer will be passed on to the non-moving washers which in turn will begin moving.

### **Newton's Second Law of Motion**

Newton's second law states that acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object).

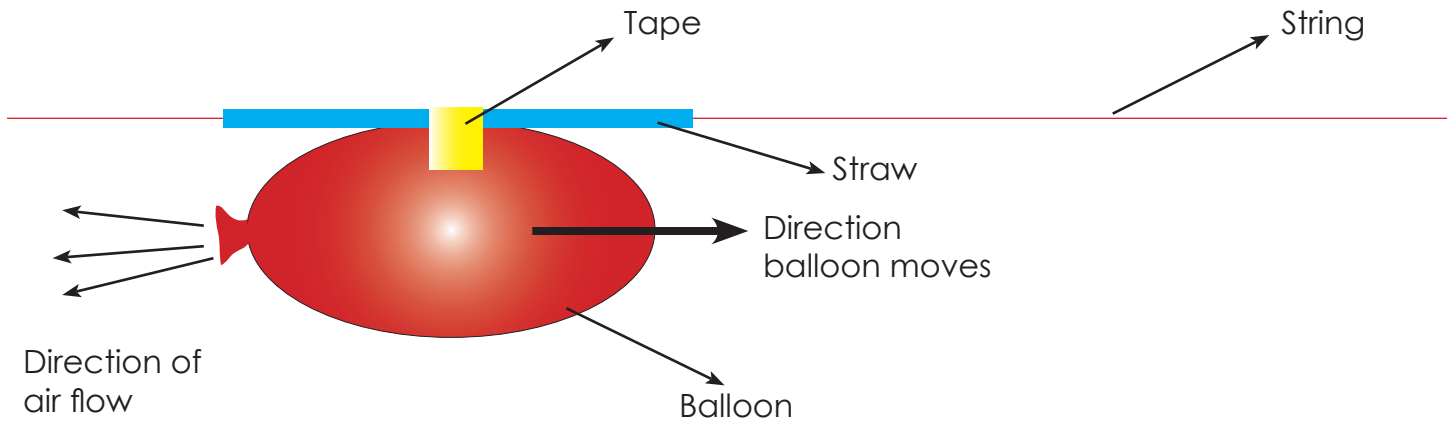
Everyone unconsciously knows the second law. Experientially we are all aware that heavier objects need more force to move the same distance as lighter objects.

This experiments helps to show just this relationship! for advanced students you can begin developing the idea that there is a relationship between these three values: Force, mass, and acceleration. The final formula being  $F=m \cdot A$  or Force equals mass times acceleration.

### **Newton's Third law of Motion**

Newton's third law states that for every action there is an equal and opposite re-action.

The idea behind this experiment is to show the children the meaning of equal and opposite re-action. To do this you will need to set up the experiment. The following figure should help.



As the air from the balloon moves out the balloon is pushed forward. Have the students experiment with the quantity of air that is inside the balloon and the distance traveled. What they will need to realize is that the more air that the balloon contains, the farther the balloon will travel. In reality the distance the balloon travels will be proportional to the volume of the air that is inside the balloon.

### What is your speed?

The speed with which we perform certain tasks often depends on the amount of practice we have given ourselves in performing these tasks. This aside, the speed with which we perform a task for the first time is a good indication of how our brain process information and in turn is interpreted by our muscular system.

The tasks that the children are asked to perform in this experiment will result in various times. However, the idea here is to understand that distance is connected to time and speed. The old formula  $d=r \cdot t$  (distance equals rate times time) will come into play here as the children discover its meaning. Please note that you can substitute speed in place of rate.

### Speed Chomps!

This experiment is similar to the previous experiment "What is your speed?"

Suggestion, you might want to divide your students and have some of them perform What is your speed while the other half can perform Speed Chomps! Once completed they can share their results with the class so that they can see the relationship that exists.

# **ELECTRICITY**

## **Changing Resistance**

Pencil lead is made of graphite. Graphite is the only non metal that is a good conductor of electricity.

In the “Old - days” lead was a mixture of graphite and the metal lead. However, today this is not the way it is. Today's pencil leads are a combination of graphite and clay. The more clay, the harder the “lead” in the pencil. Therefore, today, what we have in a pencil is the same thing found in a resistor, a composition resistor, as opposed to a metallic or wire-wound resistor. The more clay, the poorer conductor it is (this is why we advise that you use a soft pencil), the higher the resistance value. It is just that a common resistor is calibrated and the pencil lead is not. So, in a sense it IS a conductor, but only a partial conductor, which makes it effectively a resistor.

## **Discovering Electricity**

Prepare ahead of time a kit for each group of two or three students. If students work in larger groups, some will not get hands on experience. Each kit will include a brown lunch sack, one C cell battery, two insulated copper wires, one battery holder and two brass battery clips, one small flashlight bulb, and socket. All these items must be separate and in random order in the bag. The bag must be closed.

1. Give each group of students a bag and allow 10 minutes for exploration. During this time, you the teacher must remain quiet unless asked a question. The students will be very busy trying to find out what to do with the contents of the bag. Do not give any clues as to use of the contents. This is exploration time.
2. Before the 10 minutes are up some students will undoubtedly have made a simple circuit with the contents of the bag. At this time, you can stop for discussion.
3. After all students have been successful with the simple circuit, each pair must draw what they have done in their science log or on a piece of paper. Older kids will label all the parts of the circuit, etc.

## **Electrical Appliances**

Answers will vary for this activity based on what appliances each student has available at his/her home. Have the students try to understand that older appliances are usually more inefficient and cost more to operate.

## **How Temperature Affects a Solar Cell**

In this experiment the students will discover that the amount of energy that a solar panel produces is closely related to the temperature. Under ideal conditions the students will observe that the power produced by a solar panel will reach a peak. Following that peak as the temperature increases the output will begin to decrease. Usually expect to see a 40%



decrease in the amount of energy produced as the temperature increases.

## **Maximizing Solar Energy**

To get the most from solar panels, you need to point them in the direction that captures the most sun. But there are a number of variables in figuring out the best direction.

Based on the directions for this experiment you are to assume that the panel is fixed, or has a tilt that can be adjusted seasonally. (Panels that track the movement of the sun throughout the day can receive 10% (in winter) to 40% (in summer) more energy than fixed panels. This is a concept that the students will ultimately come to realize directly or indirectly. You can also ask them the question if you see that this concept is escaping them.

Solar panels should always face true south if you are in the northern hemisphere, or true north if you are in the southern hemisphere. True north is not the same as magnetic north. If you are using a compass to orient your panels, you need to correct for the difference, which varies from place to place. Search the web for “magnetic declination” to find the correction for your location.

The next question is, at what angle from horizontal should the panels be tilted? Books and articles on solar energy often give the advice that the tilt should be equal to your latitude, plus 15 degrees in winter, or minus 15 degrees in summer. These are all concepts that you can explore with the groups.

## **HEAT**

### **Hot and Cold Colors**

Hot water tends to be less dense than cold water. For this reason food coloring will usually spread much faster in hot water as opposed to cold water.

### **Hot and Cold**

Answers will vary depending on types of windows that your school has and the types of shading that you are using.

In general terms however, please note that vinyl and plastic coverings will provide a better insulation and will keep heat from reaching the beakers.

## **Energy Roller Coaster**

This experiment is used to show students potential and kinetic energy.

Remember: Potential energy is seen when the marble is at the top of the U track. At that position it has the potential of “doing” an activity or it has potential energy. When the marble is traveling down the side of the U track it is using the potential energy it had to convert it into

kinetic energy. The moment the marble passes the midpoint at the bottom of the U track the kinetic energy begins to transform into potential energy as the marble continues to climb up the opposite side of the U. When the marble turns around and moves the other way the potential energy is converted back to kinetic and so on.

Eventually the marble will come to a complete stop at the midpoint at the bottom of the track. The energy did not get lost. Instead you want to help the students understand that the energy was converted to heat (through friction) which was lost to the air around the marble.

For the conclusion of this experiment the students should begin to see that energy is transferable. Energy can move between one object and another. Note that this is what was happening with friction. (air molecules)

## **Potential and Kinetic Energy**

Work: Work is the product of force and the distance over which it moves.

Mechanical Energy: Mechanical energy is the sum of potential energy and kinetic energy.

## **Apple Energy**

Answers will vary

## **Heat Energy and Radiation**

The result that students will discover in this experiment is that darker color substances tend to gain heat and lose heat faster. The idea behind this is the amount of light that each color is capable of absorbing or repelling. Remember that white is the result of mixing all colors (wavelengths). The reason you are seeing white is because none of the colors are absorbed instead they are reflected which results in white. Black on the other hand is created because all the colors are absorbed and none are reflected. Since all colors (wavelengths) are absorbed black tends to heat up faster.

## **LIGHT**

### **Novas and Supernovas**

Answers provided

Protection from UV

UV beads can be obtained online. Simply do a search on UV beads and a number of sites will pop up. (i.e. <http://www.stevespanglerscience.com/product/color-changing-uv-beads>)

The idea behind this experiment is to get the students to realize that UV rays are often harmful. Furthermore, students should realize that UV rays are capable of penetrating a

variety of containers and shades.

## **Making the Spectrum**

This experiment will help children understand that light (as we see it or don't see it) is made of several colors. The first thing most students say when see the spectrum is "rainbow." Help the students understand that white light is white because it includes all of the colors they are able to observe in the "rainbow."

## **The Color Wheel**

This experiment is similar to the one before it. It approaches the subject of white light from a different point of view. Again the idea is to have students understand that white light is made from several colors. White itself is not necessarily a color but rather all the colors.

## **How the Brain Sees Light**

Fun activity. Explore why you see what you see. Have the students research and come up with additional activities that "play with your mind."

# **SIMPLE MACHINES**

## **Simple Machines - Levers**

Students should realize that simple machines actually cut down in the amount of work and force required to perform an action.

In general a lever uses a pivot point (referred to as a fulcrum) to reduce the force needed to lift an object through the magical property of SHARED FORCES. The force(s) applied at end points of the lever are proportional to the ratio of the length of the lever arm measured between the fulcrum and application point (where you press) applied at each end of the lever, shown through the formula  $M = Fd$  (in which "F" is the force, "d" is the distance between the force and the fulcrum, and "M" is the turning force known as "torque" or as it's sometimes called, though technically not correct, the "momentum.")

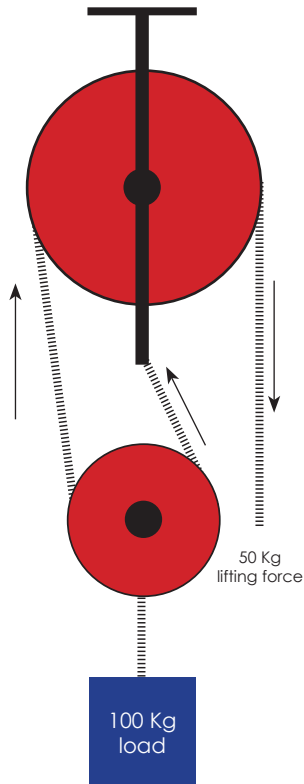
## **Simple Machines - Pulleys**

A pulley is simply a collection of one or more wheels over which you loop a rope to make it easier to lift things. Pulleys are examples of what scientists call simple machines. That doesn't mean they're packed with engines and gears; it just means they help us multiply forces. If you want to lift a really heavy weight, there's only so much force your muscles can supply, even if you are the world's strongest man. But use a simple machine such as a pulley and you can effectively multiply the force your body produces.

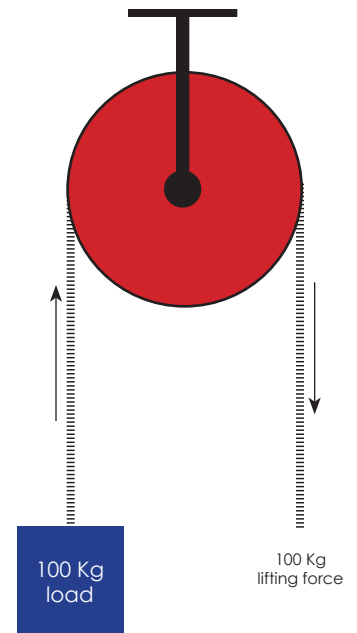
How do pulleys work?

If you have a single wheel and a single rope, a pulley helps you reverse the direction of your lifting force. So, as in the picture below, you pull the rope down to lift the weight up. If you

want to lift something that weighs 100kg, you have to pull down with a force equivalent to 100kg. If you want to raise the weight 1m into the air, you have to pull the rope a total distance of 1m at the other end.

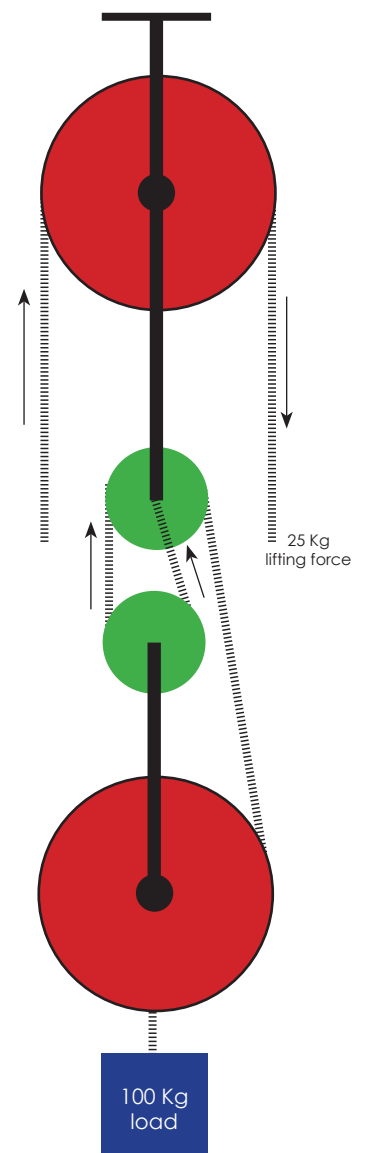


Now if you add more ropes and wheels, you can reduce the effort you need to lift the weight. Suppose you have two wheels and two ropes, arranged as in the figure below. The 100kg weight is now supported by two ropes instead of one (ignoring the loose end of the rope you're pulling with), so you can lift it by pulling with a force of just 50kg—half as much! That's why we say a pulley with two wheels and ropes gives a mechanical advantage (ME) of two. Mechanical advantage is a measurement of how much a simple machine multiplies a force. The bigger the mechanical advantage, the less force you need.



Okay, what if you use four wheels held together by a long rope that loops over them, as in the picture on the right? You can see that the 100kg weight is now supported by four ropes on the left (ignoring the end of the rope you're pulling with). That means each rope is supporting a quarter of the total 100kg weight, or 25kg, and to raise the weight into the air, you have to pull with only a quarter of the force—also 25kg. We say a pulley with four wheels and ropes gives a mechanical advantage of four. That's twice as good as a pulley with two ropes and wheels.

Woodford, Chris. (2011) How pulleys work. Retrieved from <http://www.explainthatstuff.com/pulleys.html>. Accessed (06/29/2011)





## **Simple Machines - Inclined Plane**

Inclined planes work by increasing the distance the load must be moved, thereby decreasing the force necessary to move the load. An example is pushing a couch up the platform of a moving van. A few people could probably heave the couch up into the van, although it would be difficult; the better solution is to have two people use the ramp to the van (a classic inclined plane) to lift the couch.

Based on this the longer the plank the less the rubber band will stretch.

Technology reference:

Read more: How Does an Inclined Plane Work? | eHow.com [http://www.ehow.com/how-does\\_5122555\\_inclined-plane-work.html#ixzz1Qgn2UZ3v](http://www.ehow.com/how-does_5122555_inclined-plane-work.html#ixzz1Qgn2UZ3v)

[http://www.ehow.com/how\\_5904861\\_determine-work-input-inclined-plane.html](http://www.ehow.com/how_5904861_determine-work-input-inclined-plane.html)

## **Simple Machines - Wheels**

It is obvious, and many students will quickly realize that wheels do actually decrease the amount of friction that two surfaces generate.

However, how do wheels actually do work?

A wheel is a circular device capable of rotating on its axis, facilitating movement or transportation or performing labour in machines. A wheel together with an axle overcomes friction by facilitating motion by rolling. Common examples are found in transport applications. More generally the term is also used for other circular objects that rotate or turn, such as a Ship's wheel and flywheel.

The wheel (with axle) is considered one of the simple machines and lies near the starting point of advanced human technology (advanced, that is, in comparison with even earlier mechanical innovations such as stone/bone knives and axes, tension-sprung projectiles, scoops and shovels).

When wheels are used in conjunction with axles, either the wheel turns on the axle or the axle turns in a vehicle (as in a cart) or a housing (as in a mill). The mechanics are the same in either case.

Today there are numerous examples of machines that make use of a wheel and axle. However, we can divide them into 5 main categories:

- Crank
- Flywheel
- Reaction wheel
- gyroscope
- windlass

## **Simple Machines - Screw**

Answers will vary depending on the type, size and number of threads that a screw has.

Conclusion Answers:

1. The more threads a screw has the longer the inclined plane would be.
2. Mountain roads actually go around the mountain and are often in a zig zag pattern the reason being that they are trying to implement the inclined plane machine and benefits.
3. No we cannot usually pull out a screw with our fingers. The reason why we use tools is because we would need to add an incredible amount of energy or force to undo the amount of work that the screw has performed. The tools will actually help us cut down in the amount of force that will be used and ultimately the Force.
4. Tools are often developed out of necessity. Farmers often invent their own tools and today many of the tools that we use in our everyday life were actually developed by farmers that needed to make their work easier and quicker.

The rest of the answers will be based on the experiences that each child has acquired. Therefore, answers will vary.

## **Simple Machines - Wedge**

Wedges are yet another form of an inclined plane. Have a discussion with the children in your class so that they can see the similarities and differences that a wedge has with that of an inclined plane.

# **SOUND**

## **Making a Simple Instrument**

Answers will vary

## **Listening to Sound**

Sound is transmitted by particles (atoms or molecules) in a solid, liquid or gas colliding with each other. It is a wave which is created by vibrating objects and propagated through a medium (solid, liquid or gas) from one location to another. A vibrating source can be sound coming from a drum, speaker of a radio, the mouth of a person (vocal chord), a car engine, a plane above the sky and so on. Although sound is commonly associated in air, sound will readily travel through many materials that are solid, liquid and gas.

## **Seeing Vibrations**

What is sound? Sound is a form of energy, just like electricity and light. Sound is made when air molecules vibrate and move in a pattern called waves, or sound waves.

The reason the sand bounces is because sound waves are still being transmitted and are traveling through the air molecules until they collide with the sand particles.

## **Resonance**

Answers will vary

## **Echoes**

The sound was clearer with the foam board. The reason for this is that foam will actually absorb the echo and will keep the sound clean.

This is also the reason why sound studios are lined with foam. The truth about this is that studios are not actually trying to soundproof the space. On the contrary they are trying to keep the feedback from bouncing off the walls and creating an echo.

# Materials List

Most of the materials you will need can be easily located in your classroom or at home. Most local hardware stores stock these materials as well.

1. 7-8 washers
2. Small metal car
3. 3-4 meter sticks
4. 4-5 large books
5. Tape
6. Weights or washers
7. Balloons - the long and thin kind
8. Clothespin
9. Drinking straw
10. 6 feet long piece of string
11. Tape - masking tape or Scotch tape
12. Stop watches
13. 1 Meter stick
14. Masking tape
15. Bubble Gum
16. Red food coloring
17. Same size containers (e.g., beakers, glasses, measuring cups)
18. Room temperature water, hot water, and cold water
19. Access to sunlight (outdoors preferable)
20. Water
21. White paper, scissors, and tape to cover beaker sides
22. Small pieces (the size of beaker tops) of various window coverings such as: screens, tinted shading
23. Curtain materials (may use more than one type), window blinds, vinyl window shade, glass (to represent double panes)
24. Thermometer for each type of covering
25. Two chairs
26. Masking tape
27. Yard or meter sticks
28. Metric ruler
29. 3 shooter marbles
30. One 8 feet strip of vinyl ceiling molding
31. 3 marbles (Different sizes &/or weights)
32. Inclined plane
33. Milk carton
34. Five forms of apple products to serve as visual aids:
35. Home-grown apple
36. Jar of homemade applesauce
37. Store-bought apple
38. Jar of store-bought applesauce
39. Store-bought applesauce in "snack packs"
40. Writing utensil
41. Poster board
42. Battery
43. Three leads



44. Light bulb
45. Two soft pencils
46. A brown lunch sack to contain:
  - i. One C cell battery
  - ii. Two insulated copper wires
  - iii. One battery holder and two brass battery clips
  - iv. One small flashlight bulb and socket
47. Computer with internet access
48. Electrical Appliance worksheet, and pencil for students
49. Computers that have Shockwave capabilities. If your computers don't have it, you can download it for free from the internet.
50. Graph paper
51. 1 solar cell (you can get this from Radio Shack; 2cm by 4cm)
52. 1 Digital Voltmeter (you can get this from Radio Shack; they stock different models)
53. 1 Digital indoor/outdoor thermometer
54. 1 lamp w/100 watt bulb
55. 1 shoe box
56. 2 dowels- 2.5 cm
57. 2 large bottle of airbrush propellant
58. 1 hair dryer
59. 1 pair of scissors
60. 1 large piece of plywood
61. A fan
62. Voltage Meter (you can get this from Radio Shack; they stock different models)
63. String
64. Two screws
65. Protractor
66. Transparent tape
67. Safety scissors
68. 9 straws (For each student)
69. 1 cardboard strip (2 inches X 6 inches) – For each student
70. Ticking Watch
71. Paper towel cardboard tube
72. Large cake or cookie tin
73. Sheet of plastic
74. Strong rubber band
75. Baking tray
76. Wooden spoon
77. Sand
78. String
79. Three identical weights
80. Two cardboard tubes
81. Ticking clock
82. Large cardboard (15 in. x 15 in.)
83. Pieces of fabric
84. Pieces of foam
85. Strips of pliable magnets ([www.edutc.com](http://www.edutc.com))
86. Plexiglas
87. Foam core board
88. Disk ceramic magnets

89. Teflon tape (optional)
90. Extra-fine steel wool
91. Plastic bottle full of baby oil with paper label
92. Scissors
93. 3 steel metal bars
94. 2 meters of copper wire
95. 1 9V battery
96. 2 needle nose pliers
97. 1 small glass
98. 20 grams of iron filings
99. 1 grain scale
100. Donut magnets
101. Two pieces of cardboard (about 5 x 7 cm)
102. Two 1/4- inch dowels, 7 cm or longer (pencils work fine)
103. Five or six paper clips
104. Popsicle stick, straw, any nonmetallic material
105. Strip of metal strapping tape (or a butter knife)
106. Hot glue gun
107. A small shallow dish
108. A slice of cork
109. A steel needle
110. An iron needle
111. 1/4" to 1" diameter rod or similar part to use as a fulcrum
112. Broom handle
113. Jug with a closed handle filled with sand or water
114. Twine or rope
115. Small bag filled with about 1 cup of rice or dried beans closed with a twist tie
116. Rubber band
117. Table top
118. Toy dump truck
119. A block of wood
120. Scrap lumber - at least 5 cm thick
121. Four screws - the same length with various numbers of threads
122. Screw drivers
123. Wedges of different thickness
124. Screw Drivers
125. Spectra of elements (provided with the experiment. Element spectra are provided on CD-ROM)
126. Mystery star spectra (provided with the experiment)
127. UV beads
128. Assorted empty prescription containers
129. Straight-sided glass or jar
130. A piece of card with a 1/2 inch slit cut into it
131. One sheet of white paper
132. White cardboard cut into a circular shape
133. Protractor
134. Sharpened pencil
135. Paint brushes
136. Paint:
  - i. Yellow

- ii. Green
- iii. Cobalt blue
- iv. Violet
- v. Red
- vi. Orange

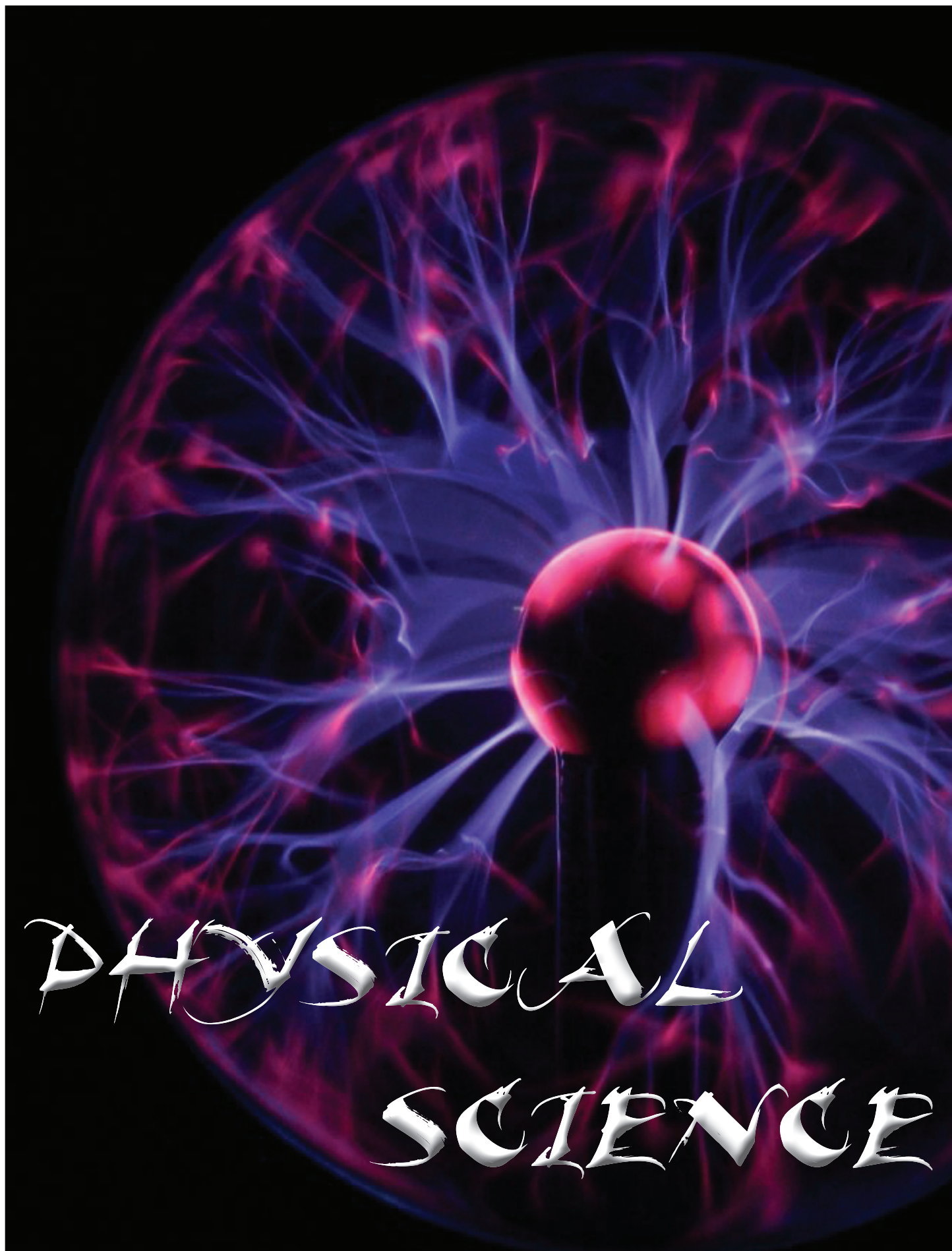
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## Home Energy Usage Survey

Families do  
this column  
together  
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Appliance	Cost Per Hour	About how many hours per week?	Cost per Week's Usage	Cost per Month's Usage	Cost per Year's Usage
Television	.04¢				
Computer	.01¢				
Stereo	.02¢				
Dishwasher	.10¢ per load	(# of loads)			
Washing Machine	.05¢ per load	(# of loads)			
Clothes Dryer	Electric: .67¢ per load Gas: .16¢ per load	(# of loads)			
Bedroom Lights	.01¢ per hour per light				
Living room Lights	.01¢ per hour per light				
Kitchen Lights	.01¢ per hour per light				
Microwave Oven	.15¢				
Oven	Electric: .11¢ Gas: .06¢				
Stove	Electric: .04¢				
Refrigerator	.02¢				
Air Conditioner	Window: .11¢ Central: .18¢				
Electric Heating System	Small Home: .12¢ Large Home: .34¢				
Gas Heating System	Small Home: .04¢ Large Home: .16¢				
Fan	.02¢				





# PHYSICAL SCIENCE

# Magnetism

## **Age**

7 years

## **Direct Aim**

To develop understanding of magnetism

## **Indirect Aim**

To prepare children for further understanding magnetism and how it relates to electricity.

## **Materials**

Nomenclature for magnetism

## **Procedure**

1. Invite the children to the lesson.
2. “Today we are going to look at what happens with magnets. Tell me what you already know about magnets.” Elicit information from the children regarding their previous experiences.
3. Present the nomenclature (M1 – M8) in sequence to give the children an overview of the history of magnetism.
4. Assign the experiments to the children.

## **Follow Up**

1. Use the research cards to help the children deepen their historical understanding of magnetism.
2. Have children make a timeline of the use of magnets.

# Simple Machines



## **Age**

7 years

## **Direct Aim**

To develop understanding of the types of simple machines

## **Indirect Aim**

To prepare children for further understanding how simple machines make work easier.

## **Materials**

Nomenclature for simple machine, 10 pencils, a book, flat surface

## **Procedure**

1. Invite the children to the lesson.
2. "Today we are going to look at simple machines. Have you ever thought how the ancient Egyptians moved those large stones to build the pyramids?"
3. "At that time, they did not have cranes to lift those heavy stones, so they used a simple machine. A machine is a mechanism that allows you to do work (*The transfer of energy from one physical system to another, especially the transfer of energy to a body by the application of a force that moves the body in the direction of the force.*) However, the work that comes out can never be greater than the effort put into the machine."

4. “Let me show you what I am talking about. Here I have a large book; now pretend that is a large, heavy stone that I need to move to the top of a pyramid. I can’t pick it up and move it because it is too big and too heavy. Here is what the ancient Egyptians did.”
5. Place the book on the flat surface and try and push it with just one finger. It may move only a little way.
6. Place the 10 pencils on the flat surface all in the same direction. Place the book on top of the pencils, and push the book with one finger again. It will move farther than without the pencils.
7. Present the nomenclature (SM1 – SM7) in sequence to give the children an overview of simple machines.
8. Assign the experiments to the children.

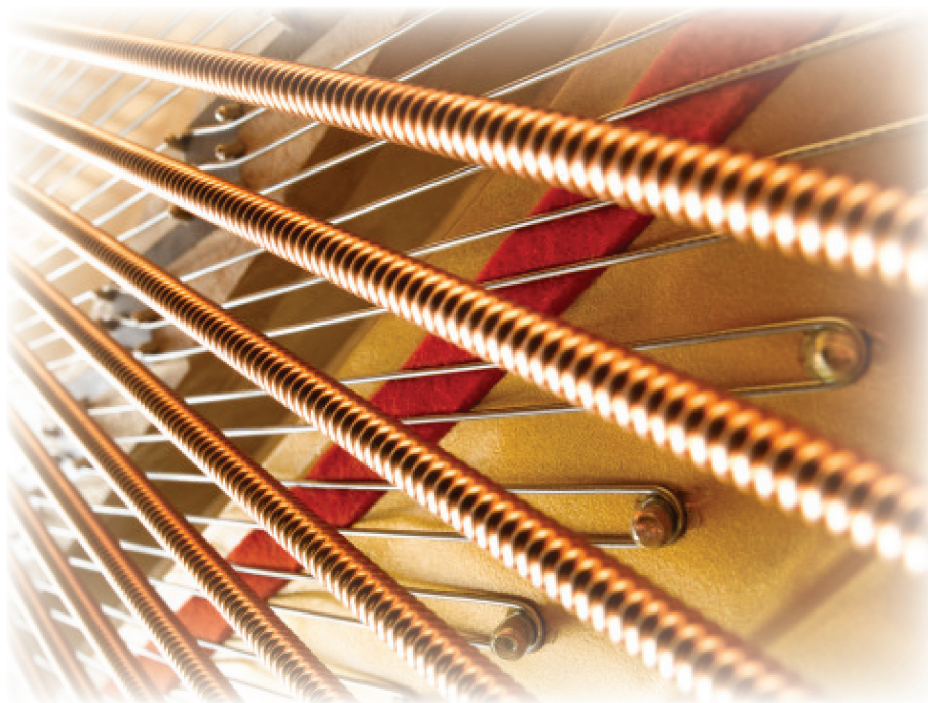
## **Follow Up**

1. Use the research cards to help the children deepen their historical understanding of simple machines.
2. Have research the use of simple machines throughout history.
3. Research Rube Goldberg and the different “machines” that he designed.





# Sound



## **Age**

7 years

## **Direct Aim**

To develop understanding of the types of sound

## **Indirect Aim**

To prepare children for further understanding how sound travels in waves to reach the ear

## **Materials**

Nomenclature for sound, metal coat hanger, string, pencil

## **Procedure**

1. Invite the children to the lesson.
2. "Today we are going to experiment with sound"
3. Take the metal coat hanger and tie two pieces of string (about 45 cm long) at the two bottom ends of the coat hanger. Have a child wrap the unattached end of string around their fingers and place their fingers in their ears.
4. Lightly tap the coat hanger with the pencil. Have the child describe what they hear.
5. The second time tap the coat hanger, but gently touch the string. Have the child describe what they hear.

6. "There must always be some material for sound to travel through to get to your ear. In this experiment it was the string and your finger."
7. "All sounds are produced by vibrations. In this case the pencil caused the hanger to vibrate, which traveled through the string and your fingers, into your ear. That is why you had problems "hearing" when I touched the string."
8. Lay out the sound nomenclature (S1-8) and introduce the terms.
9. Assign the experiments to the children.

### **Follow Up**

1. Use the research cards to help the children deepen their historical understanding of simple machines.
2. Have children make their own stringed instruments to form a band.
3. Research the wing speeds of several insects and relate that speed to the sound they make. (beetle, housefly, mosquito, and honey bee)

# Heat



## Age

8 years

## Direct Aim

To develop understanding of the types of energy

## Indirect Aim

To prepare children for further understanding of how energy is converted

## Materials

Nomenclature for heat, energy cards, energy labels, arrows, (make multiple copies of the labels, and arrows

## Procedure

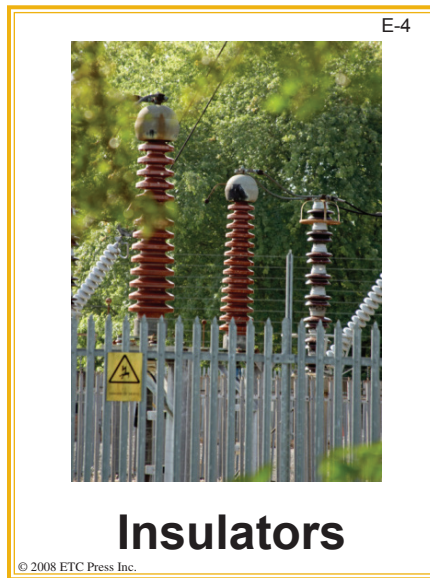
1. Invite the children to the lesson.
2. "Today we are going to look at energy."
3. Place an energy card out (light bulb) and ask which type of energy is being shown (electrical). Place the electrical label beneath it.
4. "When we turn on the light, how is this energy converted? What does it become? Place an arrow next to the electrical label.
5. Accept either light or heat. Place the label next to the arrow.
6. Place another light bulb picture out, and place an electrical energy label beneath it.

7. "A light bulb can also give out another type of energy, what could that be?" Place an arrow next to the electrical energy label.
8. Accept the other type of energy that the children give and place that energy label.
9. Continue with the other pictures and labels; show the children the conversion of the different types of energy.
10. Present the nomenclature (H1-H8) in sequence to give the children an overview of heat energy
11. Assign the experiments to the children.

## **Follow Up**

1. Use the research cards to help the children deepen their understanding of heat energy.
2. Have children draw pictures of energy conversions as they would with a food chain.
3. Have children research incandescent light bulbs and the new energy saving florescent light bulbs. How do they change the amount of heat given out?

# Electricity



E-4

Materials that do not easily transmit electricity across them are called insulators.

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## Insulators

### Age

8 years

### Direct Aim

To develop understanding of simple electrical circuits

### Indirect Aim

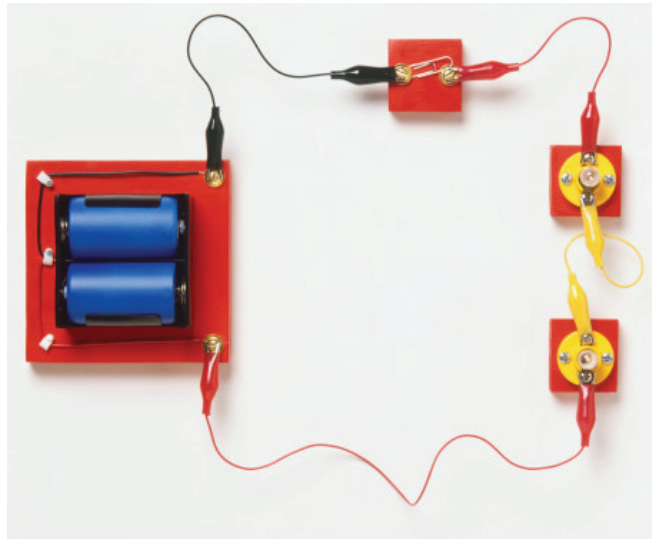
To prepare children for further understanding of electricity

### Materials

Nomenclature for electricity

### Procedure

1. Invite the children to the lesson.
2. “Today we are going to look at electricity”
3. Present the nomenclature (E1 – E8) in sequence to give the children an overview of electricity.
4. Complete experiment “Discovering Electricity” explaining how a complete circuit is necessary for the flow of electricity.



## **Follow Up**

1. Use the research cards to help the children understand the history of electricity.
2. Have the children experiment with insulators in their electrical circuits.
3. Have children build an electromagnet with 2 D cell batteries, insulated wire, and a nail. Have children experiment with how many paperclips they can pick up with a short, medium, and long piece of wire wrapped around the nail.

# Light

Light is an electromagnetic wave. Some of these waves have high energy, and some have low energy. This range of waves is called the electromagnetic spectrum. The waves in this spectrum include X-rays, microwaves, radio waves, and the waves of visible light. The waves that we can see have lower energies than microwaves and radio waves that we can't see. When you see the colors of the spectrum through a prism, you are seeing different wave lengths. The longest is red and the shortest is violet. The wave lengths, in between, make the rest of the color spectrum.



# Light



L-5

Light travels at about 186,000 miles per second through air. When it reaches glass or water, it slows down, which in turn makes it change direction. Lenses take advantage of this.

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## Speed of light

### Age

8 years

### Direct Aim

To develop understanding of the spectrum of light

### Indirect Aim

To prepare children for further understanding of how the eye and the brain perceive light

### Materials

Nomenclature for light, diffraction slide (available from [www.sciencestuff.com](http://www.sciencestuff.com) @ \$.69) dark room, light without a lamp-shade, flashlight, plastic cup with clear marbles, water

### Procedure

1. Invite the children to the lesson.
2. "Today we are going to look at light. I have a diffraction slide which is made from a piece of film that has tiny lines etched on it. These lines are equally spaced and all running in the same direction, when you look through it, the film bends the light."

3. "The different colors of light bend at different amounts, and this causes the colors to separate from each other. This is how we can see the different colors."
4. Turn off the light in the room and turn on the lamp without the lampshade. Have a child stand a few meters away from the lamp, but with the slide up to their eye.
5. "What do you see?" (It should be different bands, each with different colors) "Now just look at one of the bands of color, what do you see there?" (It should be the different colors within the band.) "Name the colors that you see in order, starting with red."
6. Turn off the lamp, but turn on the flashlight.
7. "How is the light that you see from the flashlight the same or different than the light from the lamp?"
8. Turn the slide clockwise and counterclockwise. What do you observe?
9. Fill the bottom of the plastic cup with clear marbles, and shine the flashlight up through the bottom of the cup. Through the slide, look at the marbles from the top of the cup.
10. Add water to the bottom of the cup to just barely cover the marbles. Use the flashlight to project light up through the bottom, and look at the marbles from the top of the cup.
11. "How does the light look the same or different in each of these situations?"
12. "Most object looks the way they do because light reflects off of them. However, the light passes through the glass marbles and the water, so this is why the light looked the way it did."
13. "Light not only allows you to see things, but it allows you to see color. When light shines on a object, certain properties allow that light to bounce off. Some of the light does not bounce off. We see the reflected light as color."
14. Present the nomenclature (L1-L8) in sequence to give the children an overview of light.
15. Assign the experiments to the children.

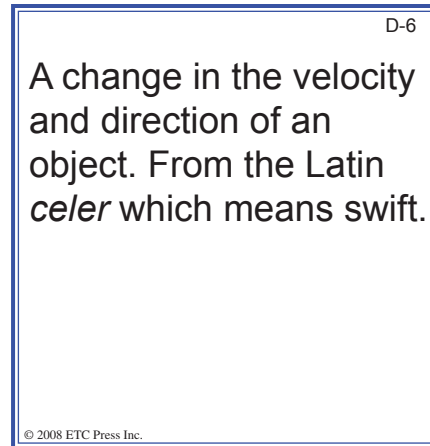
## **Follow Up**

1. Use the research cards to help the children deepen their understanding of light.
2. Have children make a periscope or a pin-hole camera.

# Dynamics

Dynamics is the study of movement, and this movement is made of different forces. It is easy to think of forces as the push and pull of our world. Everything is part of these movements and must obey certain universal laws. These are the basics of gravity, friction, centripetal and centrifugal force, and inertia. Forces are an important part of our everyday life, and these pushes and pulls affect all objects. Sometimes these forces are in balance, and when they are not, we get movement.

# Dynamics



## Acceleration

### Age

8 years

### Direct Aim

To develop understanding of the fundamental forces

### Indirect Aim

To prepare children for further understanding of universal forces

### Materials

Nomenclature for dynamics, child's skateboard (you may use a real one or the small miniature toy skateboard)

### Procedure

1. Invite the children to the lesson.
2. "Today we are going to look at dynamics. I have a skateboard here, and I am going to use it to describe different movements, because that's what dynamics is, the description of movement."
3. "There are certain forces that exist in our universe, and all objects must obey these universal laws. We can look at these forces as *pushes* and *pulls*. Let's look at this skateboard, it's just sitting there, not moving, but there are certain forces that are being acted upon it. Can you name one?"

4. "Gravity is a force that is pulling down on the skateboard; because of gravity, the skateboard stays on the ground."
5. "Now when someone gets on the skateboard, they are also being pulled down by gravity. Yet when I place my foot on the ground and push off, all of a sudden, the balanced forces are no longer balanced. This is why I get movement."
6. "What force causes the movement?" (inertia)
7. "As I am riding along on the skateboard, I have to pushing my foot on the ground, because I slow down, what force is causing me to slow down?" (friction)
8. If you have a real skateboard place a small object on the skateboard.
9. "Now, let's say that I have pushed off, and I'm going along just fine. All of a sudden, the skateboard is stopped (crash it into a wall). What happened to the object on the skateboard? What forces were being acted upon it?"
10. Present the nomenclature (D1-D12) in sequence to give the children an overview of dynamics.
11. Assign the experiments to the children.

## Follow Up

1. Use the research cards to help the children deepen their understanding of dynamics.