Objectives:

Science TEKS

3.1(A) Demonstrate safe practices during field and laboratory investigations.
3.1(B) Make wise choices in the use and conservation of resources and the disposal or recycling of materials.
3.2(A) Plan and implement descriptive investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology.
3.2(B) Collect information by observing and measuring.
3.2(C) Analyze and interpret information to construct reasonable explanations from direct and indirect evidence.
3.2(D) Communicate valid conclusions.
3.2(E) Construct simple graphs, tables, maps, and charts to organize, examine, and evaluate information.
3.3(C) Represent the natural world using models and identify their limitations.
3.4(A) Collect and analyze information using tools.
3.4(B) Demonstrate that repeated investigations may increase the reliability of results.
3.5(A) Observe and identify simple systems such as a wooden toy car.
3.5(B) Observe a simple system and describe the role of various parts.
3.6(A) Measure and record changes in the position and direction of the motion of an object to which a force such as a push or pull has been applied.

Aldine ISD Science Benchmarks

Science Processes 3.1 Investigate safely and ethically in school, field, and home.
Science Processes 3.2 Ask questions about organisms, objects, and events.
Science Processes 3.3 Identify and use senses as tools of observation to collect data.
Science Processes 3.4 Gather information using selected equipment and tools to extend the senses.
Science Processes 3.5 Measure.
Science Processes 3.8 Formulate testable hypotheses.
Science Processes 3.9 Conserve materials and resources.
Science Processes 3.11 Plan and implement investigations.
Science Processes 3.12 Isolate variables and conduct controlled experiments.
Science Processes 3.13 Record data through graphic works including simple graphs, tables, maps, and charts.
Science Processes 3.14 Identify patterns.
Science Processes 3.15 Classify and analyze information and objects.
Science Processes 3.16 Draw inferences and synthesize information.
Science Processes 3.17 Communicate problems, propose solutions, results, and conclusions in student's own words.
Science Processes 3.18 Make and defend decisions.
Science Processes 3.19 Write about science.
Science Processes 3.20 Represent the natural world using models and identify their limitations.

Newtonian Toys 1 Study systems and their parts; observe and identify simple systems and describe the role of various parts.
Newtonian Toys 2 Study force and motion; record changes in the position and direction of the motion of an object to which a force such as a push or a pull has been applied.
Newtonian Toys 3 Study energy transformation.

**TAAS Reading Objectives**
- Objective 1 Determine the meaning of words in a variety of written texts.
- Objective 2 Identify supporting ideas in a variety of written texts.
- Objective 3 Summarize a variety of written texts.
- Objective 5 Analyze information in a variety of written texts in order to make inferences and generalizations.
- Objective 6 Recognize points of view, propaganda, and/or statements of fact and nonfact in a variety of written texts.

**TAAS Mathematics Objectives**
- Objective 1.1 Compare and order whole numbers.
- Objective 1.5 Translate whole numbers.
- Objective 3.1 Recognize two- and three-dimensional figures.
- Objective 4.1 Use measurement units of time, length, temperature, and weight/mass.
- Objective 4.2 Find perimeter.
- Objective 5.1 Interpret and use charts, tables, bar graphs, and pictographs.
- Objective 7.1 Subtract whole numbers.
- Objective 7.2 Subtract money using models.
- Objective 10.1 Estimate with whole numbers.
- Objective 13.1 Evaluate reasonableness.

**TAAS Writing Objectives**
- Objective 1 Respond appropriately to the purpose/audience in a written composition.
- Objective 2 Organize ideas in a written composition.
**Background Information:** Before learning about simple machines, students should understand some of the principles that make machines work: forces, motion, gravity, friction, and inertia.

**Forces** cause things to move, stop, or change shape or direction. A force is basically a push or a pull that makes an object move. Every machine needs a force to make it work. A machine is designed so that exactly the right amount of force produces the right amount of movement where it is needed. Forces can be balanced or unbalanced. If the forces are balanced, there is no movement and consequently no work is done. Forces can also differ in size and direction. Moving an object with a large amount of mass takes more force than moving an object with a small mass. Forces can be measured in newtons and can be added or subtracted. If forces are going in the same direction, they are added. For example, if one person is pulling a heavy object while another person pushes the objects, the amount of forces each person exerts can be added together. If the people are pulling in opposite directions, the forces would be subtracted.

The **motion** of an object is the result when a variety of forces interact. A change in motion occurs if a still object moves, or an object already in motion changes speed or direction.
Gravity is a force that attracts all objects that have mass. The more mass an object possesses, the greater the force that is exerted by gravity. The force of gravitation is about 9.8 newtons per kilometer for every object on earth. Gravitational force depends on the mass of an object and how far apart the centers of the objects are. Students should understand the difference in the terms mass and weight. Mass is the measure of the amount of matter in an object. Weight is the measure of the force of gravity on an object. It can be explained by comparing the mass and weight of astronauts on the earth and on the moon. The mass of the person stays the same in both places. However, the weight of the person on the moon is about one-sixth of the weight of the same person on the earth. The gravitational pull of the moon is one-sixth less than that of the earth.

Friction is a force that keeps resting objects from moving and tends to slow motion when one object rubs against another object. Every motion on the earth is affected by friction. An object's surface area and its mass determine the amount of friction it experiences. Smooth surfaces create less friction, while rough surfaces create more friction. Heat is often produced as a by-product of friction. Friction can be reduced by using lubricants.

Inertia is the tendency of an object at rest to remain at rest or to keep moving if it is already moving. When an outside force acts on the object, there is a change in the speed or direction of movement. The more mass an object has, the more inertia it possesses.

Machines are devices that make doing work easier. Machines usually change the amount or direction of forces needed to get a job done. A simple machine has few or no moving parts. There are six kinds of simple machines: levers, screws, pulleys, inclined planes, wedges, and wheels and axles.

**Time Frame:** 5-10 minutes per day

**Materials:**
- Student Packets
- Paper bags or plastic lunch-type bags (1 for each group of 4 students)
- Crayons (for graphing)
- Pencils
- Scissors
- Heavy, thick books (dictionaries, etc.), 1 per child
- Spring scales (that measure newtons), 2 or 3 for demonstration purposes
- Corrugated paper strips for ramps, about 30 cm by 15 cm (1 per group)
- Duplicating paper
Engineering in A Bag
Daily Warm-ups

• Metal containers with lids that must be pried up to open, such as cocoa cans--be sure that the can contains nontoxic materials (1 per group)
• Flat head screwdrivers (1 per group)
• Small (30 cm by 30 cm) pieces of wood (1 per group)
• Nails, about 1 inch long (1 per student)
• Hammers (1 per group)
• Safety goggles (1 per child)
• Long board (about 4 feet)
• Large toy truck or car (must be able to remove the wheels)
• Rulers (plastic or wooden--1 per student)*
• Sponge balls (1 per group)*
• Tennis balls (1 per group)*
• Large paper clips (6 per group)*
• Rectangular, rubber erasers (1 per group)*
• Linking cubes (5 per group)*
• String (30 cm pieces--2 per student)*
• String (60 cm pieces--1 per student)*
• String (90 cm pieces--1 per student)*
• Plastic spoons (1 per student)*
• Pennies (5 per student)*
• Tape measures (1 per group of 4 students)*
• Long screws (1 per student)*
• Paper cups (1 per student)*
• Large thread spools (1 per group)*

Advance Preparation:
1. Duplicate copies of the student packets for each student.
2. Fill a bag for each group. Use the starred objects listed above to fill the bags.
3. Cut corrugated paper (boxes, etc.) into strips that measure 30 cm by 15 cm to use as inclined planes.
4. Hammer 4 nails partway in each of the small (30 cm by 30 cm) pieces of board.
5. Punch or poke 2 holes in opposite sides of each paper cup.
Week 1, Day 1

Have the students put a book on their desks. Ask, **Does the book move on its own? What do you have to do to make the book move? Are there other ways that the book can move?** Discuss how the students can make the book move by pushing it, pulling it, lifting it, etc. If no one mentions the word *force*, introduce it to the students. Have students read and answer the questions for Day 2. (Answers: 1. A push or a pull; 2. A box of books)

Week 1, Day 2

Let students look at the pictures on Day 2 of their warm-up sheets. Have them identify the forces being used as a *push* or a *pull*. After students have finished labeling the pictures, discuss their answers.

Week 1, Day 3

Briefly review units of measurement with the students. Have a student read the paragraph on Day 3 of their warm-up sheets. After students have answered the questions, discuss. (Answers: 1. centimeters; 2. newtons; 3. grams; 4. minutes)

Week 1, Day 4

Show the students a spring scale that measures newtons. Discuss the difference in measuring weight and measuring newtons. Have students look at the scales and answer the questions for Day 4. Discuss. (Answers: 1. Scale B; 2. Scale A)

Week 1, Day 5

Say, **Forces can make things move and can change the motion of objects that are already moving. Two or more forces can act at the same time. If the forces are acting in the same direction, they have a greater effect. If they act against each other, they have a lesser effect. Forces can be added and subtracted using the scientific measurement of newtons. Use what you know about forces, addition, and subtraction to answer the questions for Day 5 of your warm-up sheets.** (Answers: 1. 175N; 2. 290N)
A force is simply a push or a pull. Forces can be different in sizes and in direction. It takes a small amount of force to move a paper clip; it would take much more force to move a table.

Forces can come from up, down, left and right. Forces make things move and also stop the movement of objects.

1. In this passage, the word **force** means--
   - A direction
   - A push or a pull
   - A measurement
   - A paper clip

2. Which object would take the most force to move on a smooth surface?
   - A piece of paper
   - A measuring cup
   - A box of books
   - A soccer ball

A force is a push or a pull. Where there is a force, there is motion. Look at the pictures below. Write **push** or **pull** under each picture.
A force is a push or a pull. Just as length can be measured in units called centimeters, forces can be measured in units called newtons. Match each item below with the unit that is used to measure it.

1. length  a. minutes  
2. force  b. grams  
3. mass  c. centimeters  
4. time  d. newtons

Newton's can be measured with a spring scale. Look at the spring scales below and answer the following questions.

1. Which of the scales is holding the heaviest load? ______________
2. Which scale is holding the lightest load? ______________

Brandon and Jessica are trying to move a table. Brandon is in front of the table pulling with a force of 75 newtons. Jessica is behind the table pushing with the force of 100 newtons. What is the total force acting on the table?

- 25 newtons  
- 150 newtons  
- 175 newtons  
- 200 newtons

2. Some students are having a tug-of-war. Nelson's team is pulling with a force of 350 newtons. Nelson is pulling with a force of 60 newtons. He slips and lets go of the rope. How much force is his team pulling with now?

- 120 newtons  
- 290 newtons  
- 410 newtons  
- 700 newtons
Tell the students to rub their hands together very quickly for about 10 seconds. Ask, *How do your hands feel? Why do you think they are hot?* Introduce the word friction and discuss its meaning. Monitor as the students perform the investigation on Day 1. Discuss their results.

Help students perform the investigation. Discuss which item reached the bottom first. Have students make generalizations about what caused the objects to slide at different rates of speed.

Have students solve the problems independently. Discuss. (Answers: 1. 264 cm; 2. 7:35 p.m.)

Have the students read the paragraph silently. Review what the students know about fact and opinion. Tell the students to read the statements. Discuss whether each statement is a fact or an opinion.

Discuss how friction can be our friend or our foe. Brainstorm Ways that friction helps people and ways that it hinders us. Have students complete the chart on Day 5 of their warm-up packets.
**Engineering in A Bag**
**Daily Warm-ups**

Name ____________________________ Date __________________

**Week 2, Day 1**
Get a large paper clip and put it on top of your desk. Does the paper clip move on its own? ________ Give the paper clip a gentle push. Does it keep moving on its own? ________________ What kind of force does it take to make the paper clip move? ________________ What is the force that makes the paper clip stop? ________________

**Week 2, Day 2**
Set up a race between a paper clip, an eraser, and a linking cube. First place the paper clip, eraser and linking cube along the top edge of a large book. Then slowly raise the book to see which object will begin moving first. Which object reaches the bottom first and wins the race? ________________ Why do you think this happens? ________________

**Week 2, Day 3**
1. Jacob rolled a tennis ball 761 cm on a smooth, tile floor. When he rolled the same ball on a carpeted floor, it only went 497 cm. How much farther did the tennis ball go on the tile floor than on the carpeted floor? Mark your answer.
   - 336 cm
   - 264 cm
   - 1,258 cm
   - 111,511 cm

2. Kristen was reading a book about friction and its effect on various objects. She started reading at 7:05 p.m. If she read the book for 30 minutes, at what time did she stop reading the book? Mark your answer
   - 7:35 p.m.
   - 6:35 p.m.
   - 6:05 p.m.
   - 8:05 p.m.
Scientists look at the world around them, collect facts, and develop ideas about the world based on those facts. They try to separate scientific facts from personal beliefs or opinions.

Here are some statements about friction. Tell whether each statement is a fact or an opinion. Be ready to explain your answer.

(A) Friction is a force that works on objects to slow down and stop their movement.

(B) Friction is the most important force on the earth.

(C) Friction causes heat.

(D) Friction is a more important force than gravity.

Friction, caused by two surfaces rubbing together, fights the motion of objects. Slide a book across your desk with one finger. The book and the table rub together making your work harder. Friction can be helpful to us or not helpful when we are doing work. Without oil in a car engine, friction destroys it. Without friction between the tires and the road, you couldn't stop the car. Fill in the box below to show how friction can help or hinder people.

<table>
<thead>
<tr>
<th>HELPS PEOPLE</th>
<th>HINDER PEOPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example--car brakes</td>
<td>Example--hard to push box on floor</td>
</tr>
</tbody>
</table>

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
**Week 3, Day 1**

Give one student a sponge ball and have him/her drop the ball. Discuss what happens. Ask, *Why does the ball fall to the floor? Why doesn't it float up to the ceiling?* Write the word gravity on the board. Let students infer what the word gravity means based on the ball dropping to the floor. Have students complete the activity for Day 1 and discuss.

**Week 3, Day 2**

Tell the students they need a piece of string (30 cm long), a paper clip, a ruler, and 2 books that are the same height. Remind students of what they learned about gravity the day before. Ask, *Do hanging objects always point in the same direction?* Have students perform the investigation for Week 3, Day 2. Discuss--gravity is a force that pulls objects toward the center of the earth.

**Week 3, Day 3**

Introduce the term *center of gravity* to the students. Ask them to think about what they believe the term means. (All objects have a point where they are held in balance by the force of gravity. This balancing point is called the center of gravity because it is the place where the whole weight of the objects seems to center.) Tell the students to balance a plastic spoon on one finger. Say, *Something is balanced when all the forces pushing and pulling on it cause it to stay still. Put a penny in the bowl of the spoon and try to balance the spoon again. Is your finger in the same place? Did the center of gravity change?* Have students read the passage for Week 3, Day 3, and answer the questions. (Answers: 1. Balanced; 2. Center of Gravity)

**Week 3, Day 4**

Ask students if they have seen pictures of how the astronauts who landed on the Moon seemed to bounce as they walked. They bounced because the force of gravity on the moon is less than the force of gravity on the Earth. The Moon has a relative surface-gravity value of about 0.17 compared with Earth's value of 1.0. If a planet's surface-gravity is less than Earth's, an object would weigh less than on Earth. If it is greater than Earth's, the object would weigh more than on Earth. Have students solve the problems for Day 4. Discuss as time allows. (Answers: 1. 158 pounds; 2. 94 kilograms)

**Week 3, Day 5**

Review the effects of the earth's gravitational force. Read the writing prompt to the students. Discuss as needed. Let the students write about their imaginary planet. Share stories, if time and interest permit.
Week 3, Day 1  Gravity is a force that pulls objects toward the center of the earth. If you dropped a tennis ball and a sponge ball at the same time, would one ball fall faster than the other? __________________________________________
Why or why not? __________________________________________
Try it and see. What happened? __________________________________________
Try the investigation with a long pencil and a short pencil. Did you get the same results? ____________ Why do you think this happened? __________________________________________

Week 3, Day 2  Tie a paper clip to one end of a 30 cm piece of string. Tie the free end of the string to the center of a ruler. Stand 2 books about 25 cm apart on your desk or table. Set the ends of the ruler on the books so that the paper clip hangs down. Look at the position of the string and the paper clip. Make a sketch or picture showing what the system looks like in the space below. Now, hold one end of the ruler, and raise it about 10 cm above the top of the book. Observe the paper clip and draw a second picture showing how the system looks now.

Week 3, Day 3  When something is at equilibrium, or balanced, all of the forces pushing and pulling on it cause it to stay still. This balancing point is called the center of gravity. If you balance a spoon on one finger, the center of gravity is the one place where all of the gravitational forces pulling on it make it balance. The place where your finger is under the spoon is the support point. This is the rule for balancing things: An object balances whenever the support point is directly, under, over, or on the object's center of gravity.
1. In this passage, the word equilibrium means--
   ○ centered
   ○ gravity
   ○ forces
   ○ balanced

2. The best title for this passage would be
   ○ Objects
   ○ Center of Gravity
   ○ Science
   ○ Using Your Fingers

Page 5
Objects have weight because gravity pulls them toward the center of the earth. The greater the pull of gravity on an object, the more it weighs. Use what you know about gravity to solve the problems below.

1. Bill, an astronaut, weighs 190 pounds on the earth. Because the force of gravity on the moon is less than that of the earth, Bill weighs about 32 pounds on the moon. How much more does Bill weigh on the earth than on the moon? Mark your answer.
   - 158 pounds
   - 162 pounds
   - 222 pounds
   - 232 pounds

2. An object on Jupiter weighs a little more than twice as much as the same object on Earth. If the object weighs 40 kilograms on the Earth, which is a reasonable weight for the same object on Jupiter? Mark your answer.
   - 38 kilograms
   - 50 kilograms
   - 362 kilograms
   - 94 kilograms

Imagine that you are on a planet with a much stronger gravitational pull than the earth. On the lines below write what would be hard for you to do. Could you walk? Run? Eat? Could birds fly? Could plants grow? Write down how your body might change to work well on the planet.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Page 6
Assign the members of each team one of the following jobs: (1) Assembler--This person assembles the inclined planes for the investigation. (2) Measurer--This person measures the distances that the marble travels. (3) Slider--This person releases the marbles to slide down the inclined plane. (4) Materials Manager--This person gets and puts away the necessary materials. Tell the students to perform the investigation as stated on the warm-up sheet. Discuss their results as time permits.

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Have the students answer the questions. Discuss. (Answers: The variable was the height of the ramp. The students should conclude that the height of an inclined plane will affect the distance that an object rolling down the ramp will travel.)

Have the students read the passage. Tell them to answer the questions. Discuss. (Answers: 1. A pulley makes our work easier. 2. Inclined planes)

Discuss the graph with the students. Have them write the numbers each bar represents at the top of the bars. Tell them to answer the questions. Discuss. (Answers: 1. 55 cm. 2. 30 cm)
**Week 4, Day 1**

You will need 3 thick dictionaries, a piece of cardboard, a large marble, and a tape measure. Stack the three dictionaries one on top of each other. Make an inclined plane by leaning the cardboard strip against the edge of the books. Measure the height of the stacked books. Write this measurement in the chart below. Roll the marble down the ramp 3 times and record how far past the ramp the marble travels each time.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Height of Inclined Plane</th>
<th>Distance Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td></td>
<td></td>
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</tbody>
</table>

**Week 4, Day 2**

Your group will need 1 thick dictionary, a cardboard strip, a large marble, and a tape measure. Make an inclined plane by leaning the cardboard against the edge of one book. Measure the height of the book, and repeat the investigation, rolling the marble 3 times. Record your data in the chart below.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Height of Inclined Plane</th>
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</tr>
<tr>
<td>Three</td>
<td></td>
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</tbody>
</table>

**Week 4, Day 3**

Think about the investigations you did on Day 1 and Day 2. What was the variable (the thing you changed) in these investigations? ____________________

What conclusions can you draw from these investigations? I think ____________

because ____________________________________________
**Week 4, Day 4**

An inclined plane is an example of a simple machine. It is a flat surface that is raised at one end. It is often easier to push something up or down an inclined plane than it is to lift the object the same distance, because less force is needed. Another name for an inclined plane is ramp.

1. Which of these is NOT a fact from the passage?
   - ○ An inclined plane is a flat surface.
   - ○ A ramp is also an inclined plane.
   - ○ A pulley makes our work easier.
   - ○ An inclined plane is raised at one end.

2. What is this passage mostly about?
   - ○ Inclined planes
   - ○ Simple machines
   - ○ Forces
   - ○ Work

**Week 4, Day 5**

The graph below shows how far a ball rolled after coming down an inclined plane. Use the graph to answer the questions.

![Graph showing the distance a ball traveled for different heights of ramps.]

1. About how far did the ball travel from a height of 20 cm? Mark your answer.
   - ○ 50 cm
   - ○ 55 cm
   - ○ 70 cm
   - ○ 90 cm

2. Which is the best estimate of how many more centimeters the ball traveled from a height of 50 cm than a height of 20 cm? Mark your answer.
   - ○ 10 cm
   - ○ 20 cm
   - ○ 30 cm
   - ○ 40 cm
Week 5, Day 1
Give each student a piece of duplicating paper. Tell them to use a ruler to draw a diagonal on the piece of paper. Then cut the paper along the diagonal. Ask, What shape is each part of the piece of paper now? (triangles) What simple machine does this remind us of? (an inclined plane) Tell the students to place the two triangles together, matching the right angles. Tape or glue the two pieces together. Explain that this double inclined plane is called a wedge. Have them read the passage about wedges and answer the questions. (Answers: 1. A ramp. 2. A saw)

Week 5, Day 2
Review what a wedge is and what its uses are. Have students solve the problems. Discuss. (Answers: 1. 24 in 2. 35¢)

Week 5, Day 3
Accept answers that make sense and the students can justify. For example: A wedge and an inclined plane both incline or lean. They are both types of simple machines. They help us do work. Etc.

Week 5, Day 4
Give each student a screw to observe. Tell the students that a screw is a simple machine that is made from an inclined plane. Have each student take the point of a pencil and follow the thread of the screw from the tip to the top. Ask, Do you see the inclined plane constantly curving up around the central shaft? How do you think screws are used? Give each group of 4 students a sheet of duplicating paper. Have them fold the paper in half in a hamburger fold. Tell them to cut the paper in half along the fold line. Then tell them to use a ruler to draw a diagonal on the rectangle. Cut the rectangles along the diagonal line. Have them follow the directions for Day 4 to make their model of a screw.

Week 5, Day 5
Have students solve the problems for Day 5. Discuss. (Answers: 1. Triangle 2. Cone 3. 6 Threads)
A wedge is a simple machine formed when two inclined planes, or ramps, meet to make a sharp edge. Wedges are used to raise an object or to cut and break things apart. The force is placed on the point where the sharp edges meet, causing the object to be cut into two parts. For example, when a door wedge is jammed under a door, it raises the door slightly and exerts a strong force against it. Some other examples of wedges are knives, axes, scissors, saws, and nails.

1. An inclined plane may also be called a--
   - ○ A wedge
   - ○ A ramp
   - ○ A pulley
   - ○ A wheel

2. Which of the following is an example of a wedge?
   - ○ A rope
   - ○ A saw
   - ○ A wheel
   - ○ An object

1. A wedge is shaped like the triangle below.

```
6 in.  10 in.
  
  8 in.
```

What is the perimeter of the wedge? Mark your answer.

   - ○ 14 in.
   - ○ 16 in.
   - ○ 18 in.
   - ○ 24 in.

2. Buddy had 80¢. He bought a wedge for 45¢ at a hardware store. How much money did Buddy have then? Mark your answer.

   - ○ 50¢
   - ○ 45¢
   - ○ 35¢
   - ○ 30¢
**Week 5, Day 3**

How are a wedge and an inclined plane alike? Name three ways that a wedge and an inclined plane are alike.

(A) ______________________

(B) ______________________

(C) ______________________

**Week 5, Day 4**

Use a dark crayon to color a line about 1 cm wide on the longest side of the triangle. Roll the paper around a pencil, beginning at the shortest side of the paper with the colored line facing out. Tape the end of the paper to keep it from unrolling. This is another way to see that a screw is really an inclined plane wrapped around a shaft, or pole.

1. A wedge is a kind of simple machine. Which shape below is most like a wedge? Mark your answer.

2. A screw is a kind of simple machine that is shaped like a cone. Which shape below is a cone? Mark your answer.

3. Mr. Pat was using some screws to put up student art work. One screw had 24 threads. The other screw had 18 threads. How many more threads does the longer screw have than the shorter screw? Mark your answer.

  - 6 threads
  - 14 threads
  - 42 threads
  - 312 threads
Week 6, Day 1

Have the students perform the investigation independently. Discuss. (Answers may vary. Possible answers may be: The end with the penny goes down and touches the table; the end without the penny sticks up in the air. You can balance the ruler again by adding another penny to the other end. You can balance 2 pennies to one penny by moving the two pennies in closer to the fulcrum-the eraser.)

Week 6, Day 2

Have students read and discuss the paragraph about levers. Tell them to label the parts of the lever. (Answer:

\[
\text{force} \quad \text{bar} \quad \text{load} \quad \text{fulcrum}
\]

Week 6, Day 3

(Students need to wear safety goggles when performing this investigation. Give each group a metal container with a lid that must be pried up to open. Make sure the cans contain nontoxic materials. Have students try to remove the can lid using only their bare hands. Then instruct them to use a screwdriver as a lever to do the same job. Guide a discussion of what happened by asking, \textit{Is it possible to open the can with just your hands? Did the lever make the job easier? When you use the screwdriver to open the can, what is the fulcrum of the lever? The load? The force?} Have the students try to remove the nails from the boards with their bare hands, then using a hammer. Discuss. Have them write a brief paragraph explaining how they use levers in their daily life.

Week 6, Day 4

Have students solve the problems. Discuss. (Answers: 1. Wheelbarrow carrying a load of dirt and A batter hitting baseball 2. Kilogram)

Week 6, Day 5

Ryan could make a lever to help him lift the book. Monitor as the students make their own lever system to lift a book.
You need a ruler, 3 pennies, and a square eraser to perform this investigation. Balance the ruler on the eraser so that neither end of the ruler is touching the table. Put a penny on one end of the ruler. What happens? How can you make the ruler balance again without taking the penny off? Put 2 pennies on one end and 1 penny on the other end. Does the ruler balance? How can you make it balance?

A lever is a simple machine used to lift or move objects. The arm or bar is the part that moves. The fulcrum supports the arm, but does not move. The load is the object that is being moved or lifted. The force is applied to the lever to make the object move. Label the parts of the lever below. Use the words bar, fulcrum, load, and force.

Levers help us in many ways. Write a paragraph telling about some levers you use every day. Tell how they make your work easier. (Remember, some examples of levers are seesaws, crowbars, scissors, pliers, wheelbarrows, nut crackers, shovels, brooms, and tweezers.)
Use what you have learned about levers to answer the questions below.

1. Which of these are examples of levers?
   - A girl flying a kite
   - A pair of scissors cutting a piece of paper
   - A wheelbarrow carrying a load of dirt
   - A batter hitting a baseball

2. A lever can be used to lift a heavy rock. Which unit could be used to measure the weight of the rock? Mark your answer.
   - meter
   - liter
   - kilogram
   - hour

Christopher gave Ryan a rectangular wooden block, a wooden ruler, and a heavy book. He told Ryan to lift the book without using his hands. What simple machine could Ryan make to help him lift the heavy book, using only the ruler and the wooden block? ______________

Use a ruler and a block to lift a book yourself. How did you do it? Draw a picture to show how you did it.
**Engineering in A Bag**  
**Daily Warm-ups**

**Teacher's Guide, Week 7**

**Week 7, Day 1**  
Show students a toy car or truck from which the wheels have been removed. Roll it on the floor or a table top. Ask students what they think is missing from the car or truck. (Wheels) If they don't bring up axles, too, make sure you include them in the discussion. Ask the students if they think the toy will roll farther with or without the wheels, or the same distance with or without wheels. Encourage students to plan and implement an investigation to discover if wheels help the car travel farther. (Make an inclined plane with the long board. Let the car roll down the plane without wheels three times, measuring the distance it travels each time. Repeat after putting the wheels back on.) Discuss.

**Week 7, Day 2**  
Have the students solve the problems using the table from Day 1. Discuss. (Answers will vary according to the results of Day 1's investigation. 5. A wheel is round. All wheels are round. Not all round things are wheels. Answers will vary.)

**Week 7, Day 3**  
Have the students read the passage and answer the questions. Discuss. (Answers: 1. A doorknob; 2. A doorknob is a simple machine that makes our work easier. 3. Answers will vary.)

**Week 7, Day 4**  
Review what the students know about wheels and axles. Have them list 6 different examples of wheels and axles they can find in the classroom or their homes.

**Week 7, Day 5**  
Discuss gears with the students. Have them tell how gears and wheels and axles are alike.
Write down the data from your class investigations.

**Week 7, Day 1**

<table>
<thead>
<tr>
<th></th>
<th>Without Wheels</th>
<th>With Wheels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Week 7, Day 2**

Use the chart above to answer the questions below.

1. Put the distances the car or truck rolled without wheels in order from least to greatest.

2. Put the distances the car or truck rolled with wheels in order from least to greatest.

3. What is the difference between the least distance the car or truck traveled without wheels and the greatest difference the car or truck traveled without wheels?

4. What is the difference between the least distance the car or truck traveled without wheels and the greatest difference the car or truck traveled with wheels?

5. What is the shape of the wheel on the car? ____________ Are all wheels this shape? ____________ Are all round things wheels? ________________
   Can you think of something round that is not a wheel? ________________
A doorknob is a simple machine you use every day. It is a wheel and axle. The wheel is connected to the axle. The axle is a center post. When the wheel moves, the axle does, too. Opening a door by turning the axle with your fingers is very hard. By turning the wheel, or doorknob, you use much less force. The doorknob turns the axle for you. The doorknob makes it easy because it is bigger than the axle. You turn the doorknob a greater distance, but with much less force. A doorknob may not look like a wheel and axle, but look at the path it makes when it is turned. The path makes a circle like a wheel.

1. The word wheel in this passage means--
   - An axle
   - A doorknob
   - A tire
   - A force

2. What is the main idea of this passage?
   - Simple machines make our work easier.
   - A wheel is bigger than an axle.
   - The path of a doorknob is a circle, just like a wheel.
   - A doorknob is a simple machine that makes our work easier.

3. Why do you think the steering wheel on a large truck is bigger than the steering wheel on a small car?

Make a list of 6 different wheels and axles you can find in your classroom or your house.

1. ____________________________  2. ____________________________
2. ____________________________  4. ____________________________
3. ____________________________  5. ____________________________
5. ____________________________  6. ____________________________

Gears are "toothed" wheels that work together to regulate speed in machines. How are gears and wheels and axles alike? Name three ways that wheels and gears are alike.
Monitor as students construct and test their simple pulleys. Discuss as desired.

Assign students the following jobs: (1) Construction Supervisor--this person puts the system together. (2) Materials Supervisor--this person gets out and puts away the materials needed for the investigation. (3) Measuring Supervisor--this person makes sure the materials are the correct length. (4) Record Supervisor--this person asks and answers questions for the group and records any information. Monitor as students construct and test their pulley systems. Discuss.

Assign students the same jobs as for Day 2 or give each student a new job. Monitor as students perform the investigation. Discuss and compare their data. Draw conclusions as desired.

Have students solve the problems. Discuss. (Answers: 1. 807; 2. 700 pounds; 3. 260 cm)

Monitor as students sketch and label the six simple machines.
Name __________________________ Date ____________________

**Week 8, Day 1**
Take a 30 cm piece of string and tie an end in one of the holes in your paper cup. Tie the free end to the other hole in the cup. Take the 90 cm piece of string and tie it in the middle of the string handle. Tape the other end of the string to a pencil. Put 5 pennies in the cup. Hold the ends of the pencil and spin the pencil towards you. What happens to the "bucket"? ______________ This is a kind of simple machine called a pulley. What do you think might be some uses for a pulley? ______________

**Week 8, Day 2**
A pulley is a lifting device that helps lift heavy objects or raise objects up in the air. You need a 60 cm piece of string, a thread spool, some tape, and a "bucket" from yesterday's investigation for each group. Pull the 60 cm piece of string through the center of the spool so that the spool is in the middle of the string. Tape one end of the string going through the spool to a desk or table. Tape the other end to a different desk or table so that the spool is suspended between the two desks or tables. Put your "bucket" on the floor and place 5 pennies in the bucket. Make a pulley system by looping the attached string over the spool. Add more string to the free end if it is not long enough to reach. Lift the bucket off the floor by pulling the string downward against the spool. (Be sure your spool string is taped securely!!!) Let each person have a turn lifting the bucket.

**Week 8, Day 3**
Set up the same pulley system that your group made yesterday. Before you loop the long string over the spool, use a tape measure or ruler and a marker to mark the string at 5 cm intervals. Lift the bucket slowly. Have the recorder fill in the chart below to show how far the string moves as the bucket is lifted.

<table>
<thead>
<tr>
<th>Distance Bucket Lifted</th>
<th>Distance String Pulled</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 cm</td>
<td></td>
</tr>
<tr>
<td>20 cm</td>
<td></td>
</tr>
<tr>
<td>30 cm</td>
<td></td>
</tr>
<tr>
<td>40 cm</td>
<td></td>
</tr>
</tbody>
</table>
1. Mr. Donaldson dug a water well on his farm. He used a pulley and a rope to get water out of the well. The rope was eight hundred seven feet long. Which number is eight hundred seven? Mark your answer.

   ○ 87
   ○ 870
   ○ 807
   ○ 800,007

2. Mr. Donaldson took two cows to the cow auction. He had to use a pulley to lift the cows into his trailer. The first cow weighed 231 pounds. The second cow weighed 484 pounds. Which is the best estimate of how many pounds he lifted altogether? Mark your answer.

   ○ 700 pounds
   ○ 500 pounds
   ○ 400 pounds
   ○ 200 pounds

3. Mr. Donaldson has a flagpole on his farm. The flagpole has a pulley to lift the flag up the pole. The flag he raises is a rectangle. The flag is 80 cm long and 50 cm wide. What is the perimeter of the flag? Draw a picture to help you solve this problem. Mark your answer.

   ○ 130 cm
   ○ 230 cm
   ○ 260 cm
   ○ 290 cm

Week 8, Day 5

Draw a sketch of each of the six simple machines. Label each sketch.
Have the students read the passage and answer the questions. Discuss. (Answers may vary. 1. The elevator works with a pulley system. 2. The wheelchair uses a wheel and axle. 3. The ramp was an inclined plane. 4. He was able to walk again.)

Have the students answer the questions. Discuss. (Answers: 1. A scale. 2. Josie would be closer to the fulcrum, because the heavier weight needs to be closer to balance the lighter weight.)


Answers will vary. Discuss.

Have students complete the crossword puzzle.

Answers:

Across
1. Compound machine
2. Fulcrum
5. Gravity
6. Machine
8. Wheel and axle
9. Simple machine

Down
2. Pulley
3. Inclined Plane
4. Force
7. Levers
Read the following passage and answer the questions that follow.

Machines That Make a Difference

Chuck fell down while he was rollerblading and broke his leg. He had to stay in the hospital for a few days. One day Chuck was sitting in a wheelchair in the hall. A nurse walked by and noticed that Chuck was looking kind of sad. "What's the matter, Chuck?" she asked. "I can't get to the candy machine up the stairs in this wheelchair," Chuck explained.

"Oh, that's no problem," the nurse said. "Around the corner, there's a wheelchair ramp that you can use to get up there. A wheelchair ramp is an inclined plane. You have to go a little farther when you use it, but using it is a lot easier than trying to pull yourself up the stairs. There is also an elevator that you can use to go to other places in the hospital. An elevator is a compound machine that goes up and down by a pulley system."

Chuck thanked her and pushed himself up the ramp. He used the elevator to go visit other floors in the hospital. He enjoyed rolling around the hospital so much that he did it every day until he went home. After a few months, Chuck's leg was completely healed and he was able to walk again.

During his hospital stay, Chuck used the three simple machines below. After each machine, tell what he used in the hospital that was an example of each and how he used it.

1. Pulley

2. Wheel and axle

3. Inclined Plane

4. What happened after Chuck's leg was healed?
   - He went upstairs in his wheelchair.
   - He was able to walk again.
   - He broke his leg.
   - He talked to the nurse about the ramp.
Week 9, Day 2

Think about the things you have learned about simple machines. Use what you learned to answer the questions below.

1. Jonathan wants to measure the force of gravity on a table. What tool should he use? Mark your answer.
   - ○ A tape measure
   - ○ A ruler
   - ○ A measuring cup
   - ○ A scale

2. Janie and Josie are sitting on a seesaw. Janie weighs 100 kg and Josie weighs 120 kg. If the seesaw is evenly balanced, who is sitting closer to the fulcrum? How do you know?

3. What is another name for an inclined plane wrapped around a post?
   - ○ A pulley
   - ○ A wedge
   - ○ A screw
   - ○ A lever

4. Which of the following does not belong with the other three items? Mark your answer.
   - ○ A bicycle
   - ○ A pulley
   - ○ A lever
   - ○ An inclined plane

Week 9, Day 3

Unscramble the letters of the words to answer each question.

1. Which of the following words is not an example of a simple machine?
   - finek
   - esewas
   - norbodok
   - doari

2. Alicia rolled a ball down the sidewalk. Which of the following forces will make the ball stop?
   - terfnioi
   - vyrgtia
   - iiatenr
   - shup

3. Which of the following vegetables could be considered a wedge?
   - sbnae
   - trcrao
   - nroc
   - aspe
List all of the simple machines you can find on the bicycle and on the can opener. The first two have been done for you.

<table>
<thead>
<tr>
<th>Bicycle Part</th>
<th>Simple Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>wheels</td>
<td>wheel and axle</td>
</tr>
<tr>
<td></td>
<td>blade</td>
</tr>
<tr>
<td></td>
<td>wedge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Can Opener Part</th>
<th>Simple Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>blade</td>
<td></td>
</tr>
</tbody>
</table>

Page 19
Use the words in the box below to complete the puzzle.

Across
1. Machine made up of two or more simple machines.
4. Fixed point on which a lever turns.
5. Force that pulls objects toward the center of the earth.
6. Something that makes our work easier.
8. Simple machine that helps roll heavy objects.
9. Machine with few or no moving parts.

Down
2. Machine used to make lifting objects easy.
3. Simple machine with a slanted surface.
4. A push or a pull.
7. Bars that turn around a fixed point.
Teacher Resources:


