

Innovation: Simple machines

Introduction	This lesson provides students with a review of simple machines and their tasks. It works best in combination with your lesson on simple machines, or as a review/additional activity.
Level	Grades 3-12
Time	This activity can be done in one 45-minute class period or as part of a class period and a homework assignment.
Lesson Preparation	Photocopy worksheet
Prior Knowledge Required	Students should know the 6 types of simple machines and what they do (inclined plane, screw, pulley, wheel and axle, wedge, and lever). They should also know what a gear is (sometimes considered a simple machine or a “specialized” wheel with levers).
Background Information	<p>Simple machines make work easier for us by allowing us to push or pull over increased distances.</p> <p>“A simple machine is a non-powered mechanical device that changes the direction or magnitude of a force. In general, they can be defined as the simplest mechanisms that use mechanical advantage (also called leverage) to multiply force. A simple machine uses a single applied force to do work against a single load force. Ignoring friction losses, the work done on the load is equal to the work done by the applied force. The machine can increase the amount of the output force, at the cost of a proportional decrease in the distance moved by the load. The ratio of the output to the applied force is called the mechanical advantage.”*</p> <p>*Wikipedia – “Simple Machines” – accessed July 7, 2014</p>
Vocabulary	<ul style="list-style-type: none"> • Pulley – change direction of a force • Lever – increase or decrease applied force • Wheel and Axle – reduce friction of moving something • Screw – hold things together or move an object • Inclined Plane – reduce force of moving something • Wedge- used to push two objects apart, or cut an object into pieces. It can also hold objects in place. • Gear (sometimes considered a simple machine, sometimes a complex machine) – increase force, change speed or direction of power source – made up of a wheel and axle with levers • Work – exertion or effort directed to produce or accomplish something; labor; toil.
Anticipated Student Preconceptions/ Misconceptions	<p>Students may mistakenly believe that:</p> <ul style="list-style-type: none"> • Machines put out more work than people put in. • Work is any activity one gets tired doing, paid to do or doesn’t like doing.

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Frameworks	<p>Massachusetts Science Curriculum Frameworks</p> <p>Grade 4: Physical Science Technological Systems 3-5-ET2-2 – Describe that technological products or devices are made up of parts. Use sketches or drawings to show how each part of a product or device relates to the other parts in the product or device.</p> <p>Grade 8: Technology/Engineering Energy and Power Technologies MS-ETS4-1 – Explain how a machine converts energy, though mechanical means, to do work.</p>
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Guiding Question	How do simple machines work together to create mechanical advantage?
Objectives	<p>At the conclusion of this lesson, students will be able to:</p> <ul style="list-style-type: none">Identify how simple machines operate in a system to create mechanical advantage.
Activity	<p>Class Discussion</p> <ol style="list-style-type: none">Review the six types of simple machines and what types of mechanical advantage do they provide (inclined plane, screw, pulley, wheel and axle, wedge, and lever). Also talk about gears (sometimes considered a simple machine or a “specialized” wheel with levers). See handout.Discuss how the machine converts energy, though mechanical means, to do work. <p>These next steps can be done in class, or as a homework assignment:</p> <ol style="list-style-type: none">Pass out the worksheets and review the assignment.Students complete their worksheets as an in-class assignment or homework.After the worksheets are complete, or the next day, review the answers with the whole class.
Assessment	Worksheet – see attached rubric
Differentiation Suggestions	<p>Students may work in groups to complete the worksheet.</p> <p>Bring in a bicycle for students to investigate.</p>
Adapting the	Younger students might want to investigate this website for clues to how simple

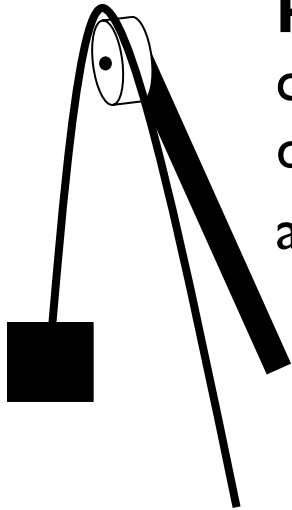
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Activity for Other Grades	<p>machines provide mechanical advantage in everyday life. http://teacher.scholastic.com/dirtrep/simple/index.htm http://www.msichicago.org/play/simplemachines/ http://www.neok12.com/Simple-Machines.htm</p> <p>For older students: this website contains a lot of lesson and activity ideas for further exploration. http://science-class.net/archive/science-class/Physics/simple_machines.htm</p>
Bibliography	<p>Weakland, Mark. <i>Smash!: Wile E. Coyote Experiments with Simple Machines (Wile E. Coyote, Physical Science Genius)</i>. North Mankato: MN: Capstone Press, 2014.</p>

Grading Rubric

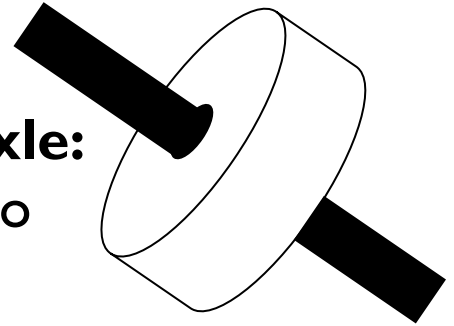
CATEGORY	4	3	2	1
Correctly labels simple machines	Labels all five simple machines	Labels three-four simple machines	Labels one-two simple machine	No simple machines labeled
Correctly describes how each simple machine works to provide a mechanical advantage	Gives all five Explanations	Gives three-four explanations	Gives one-two explanations	No explanation given
Correctly describes how the machine converts energy, though mechanical means, to do work.	Excellent explanation	Good explanation	Satisfactory	No explanation given

Simple Machines

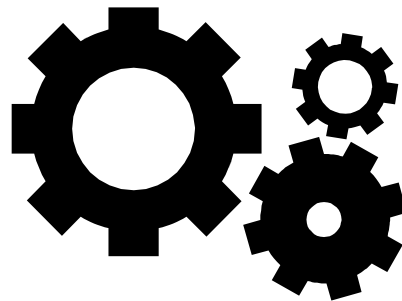
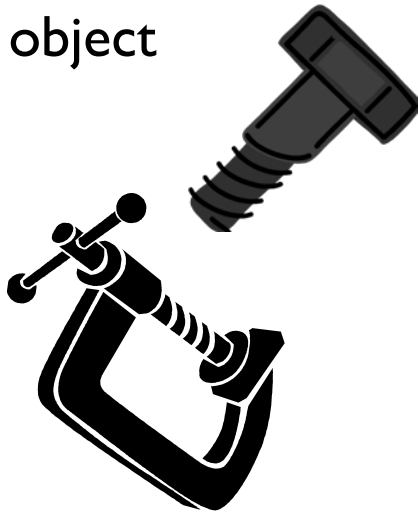


Pulley:
change the
direction of
a force

Wheel and Axle:
make it easier to
move an object



Screw: hold
things together
or to lift an
object



Gear: move an
object with control
or change its speed.
Composed of a
wheel and axle and
levers.

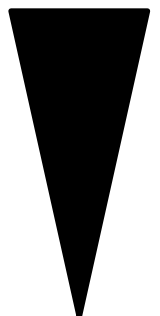
Lever: increase or
decrease applied force



Inclined Plane: help
for raising or lowering
a load

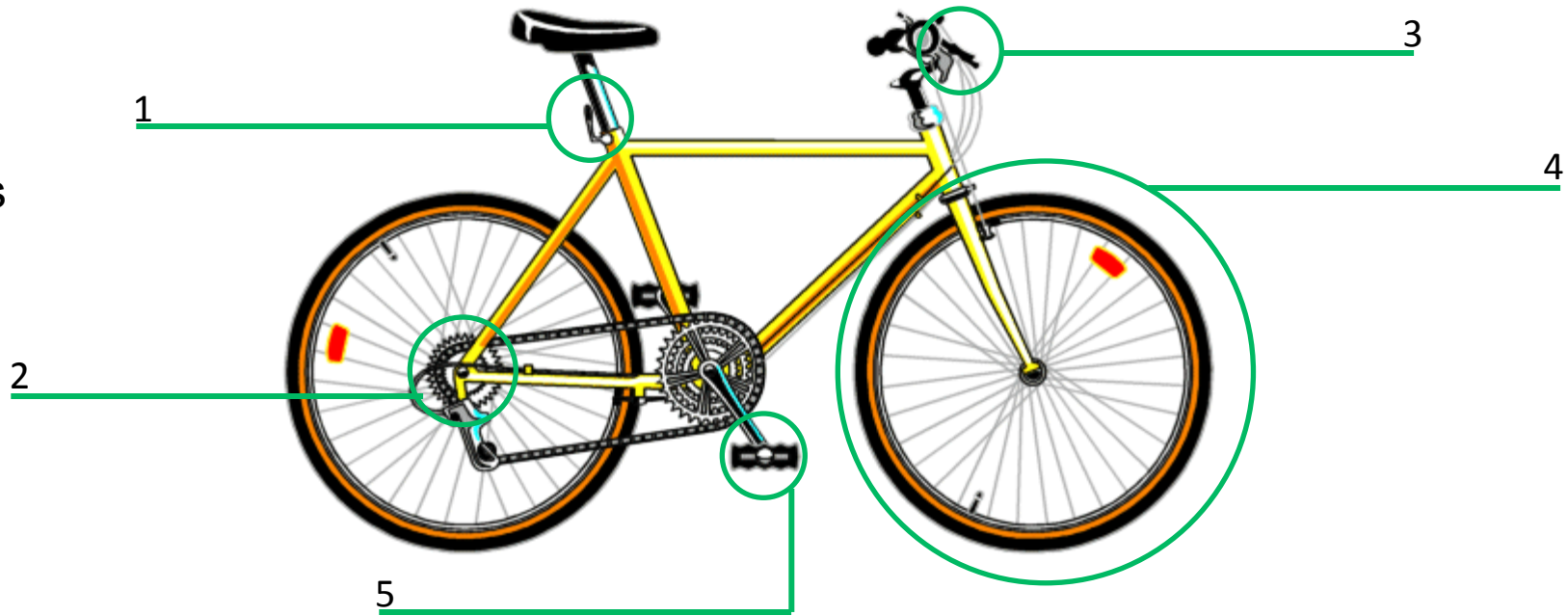


Wedge: separate
an object or hold it
in place



Bicycle

Label the simple machines on the picture.



Describe how each simple machines work as part of this complex machine.

1

2

3

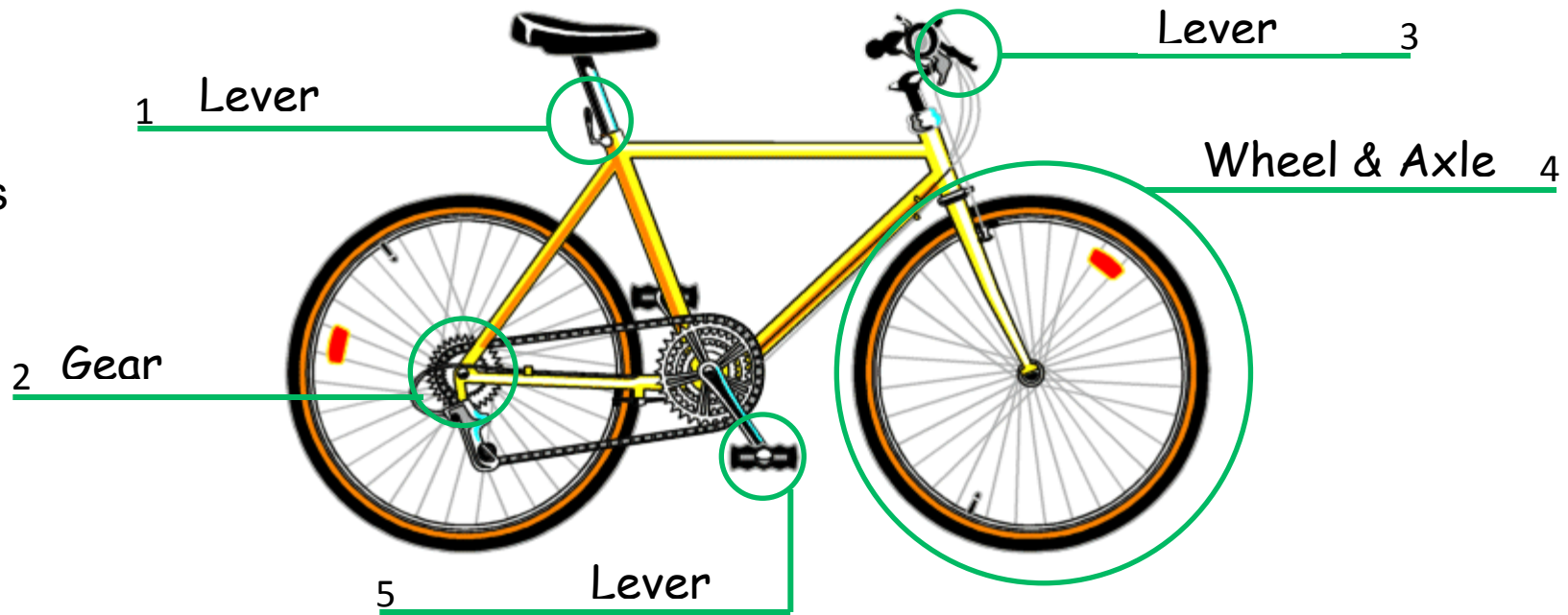
4

5

Describe how the machine converts energy (the cyclist's power), through mechanical means, to do work.

Bicycle

Label the simple machines on the picture.



Describe how each simple machines works as part of this complex machine.

1 Applies force to the handle under the seat to hold it in place

2 By switching gears, the rider can make it easier or harder to peddle

3 Applies force to the brake, slowing the bike

4 Allows the wheel to rotate, creating motion

5 By pushing down on the peddle, the rider can increase momentum

Describe how the machine converts energy (the cyclist's power), through mechanical means, to do work.

Pushing down on the peddle increase the momentum, which is transfer to the gears that can control the speed of peddling. Because the gears are attached to the wheels, the energy is transferred to the wheels that freely rotate on their axles until the force of the brake is applied.

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