# Simple Machines

*Activities:*

- Six Do it All
- Tilling with Tools

## *Description:*

Students will learn the six simple machines that do it all! After, students will understand that even complex machines are made up only six simple machines. Students will then work hands on with gardening tools to see what makes the work easier. Additionally, students will plant turnips (or other preferred crop) and 'feed' them compost.

*Activity #1*

## Six Do it All

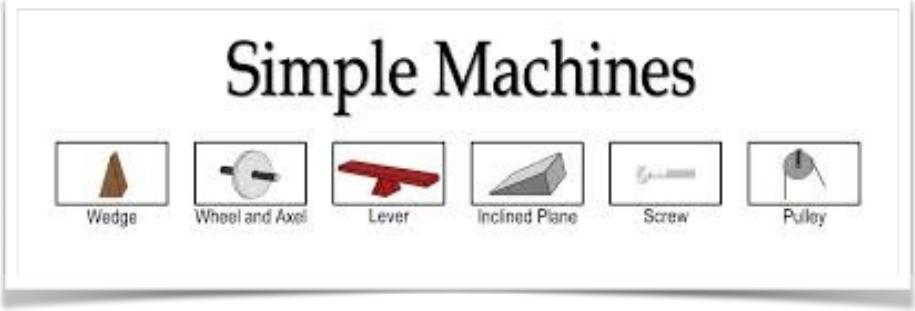
adapted from CFAITC

### *Description*

Students create models of the six simple machines.

### *Objective*

The purpose of this lesson is for students to become familiar with the six kinds of simple machines – the inclined plane, pulley, screw, wheel and axle, lever, and wedge. These machines are combined to form complex machines.



## *Materials*

*For the class:*

- Large piece of butcher paper

*For each student:*

- Inclined Plane and Lever template copied onto tag board (see below)
- Wedge template copied onto tag board (see below)
- Screw and Wheel and Axle template copied onto tag board (page 24)
- One round wooden "tinker toy," drapery pulley, empty sewing thread spool, or bobbin
- String (one 1-foot piece and one 2-foot piece)
- Straw
- Pencil
- Scissors
- Paper clip
- Masking tape or cellophane tape

## *Class Discussion*

Theoretically, machines are devices that help make work easier for people. Most machines consist of a number of elements, such as gears and ball bearings that work together in a complex way. But no matter how complex they are, all machines are made of one or more of the six types of simple machines – the inclined plane, pulley, screw, wheel and axle, lever, and wedge. Historically, simple machines were invented and used long before anyone ever classified them. Examples of the six types of simple machines are listed below.

## *Action*

Six Simple Machines

1. Discuss with the students that each team will do the following for each simple machine:
   * Make a model of it.
   * As it is built, discuss geometric terms such as faces, vertices, planes, etc.
   * Write its name of the simple machine on the model.

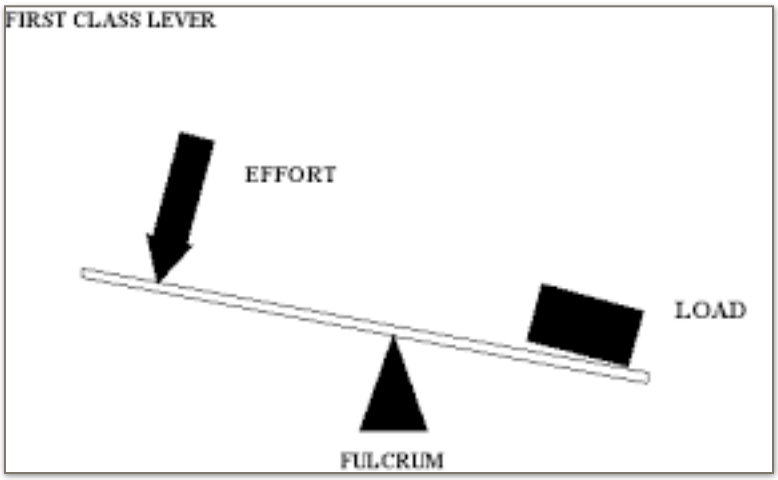
* Explain how it makes work easier for people.
* Create a list of examples of the simple machine.

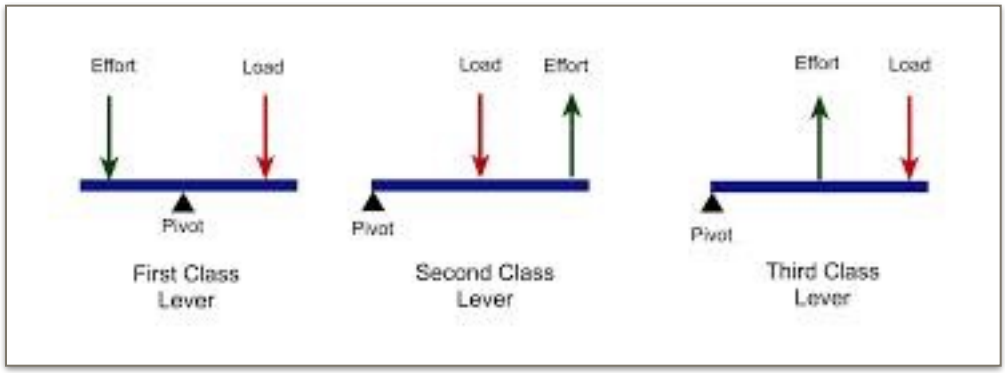
**Lever Activity**

A. Cut out the lever pattern.

B. Fold and tape the base (fulcrum).

C. Set a small paper clip on one end of the lever and push the other end down. It should lift the paper clip up. This model is a first class lever.




There are three classes of levers.

- Examples of levers include: see-saws and car jacks (first class), wheelbarrows and nutcrackers (second class), and shovels and brooms (third class).
- A lever has three parts.effort, fulcrum, and load or resistance. The fulcrum is the point on which the lever pivots. This allows the weight to be moved a short distance with a concentrated amount of force (effort).

**Inclined Plane Activity**

A. Cut out the inclined plane patterns; fold and tape as shown.

B. Set the inclined plane on the table with one long side down.

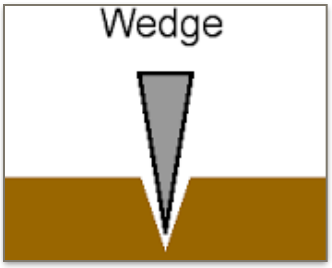
C. Roll a pencil up and down the incline.

- Examples of inclined planes include boat ramps, stairs, wheelchair ramps, truck loading ramps, and driveways, and grain elevators.
- An inclined plane spreads the amount of work needed to move an object over a larger distance so that less force is needed at any particular instant.

**Wedge Activity**

A. Cut out two wedge patterns.

B. Fold and tape them together.




•Examples of wedges include axes, wedges, nails, ice picks, knives, plows, discs, treads on tires, and other objects that split things in two.

•A wedge is theoretically two inclined planes attached together. A wedge makes work easier for people by splitting something perpendicular to the force that is applied. Wedges are often used in conjunction with levers.

**Screw Activity**

A. Cut out the triangle.

B. Using the arrows as a guide, roll the paper around a pencil and then tape in place.

- Examples of screws include bolts, wood screws, jar lids, augers, and drill bits.
- A screw is an inclined plane rolled up. A screw concentrates the force applied on an object to a smaller area. It pushes a concentrated amount of force away from you.

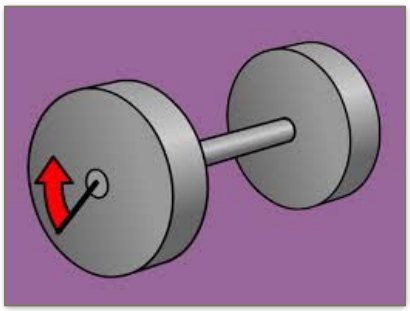
**Wheel and Axle Activity**

A. Cut out the two circle patterns and punch or poke a hole in the center of each circle. The hole should be slightly smaller than the diameter of the straw.

B. Insert the straw through both holes.

C. Roll the wheel and axle across the desk. The circles are the wheels and the straw is the axle. If appropriate, have the students tape the wheels to the axle.

- Examples of wheels and axles include tires, doorknobs, the crank shafts on bicycles, steering wheels, gears, and egg beaters.
- A wheel and axle reduces the amount of friction an object creates during its motion, because less surface is exposed to the stationary object, usually the ground, at any given time.

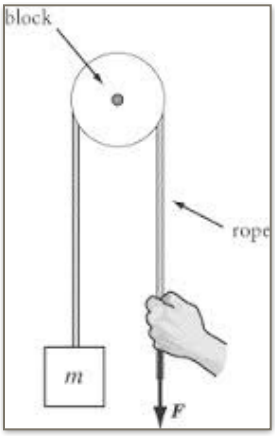


**Pulley Activity**

a. Cut a one-foot piece of string and thread it through the middle of a round wooden "tinker toy," drapery pulley, thread spool, or bobbin.

b. Tape the two ends of the string on the edge of the desk so that the "pulley" hangs freely off the edge of the desk.

c. Thread the remaining piece of string around the top of the "pulley" so that it fits into the groove. Have students attach their pencils or other objects to one end of the string and provide time for students to experience how a pulley works.




•Items that contain pulleys include drape draws, elevators, flagpoles, sails on windsurfers and sailboats, scaffolding for window washers, engine hoists, and cranes.

•Pulleys make work easier by changing the direction of the force applied. With a pulley, when one pulls down, the object goes up.

## *Wrap-up*

What kinds of simple machines have you used before?
Do these machines make your life easier? How?

What kinds of complex machines could we make with these simple machines?

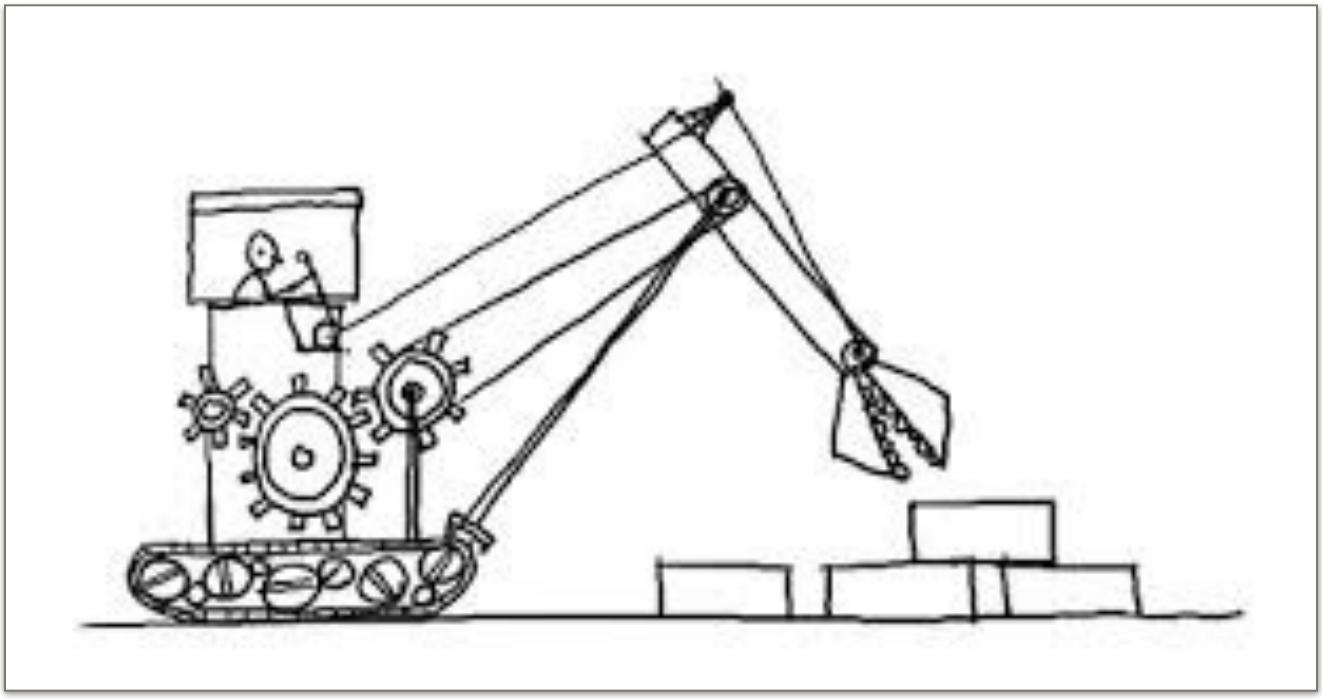
Debrief the activity using the "What? So What? Now What?" model to help guide understanding of the activity, what it means, and what we can do with this information.

## *Evaluation*

Have students list a least 3 examples of each kind of simple machine.

## *Digging Deeper*

Ask your students to be observant of the six simple machines in our complex world.
Where do these machines exist?
Where are they combined to make complex machines? Just maybe they can see how these machines are making our lives more simple…



*Activity #2*

# Tilling with Tools

adapted from Edible Schoolyard Pittsburgh

## *Description*

Students will till soil using a variety of tools to discover which tools help make the job easier. Students will also plant turnips and add nutrients/compost to optimize their growth.

## *Objective*

- Students will understand how to properly use garden tools
- Students will be able to compare the effectiveness of different garden tools at tilling the soil
- Students will compare the pros and cons of industrial and sustainable agriculture

## *Materials*

- School Garden with an unused garden bed, that could use some tilling, and is available to plant turnips
- Garden gloves (1 pair per student)
- Hand forks and trowels (1 tool per student), placed in a 5-gallon bucket
- Additional larger tools such as spading forks, shovels, rakes, and/or Garden Weasels
- Two 5-gallon plastic buckets for compost
- Enough compost to cover the garden bed(s)

## *Class Discussion*

Much of the food we eat is grown on large-scale farms. Given the abundance of land, farmers use machines such as tractors in order to help them prepare the soil and plant their seeds. In contrast, we don't have to rely on machines. Instead, we can get by with basic garden tools and a little bit of muscle. Today we are going to use these tools to prepare the soil for planting. In addition, we'll be adding a natural fertilizer to the soil – compost! Compost is an all-natural alternative to the synthetic fertilizers often used on large-scale farms.

**Industrial vs. Sustainable Agriculture**

*Labor and Productivity* – The development of specialized agricultural machinery replaced the need for human labor and made it possible for farmers to grow on increasingly larger plots of land. Nowadays, most industrial farms rely on machines to do basic agricultural tasks such as tilling, planting, and harvesting. While some sustainable farms may also use machines, many small farmers use traditional hand tools and manual labor to get the job done. Basic farm tasks might be more physically taxing and take longer to complete, however, many farmers prefer such "old- school" methods for a variety of physical, emotional, and philosophical reasons.

*Nutrient Cycles* – Whereas industrial farmers often rely on synthetic chemical fertilizers to boost the soil's nutrient content, organic farmers organic farmers use a variety of natural methods to improve soil tilth and promote healthy nutrient cycles. Soil amendments such as compost, chicken manure, or worm castings are naturally nutrient-rich and help to sustain soil health over the long run. In contrast, industrial fertilizers often leech out of the soil and have to be re-applied yearly, at a great expense to the farmer.

*Environmental Impact* – Naturally, larger plots of land yield larger harvests, enabling farmers to feed even larger numbers of people. However, productivity comes at a cost. Industrial agriculture is a chemical-intensive enterprise, requiring numerous external inputs, such as chemical fertilizers and petroleum. Sustainable farmers, however, seek to work in harmony with the environment by mimicking the closed nutrient systems found in nature.

## *Action*

**Part 1: Aerate Soil**

- As a class, gather in the garden. Arrange students evenly around the turnip bed(s) and distribute garden gloves. Draw a line in the soil down the middle of the garden bed. Instruct each student to mark a small "personal workspace" in the soil in front of them. Assist the group in determining proper spacing between students. When finished, the garden bed should be evenly divided into small sections.

- Demonstrate how to properly use hand tools to till the soil. Pass out hand forks and trowels and begin tilling. As students work, remind them to till the entire area their personal soil section. After a few minutes of tilling, allow students to trade hand tools and till for a little longer. When tilling is sufficient, collect hand tools.

- Arrange large garden tools over the garden bed, starting with forks and shovels and ending with Garden Weasels and rakes. Moving from left to right, introduce each garden tool and demonstrate how to properly use it. Beginning with the first tool, select a few

students to use the tool to the till the soil. After a few minutes, collect that garden tool and move onto the next one, selecting a new group of students to till the soil.

- As one group works, encourage other students to observe how the tool affects the soil. "Which large tools are the most effective at breaking up large clumps of soil? Which tools are best at digging deep? Smoothing?" When finished, collect large garden tools, reserving the rake for the next part.

**Part 2: Spread Compost**

- As a class, visit the compost bin. Arrange students in a large half-circle around the compost bin. Remove the top of the bin and grab a large handful of newly added plant matter to display to the group. "As these plants decompose, they release valuable nutrients into the soil." Open up the bottom drawer of the bin and display finished compost. "Over time, plants will break down into this – nutrient-rich compost that is ready for use!"

- Select two students to use the hand trowels to remove a few large scoops of compost from the bottom of the pile. Place compost in the bucket. Select two new students to do the same, cycling through students until both plastic buckets are halfway full. Select two volunteers to transport the buckets to the turnip bed(s).

- Arrange students evenly around the garden bed. Demonstrate how to evenly broadcast a handful of compost over the soil. Next, pass the first bucket of compost down the line. Instruct each student to broadcast a large handful of compost over the soil directly in front of them. When finished, collect buckets and demonstrate how to use a rake to blend compost into the soil. Select a few students to give it a try. Finally, demonstrate how to use the rake to smooth out the soil surface. Gather lesson materials and return to the classroom.

## *Wrap-up*

Which tools were most effective? Which tools made the job easier? Did any make the job harder? What kinds of tools do you think large-scale farmers use? What is the use of compost? What do you eat/take that give you extra nutrients?

## *Evaluation*

Index Card Mini-Assessment – on one side of the index card have students write the coolest thing they learned in the garden and which tools they found the best, on the other side write one thing they are still confused about.

## *Digging Deeper*

Students will have a chance to watch the turnips grow throughout the year.

# Six Do it All

## 3rd Grade

### *Math*

Measurement and Geometry objects 2.5
All Identify, describe, and classify common three-dimensional geometric

Measurement 2.6
Identify common solid objects that are the components needed to make a more complex solid object.

## 4th Grade

### *Math*

Measurement and Data

4MD3
Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.

Geometry

4G.
Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

# Tilling with Tools

## 3rd Grade

### *Science*

Physical Science

3.c.
Students know living things cause changes in the environment in which they live: some of

these changes are detrimental to the organism or other organisms, and some are beneficial.

3.d.
Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.

5.d.
Predict the outcome of a simple investigation and compare the result with the prediction.

## 4th Grade

### *Science*

Investigation and Experimentation

6.d.
Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.