

What You Might Find:

If any construction or gardening is under way on school grounds, take students out to look for simple machines at work. Watch for any opportunities students might have to use tools, such as hammers or screwdrivers.

Guiding the Investigation

1. Review the six simple machines with your class. Ask, *Do you think we can find any of these in the schoolyard? Where?*
2. Pass out student sheet no. 32 *Home/School Connection* with the inclined plane, wedge, and screw on it. Have students turn the paper over, and make a three-column chart listing the three other simple machines: lever, pulley, and wheel and axle. Ask students to list the examples they find in the schoolyard in each column.
3. As you look at each simple machine that students find, ask, *What work is this machine doing? Why did the designer (of this bench, ramp, flag pole, etc.) use a simple machine here?*
4. Back in the classroom, create a chart listing the examples found for each simple machine. Encourage students to add to the list if they find additional examples over the course of the module.

Levers and Pulleys > Investigation 2: *More Leverage* >

Part 4: *Lever Pictures*, page 23

Do Schoolyard Work Using Levers

Boston Schoolyard Initiative Extension

When to Go Out

Following Part 4, take students outside to perform needed tasks in the schoolyard using tools (levers), such as rakes and shovels.

Outdoor Objective

Students will help take care of their schoolyard and experience how (class-1, class-2, and class-3) levers can reduce effort and make work easier. Students will discover where they should place their hands to maximize efficiency of the tools. They will also label the fulcrum, effort, and load.

Materials

For Each Student	Science notebook
	1 Clipboard
	1 Pencil
For the Class	Levers, such as rakes, brooms, hoes, shovels, bulb hole diggers, spades, wheelbarrows, or 2-wheeled trash barrels
	Bags or barrels
	Bulbs or plants

Getting Ready

Time: 45–60 min.

Site: Select areas where work is needed in the schoolyard. See Seasonal Tips.

Seasonal Tips: In the fall, students can rake leaves into barrels, bags, or piles; they can also plant bulbs. In the winter, students can shovel snow or rake up remaining leaves. In the spring, students can plant or turn the soil to prepare it for planting. In any season, compost can be turned or the pavement can be swept clear of wood chips, gravel, or litter. Make sure you know where raked leaves should be left.

Safety Note: Be aware of allergies that might limit what some students can do. Send home a notice letting parents know, and asking that students wear appropriate clothes. You might also invite them to help too!

Guiding the Investigation

1. Review the real-world examples of levers the class discussed in Part 3. Tell students they will be doing needed work in the schoolyard using class-1, class-2, and class-3 levers. They will also learn how tools function as levers.
2. Divide into groups and assign each group to a station. Describe the work students will do at each station; examples include raking, sweeping, digging, and spreading mulch.
3. Explain that their first task as a group is to figure out how they would hold their tool (where they would place their hands) to get the least leverage and the greatest leverage. Use tape to mark the fulcrum, load, and effort. Model an inefficient way of holding a tool like trying to rake leaves with both hands at the top of the rake. Ask, *Is there a better way to hold this tool?* Allow students to figure this out on their own! After marking their tool with tape, they should make a sketch in their science notebook labeling the fulcrum, effort, and load.
4. Give students enough time to feel the satisfaction of having completed their task.
5. Consider asking students to compare the effort involved in using a push broom vs. a sweep broom; kid-sized vs. adult-sized tools; or trowels vs. spade shovels depending on the tasks you are doing.

What You Might Find:

If you put a message out to the staff and families ahead of time requesting tools, you may be able to get all the tools you need. Make sure all borrowed tools are labeled!

“Most of my students felt enormous satisfaction from doing this hard work in the schoolyard and I could tell they were proud of their effort (and dirty hands). My students even asked if they could continue the work at recess the next day. So I went out with them at recess to work some more.”

Erica Beck Spencer
Science Specialist

6. Allow time for the class to visit each station to hear the group's report on what they learned about their tool, including whether it is a class-1, -2, or -3 lever, and to show off the work they did.
7. Return to the classroom to wash hands and reflect on what students observed.

Levers and Pulleys > Investigation 3: *Pulleys* >

Part 3: *Pulley Game*, page 21

Do Real Work With Pulleys

FOSS® Extension, page 28

When to Go Out

Following Part 3, take students outside to lift heavier weights.

Outdoor Objective

Students will rig up and experiment with working pulley systems in order to reduce the perceived effort needed to lift the load and experience real-world applications of the work that pulleys do.

Materials

For Each Student	Science notebook
	1 Clipboard
	1 Pencil
For the Class	2–4 Pulleys (one or two fixed pulleys attached to a tree limb or play structure)
	Strong rope (approximately 12 meters long)
	1 Load or a 15–35 liter bucket filled with sand, gravel, or bags of cement
	1 Pair of work gloves

Getting Ready

Time: 15–20 min.

Site: Attach 1–2 fixed pulleys to a play structure or a strong tree branch. Heavy-duty pulleys and strong rope can be found in hardware stores.

Safety Note: Work gloves will prevent rope burns. Make sure you have rope designed to hold the weight you will be lifting. If you do not know how to tie a proper bowline, find someone who does. Remove the rope from the fixed pulley when you are done with this activity.

Guiding the Investigation

1. Review what students have learned about pulleys and tell them you will be going outside to see if they can use their knowledge to figure out how to lift a heavy load (a large bucket of sand).
2. At your outdoor station, allow plenty of time for students to try lifting the load without a simple machine.
3. Ask students to draw in their notebooks a pulley system that they think will work. Have them share their ideas and explore various pulley systems. Let this be a class challenge that your students solve together.
4. Once students have a system that works, make sure everyone has a chance to try it.
5. On the way into the classroom, have students observe the schoolyard or neighboring yards for any pulleys.

Levers and Pulleys > Investigation 3: *Pulleys* >

Part 3: *Pulley Game*, page 21

Broomstick-Pulley System

FOSS® Home/School Connection, page 28

When to Go Out

Following Part 3, take students outside to give them more room to do this exercise.

Outdoor Objective

Students will make broomstick-pulley systems and use them to overcome the resistive force of others trying to prevent the sticks from being pulled together.

Materials

For the Class	1–2 Pieces of thin, smooth rope about 15 meters
	2–4 Broomsticks
	1–2 Pairs of work gloves

Getting Ready

Time: 15–20 min.

Site: Select a grassy area where students can spread out.

Caution: It is important to use good knots. Two half hitches or a bowline would work for attaching the rope to one of the broomsticks.

Guiding the Investigation

Take students outside and follow the directions on student sheet no. 34 *Home/School Connection*. If you have access to four brooms, two groups will be able to try this at the same time.

Levers and Pulleys > Investigation 4: *Pulleys at Work*

Testing: Do Simple Machines Really Make the Work Easier?

Boston Schoolyard Initiative Extension

When to Go Out

Take students outside before you begin the module or at the end of the module to summarize learning. This is an assessment opportunity.

Outdoor Objective

Students will rotate through four stations to measure the effort needed to lift real-world loads with and without simple machines.

Materials

For Each Student	Science notebook
	1 Clipboard
	1 Pencil
For the Class	4 Strong bags with 3 bricks in each
	4 Strong scales
	4 Large pulleys
	2 Studs (5 cm x 15 cm x 2 m)
	2 Fulcrums

Getting Ready

Time: 45–60 min.

Site: Set up two pulley systems on a play structure as separate stations. Space between the four stations helps groups stay focused on the task. You will need pulleys larger than those in the kit. You will need heavier duty pulleys and scales than those provided in the kit. Possible sources include fish and tackle or sporting goods stores.

Guiding the Investigation

1. Ask, *What is the point of using simple machines?*
2. Tell students they will go outside to measure the effort of three simple machines. There will be four stations: two pulley stations, one lever station, and one inclined plane. They will rotate through all four stations and measure the load with and without the use of a simple machine.
3. Have students set up their notebooks inside with four sections to record the results and draw the simple machines.
4. Go outside and demonstrate what students will do at the four stations. Show students how they will attach the scale to measure the load. Remind students that they need to record the effort without using the simple machine first; then they will record the effort using the simple machine. Students should also record whether they gained a mechanical advantage or a directional advantage.

Class-1 Lever: Students will use one hand to lift the bag without using the lever. Then students will place the load on one end of the lever and again use one hand to lift it. Students may move the fulcrum around to try to reduce the effort.

Inclined Plane: Take one of the 5 x 15 cm studs and rest one end on the ground and the other end about 1 m off the ground on a rock wall or part of the play structure. Students will slide one of the bags of bricks up the incline with a scale attached to the handle of the bag. Pull the bag up while holding on to the scale and measure the effort.

One Pulley System (Single-fixed): Attach one pulley above the students' heads to the play structure, so that rope can easily slide through it.

Two Pulley System (Single-fixed/Single-moveable): Attach one pulley to the play structure and tie a rope to the bottom hook on it. Let the rope fall to the ground; run this rope end through another pulley, which will be attached to the bag. Lead the rope back up through the fixed pulley and down again.

5. Have an equal number of students at each station. Together they will measure and record their results. Students will have about 8 minutes at each station.
6. Gather students together to discuss the results and ask, *Do simple machines really make the work easier?*

“Using the heavier weights in the schoolyard made it really click for them that if you have something that’s really heavy, a lever or a pulley or an inclined plane is going to make doing that work easier.”

Erin Flynn
Science Specialist



Teacher Notes: