Big Blue Blocks and Simple Machines

Third Grade Unit Plan: 3-5. Engineering Design Awesome Engineering!: Simple Machines
Standards Aligned to NGSS Engineering standards 3-5-ETS1-1.: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2.: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3.: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Unit Objectives In this unit, students will be able to: ● Identify 6 different types of simple machines and describe the key features ● Demonstrate understanding of how each simple machine works and can be used in real-life engineering contexts ● Measure the impact simple machines have on moving objects ● Design and carry out an investigation into the different properties and applications of simple machines ● Represent the results of their experiments in a variety of methods ● Generate and compare solutions to different engineering problems using simple machines according to goals and constraints ● Use simple machines in a practical construction context

Lesson Title	Standards	Lesson Description	Assessment
Raising Ramps!	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Introduction to the 6 different simple machines (wheel and axle, lever, inclined plane, pulley, screw, and ax) using diagrams and real-world images. Together the class will explore the concept of *work*, and the ways that simple	Students will play an identifying game with the six simple machines. Students will measure how the necessary force required to move the bag of rocks changed with the

		machines make work easier. Students will explore the inclined plane, by building a ramp with Big Blue Blocks. Using spring scales, students will explore how the force required changes when lifting a bag of rocks straight up, versus using a ramp. The students will determine how changes to the angle of inclination impact the force used. Together the class will come up with a list of benefits and drawbacks to the different angles, and discuss why engineers might use different angles for their ramps.	angle of inclination and record it as a group. Students will do a scavenger hunt looking for examples of inclined planes in their daily life.
Lifting Levers	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Students will explore the properties of class-1 levers. Educators will quickly define and model the key features of a lever (the fulcrum, load, and effort) before prompting students to create their own with the Big Blue Blocks. Together, the class will come up with possible changes to the design (moving the fulcrum, changing the length of the lever arm) and implement them in the lever building activity, making sure to record their impressions and changes along the way.	Students will design and record the results of their lever experiment, and rank them for the class. Students will do a scavenger hunt looking for examples of levers in their daily life.
Pulley-ing it up!	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Teacher will explain the idea of a pulley and its key properties. Teacher will model for students how to make their	Students will do a scavenger hunt looking for examples of screws in their daily life.

		own pulley out of string, a spool, and a rod. Students will run their own experiment to see how many Big Blue Blocks they can lift up with the pulley they make using the Lil Cheese blocks and noodles.	
Archimedes Who? Archimedes Screw!	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Introduction to the screw. Teacher will explain the idea of a screw and its key properties. Screws hold things together, but they can also be used to move objects. Students will build a version of the Archimedes screw using tubing wrapped around noodles from the Big Blue Blocks. Have them practice trying to move water between two different bowls. Have them record the amount of water they start with, and how much they manage to transport. Discuss the efficiency of the Archimedes screw.	Students will measure how much water they managed to transport using the Archimedes screw and suggest ways to improve the amount. Students will do a scavenger hunt looking for examples of screws in their daily life.
Ax-ing the right questions!	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Students will design and run an experiment using the Big Blue Blocks and the Angles set to determine the optimal angle needed to cut, or split a variety of different materials (play-dough, two blocks held together, two books held together.) Have students share conclusions about different	Students will do a scavenger hunt looking for examples of wedges in their daily life.

		materials and why different angles have different uses.	
Roll on, roll off.	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Together, students and teachers will explore the concept of a wheel and axle. The teacher will explain the idea of *friction*, and the role that the wheel and axle play in reducing the friction. Students will practice by pushing a box filled with weights across the floor. The lesson will then contrast this with one of the following activities: ● Wheelbarrow race using the Lil Cheeses from the Big Blue Block set and a homemade axle to ● Roller Conveyor: Students will use the noodles laid on the floor to "roll" a box over a long distance. Play as a racing game, with students grabbing and moving the noodles to the front of the line to keep the box going.	Students will measure and compare how much further they were able to roll a box using the rolling conveyor over just pushing a box. Students will do a scavenger hunt looking for examples of wheels and axles in their daily life.
Big Build: Pyramid	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Students will be given the opportunity to apply the different simple machines to their own building project. Educators will give students a challenge: build a pyramid with the Big Blue Blocks. The catch is that they are unable to use their hands to just lift	Students will share the designs for their pyramid/other building with the class.

		blocks. Rather, they must do it using only simple machines. Give them time to design and plan out their build beforehand. Let the class build in groups or all together, depending on group size. Have students share their impressions, discussing what worked, what didn't, how many simple machines they used to build the pyramid, and how successful they rate their build.	

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Simple Machine Scavenger Hunt!

Instructions: Engineering is all around us. After learning about each different simple machine, see how many of each type you can spot at home! Draw a picture or write it down in the appropriate box.

Inclined plane	Lever	Pulley
Screw	Wedge	Wheel and axle

Sample Lesson Plan for Imagination Playground

Topic: Lifting Levers

Part of the "Awesome Engineering" module.

Standards

NGSS Engineering standards 3-5

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Objectives

At the end of the lesson, students will be able to:

1. Identify the key properties of class-1 levers
2. Design a simple lever using Big Blue Blocks and classroom supplies
3. Plan and carry out an experiment involving levers and controlled variables
4. Identify failure points and areas of improvement
5. Link levers to real-world applications

Materials

1 set of Imagination Playground Big Blue Blocks or Medium Blue Blocks
1 set of Imagination Playground Small Blue Blocks
Stack of books
Recording sheet for each group
Box filled with items to act as load for each group
Board and writing supplies for creating diagrams

Vocabulary

Effort: the force used to move the load
Fulcrum: the point on which the beam, or lever arm, pivots.
Lever arm: the rigid beam that pivots against the fulcrum and lifts the load
Load: the object being lifted

Simple machine: a machine with few or no moving parts that is used to make work easier *Work:* Force on an object multiplied by the distance it moves. If an object doesn't move, there has been no work done.

Lead into the lesson	Assignment from previous class. Ask students to share what different inclined planes they saw on their own time as part of the Simple Machines Scavenger Hunt. Activate prior knowledge by asking students whether they can remember what the different types of simple machines are. Have them share with the group. Write down on a board so they can see. They should produce answers like wheel and axle, pulley, inclined plane, wedge, lever, and screw. Ask them if they remember what simple machines do (*they make work easier*). Today they're going to build their own levers. Give them an explanation of the different components of a lever using a diagram, or example like a see-saw. Go through the definition of a fulcrum, a lever arm, effort, and load.	*Check for understanding*: ask the students if they can remember the definitions from the introductory lesson to the unit, rather than providing them with the definitions outright. Use images and diagrams throughout this activity.
Setting up the activity	Model a small lever on the desktop using Imagination Playground's Small Blue Blocks. Take one 3" plug or 6" plug as fulcrum, and one small long block and set up a lever, with the fulcrum as far away from the load as possible. Using books or other blocks as the load, ask the students to predict whether a single finger can lift the books up.* Have a volunteer come and try to push the load up with a single finger.	**Note: it is important to test this beforehand. Make sure the load is heavy enough to require some effort.* *Check for understanding*: ask students to describe

	When they can't, or if they find it difficult, ask the students what they think could be done to make raising the books easier? Write these down. With those suggestions, move on to the main activity, which gives students the opportunity to test out their theories.	what they're seeing, using the vocabulary given earlier. Use open ended questions when asking students to assess what changes could be made.
Activity	Divide the group into smaller groups, depending on size and number of Big Blue Blocks available. With the 105 piece set, for example, there are 4 long blocks which will function as the lever arm, which means that the classroom can be separated into 4 groups. Have one student be designated as the recorder. They will draw the lever on a sheet of paper and record any changes. Give each group one long block and one plug piece. Give each group a box of books, or whatever heavy item that will serve as the load.* Ask students to identify the pieces of the lever: which block is the lever arm? What are they using for the fulcrum? And what is the effort? Give the instructions. Start with the fulcrum in the same position as the desktop model. Have the student who is recording draw the lever. Then, ask the groups to try to lift their load with one hand. Record any impressions, whether it was easy or difficult. Make sure to check in and check for understanding	**Note: again, it is important to test the weight of the proposed items that will act as the load. Something heavy enough to require some effort, but also will not be too heavy so as to break the foam blocks or be too heavy to lift. A cardboard box of some books, a bag of rocks, a weight, are some options** *Check for understanding*: asking the students to identify the different components of the lever helps strengthen the definitions in their mind. Make it active, like having them put the pieces in the air. For effort, make them jump or show their hands, or any other energizing method.
Group led practice	Have students test out some of their suggestions from the earlier classroom demonstration. This is where they get to experiment more freely.	*Check for understanding:* go around during this time and look at the

	Make sure to emphasize the importance of recording the changes they make, like real engineers. So, if they change the position of the fulcrum, make sure the drawing reflects that change. Each time make sure the recording student draws out what the lever looks like and writes down group results and impressions.	drawings and recordings being made. Remind students of the different theories they came up with for improving the desktop model. Make sure to ask the students to describe what they are doing. Adjust and offer explanations to groups on an as-needed basis.
Concluding the activity	Ask each group to make a ranking of the different designs they tested, from hardest to lift to easiest. Bring students back together and ask each group to share their results. Have them answer the questions "What happened when the fulcrum was closer to the load? Was the load easier or harder to lift? What other changes did you make that made it easier to lift the load?" The load should be easier to lift the closer the fulcrum is to the load. Explain that this is due to something called "mechanical advantage," which can be calculated with a mathematical formula. In general, though, levers work by reducing the amount of force needed to lift an object. Have students share if they can think of any levers they have encountered. They should come up with see-saws/teeter-totters, but there are also scissors, crowbars, and a balance scale. Activate their imagination by encouraging the students to imagine themselves as engineers. Ask them to think of ways a lever could be helpful if they were constructing a building!	*Check for understanding*: have the students describe in their own words what changes they made to their lever.

	Remind them to fill in the next box on the scavenger hunt series with any other examples of levers they can find on their own.	