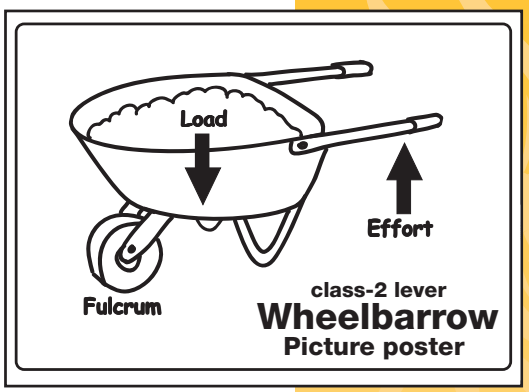
OVERVIEW
LEVERS AND PULLEYS



GOALS

Humans are the only living creatures that have been able to put materials together to construct machines to do work. Our capacity to see and invent relationships between effort and work produced through simple machines has led us into a world that is becoming more technologically oriented. Knowledge of these relationships is necessary for understanding all mechanics. The **Levers and Pulleys Module** consists of four investigations that involve students in fundamental concepts of simple machines.

FOSS EXPECTS STUDENTS TO

- Gain experience with the concept of force and the application of force to do work.
- Gain experience with the relationships between the components of lever systems and pulley systems.
- Gain experience with the concept of advantage as it relates to simple machines.
- Analyze real-world tools and machines in terms of the simple machines that make them work.
- Systematically collect and record data.
- Use measurement in the context of scientific investigations.
- Use diagrams to translate three-dimensional relationships into two dimensions.
- Acquire vocabulary associated with two simple machines (levers and pulleys).
- Apply mathematics in the context of science.
- Use scientific thinking processes to conduct investigations and build explanations: observing, communicating, comparing, organizing, and relating.

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LEVERS AND PULLEYS MODULE MATRIX

SYNOPSIS	SCIENCE CONTENT	THINKING PROCESSES
1. LEVERS		
Students are introduced to levers as devices that help lift weight or overcome resistance. Students investigate the fulcrum, effort, and load of one kind of lever (class-1) and conduct experiments with a spring scale to discover the relationships between the parts of lever systems. They draw and graph their results.	• A lever is a simple machine that people use to gain an advantage, such as making work easier. • An advantage is a benefit obtained by using a lever (or other simple machine). • Effort is the force needed to move a load or overcome a resistance. • Fulcrum is the point where a lever arm pivots. • Load is a mass lifted or a resistance overcome by a lever.	• Measure the effort to lift a load when the load remains constant and the effort changes position. • Measure the effort to lift a load when the effort remains stationary and the load moves. • Organize observations on a record sheet. • Discover the relationships between the parts of a lever.
2. MORE LEVERAGE		
Students investigate and diagram class-1, class-2, and class-3 lever systems. They investigate and diagram common tools to determine how the tools apply levers.	• A class-1 lever has the fulcrum between the load and the effort. • A class-2 lever has the load between the effort and the fulcrum. • A class-3 lever has the effort between the fulcrum and the load. • Conventions are operating procedures that help people communicate more efficiently. • Advantage is a gain in effort, distance, or change of direction resulting from the use of a simple machine.	• Observe the behavior of different kinds of levers. • Compare the effort to lift loads with different kinds of levers. • Diagram the relative positions and sizes of lever components in different systems. • Analyze tools in terms of their application as levers.
3. PULLEYS		
Students are introduced to a second simple machine and discover how to set up single fixed and single movable pulleys to lift a load. They use a scale to quantify effort with single pulleys. They go on to set up and diagram multiple-pulley systems.	• A single-pulley system can be set up in two ways, fixed or movable. • A single-movable-pulley system provides a mechanical advantage for its user. • A single-fixed-pulley system provides no mechanical advantage, but changes the direction of the effort. • A two-pulley system can be made with one fixed and one movable pulley. • A two-pulley system in which the effort is applied upward provides a greater advantage than one in which the effort is applied downward.	• Observe and measure the effort to lift a load with single-fixed- and single-movable-pulley systems. • Organize information on a data sheet. • Diagram and compare the components of four kinds of pulley systems.
4. PULLEYS AT WORK		
Students systematically investigate four pulley systems. They record data on each system. They graph and determine the relationship between the number of ropes pulling on the load and the effort needed to lift it. They determine the distance that the load and effort travel when work is done. Students determine the advantage (and disadvantage) of different pulley systems.	• The effort needed to lift a load with a pulley system can be predicted. • The amount of work put into a system is equal to the work output of the system.	• Observe and measure the effort to lift a load with one- and two-pulley systems. • Organize information on a data sheet. • Determine the advantage of pulley systems. • Measure and compare the distance the effort and load travels in different pulley systems.

INTERDISCIPLINARY EXTENSIONS	FOSS SCIENCE STORIES	TECHNOLOGY/HOME CONNECTION
Math Extensions • Problem of the week. • Introduce decimals. **Science Extensions** • Build a teeter-totter. • Pull some nails.	See the Science Stories folio. • *Simple Machines* • *Class-1 Levers* • *The Wheel and Axle*	www.fossweb.com Check the FOSS website for interactive simulations, to write questions to a scientist, for teaching tips, and to talk with other classes using FOSS. Home/School Connection: Students and families list three simple machines they can find: inclined plane, wedge, and screw.
Language Extensions • Make up riddles. • List everyday levers. • Diagram make-believe levers. **Art Extension** • Make a levers bulletin board. **Math Extensions** • Problem of the week. • Graph class-2 levers. • Graph class-3 levers. **Science Extension** • Build a compound lever.	See the Science Stories folio. • *Class-2 Levers* • *Class-3 Levers* • *The Inclined Plane*	Home/School Connection: Students look for pictures of levers in magazines and analyze the class of the levers.
Language Extensions • Write about Sparky and his troop. • Research *block and tackle.* • Write a make-believe story about how the pulley got its name. **Math Extensions** • Problem of the week. • Explore number patterns. **Science Extensions** • Set up a pulley learning center. • Do real work with pulleys. • Find pulleys in use at home and school.	See the Science Stories folio. • *Pulleys* • *Dear Boss* • *The Wedge*	Home/School Connection: Students make broomstick-pulley systems with friends and family and determine the mechanical advantage.
Language Extensions • Research other simple machines. • Research complex machines. **Math Extensions** • Problem of the week. • Graph pulley results. **Science Extensions** • Try a different approach with two pulleys. • Send pulleys home. • Set up a complex system.	See the Science Stories folio. • *The Work of Pulleys* • *The Screw* • *Thank You, Mr. Clumpet*	Home/School Connection: Students will need some extra time at home to work on their projects and get them ready to present to the class.

FOSS AND NATIONAL STANDARDS

The **Levers and Pulleys Module** helps students develop the skills of inquiry and controlled experimentation. This module supports the following National Science Education Standards.

SCIENCE AS INQUIRY

Develop students' abilities to do and understand scientific inquiry.

- Identify questions; design and conduct scientific investigations to answer those questions.
- Employ tools to gather, analyze, and interpret data.
- Use data to construct reasonable explanations.
- Develop and communicate explanations using evidence.
- Recognize and analyze alternative explanations and predictions.
- Use mathematics in scientific inquiry.
- Understand that scientists use different kinds of investigations and tools to develop explanations using evidence and knowledge.

CONTENT: PHYSICAL SCIENCE

Develop students' understanding of motion and forces.

- If more than one force acts on an object along a straight line, the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces change the speed or direction of an object's motion.

SCIENCE AND TECHNOLOGY

Develop students' understandings about science and technology.

- Scientists work collaboratively in teams and use tools and scientific techniques to make better observations.
- Many different people in different cultures have made and continue to make contributions to science and technology.

HISTORY OF SCIENCE

Develop an understanding of science as a human endeavor.

- The work of science relies on basic human qualities such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.