

SIMPLE MACHINES AND FORCE

NGSSS:

1. **SC.8.N.1.1:** - Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions
2. **SC.8.N.1.2:** - Design and conduct a study using repeated trials and replication
3. **SC.8.N.1.3:** - Use phrases such as “results support” or “fail to support” in science, understanding that science does not offer conclusive ‘proof’ of a knowledge claim.
4. **SC.8.N.1.6:** - Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence
5. **SC.6.P.13.1:** - Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.
6. **SC.6.P.13.2:** - Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.
7. **SC.6.P.13.3:** - Investigate and describe that an unbalanced force acting on an object changes its speed, direction of motion, or both.

COMMON CORE:

1. **CCSS.ELA-Literacy.RST.6-8.3:** - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
2. **CCSS.ELA-Literacy.RST.6-8.4:** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
3. **CCSS.ELA-Literacy.RST.6-8.7:** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
4. **CCSS.ELA-Literacy.RST.6-8.9:** - Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

OBJECTIVES: Students investigate the way simple machines decrease the amount of force necessary to cause an object to move. Using the force sensor, students measure the force required to lift an object with and without a pulley.

SKILLS:

- Students gain experience conducting the following procedures:
- Setting up equipment and work area to measure the force required to lift a mass with and without a pulley
- Designing and building structures to test how pulley systems change the direction or amount of applied force or both
- Assembling fixed and moveable pulley systems

MATERIALS:

- Eurosmart datalogger
- Force sensor with hook
- Pulley
- String
- 0.2-0.5 kg mass
- Balance
- Tinker Toys™ or other building materials

DRIVING QUESTION: *Do simple machines reduce the force needed to move an object?*

LAB SUMMARY: Students construct a pulley support tower and pulley with wheels and string using Tinker Toys or other similar products. Other supplies like coat hangers and pulleys from a hardware store can be purchased if Tinker Toys are not available. Students predict the force required to lift a mass of 0.2 kg. Students will attach the force sensor to the mass and raise it up while recording. They will observe force vs. time on the graph. Next they will set up a fixed pulley with the force sensor at the end of the string so that when the force sensor is pulled down, the mass is pulled up. Holding the force sensor steady, pull down on the string until the mass is lifted off the table. Lower and raise the mass two more times while recording. Stop data recording. Observe the graph of force vs. time. Next they will set up a movable pulley system where the pulley is attached to the mass. The pulley will move with the mass. Students will record the force while pulling up on the string until the mass is lifted off of the table until the force stabilizes. Repeat the lowering and raising of the mass two more times and then stop the recording. Observe the graph of force versus time and note any patterns or observations.