MiSP SIMPLE MACHINES/LEVERS
Teacher Guide, L1

Introduction

The Simple Machines/Levers MiSP five-day unit may be included as part of a physical science energy and motion unit, or as a separate simple machines unit. The MiSP Simple Machines unit should be incorporated into the regular simple machines curriculum and would work nicely as a culminating activity.

This is one of two Simple Machines MiSP units. The other focuses on inclined planes and wedges. Teachers in the MiSP program may choose to do none of these units, one, or both.

Lessons in the unit utilize activities from the AIMS Education Foundation's *Machine Shop*. By purchasing this book, a school may duplicate the activities (a maximum of 200 copies may be made; unlimited rights for duplication are available at a small cost).
(For the book, see: http://wwws.aimsedu.org/aims_store/Machine-Shop-p-886.html. For information on duplication rights, see: http://www.aimsedu.org/documents/duprights.html.)

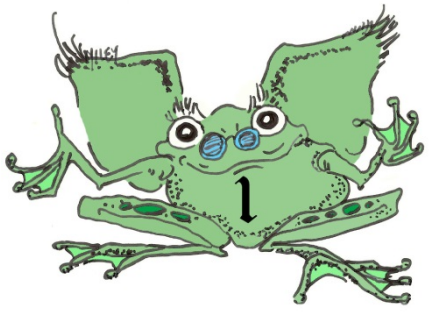
The AIMS activities for this unit are focused on levers, specifically first- and third-class levers, so MiSP instructors may consider doing laboratory activities involving simple machines other than those two. Many of the AIMS activities in *Machine Shop* are worth doing. Instructors may want to plan all of their simple machines lessons using that resource.

Standards

ILST Core Curriculum — Major Understandings:
Standard 4 Physical Setting 5.2c, 5.2f, and 5.2g

Lesson Objectives: After completing this unit *and regular simple machines instruction*, students will be able to:

- Explain that simple machines are used to move things and may increase or decrease force required, change the direction of applied force, or increase or decrease the speed of the object moved
- List (at least) these types of simple machines: lever, pulley, wheel and axle, and inclined plane
- Describe everyday examples of simple machines
- Define and give examples of complex machines



- Collect and graph data from simple machines experiments: mechanical advantage and effort arm length; ideal mechanical advantage and effort distance
- State the relationships shown in simple machines graphs
- Interpolate and extrapolate from simple machines graphs
- Calculate unit rate of change (slope) (L2) and correlate that number with the graphed trends
- Determine the equation of a line on a simple machines graph, and use the equation to calculate *x* and *y* measurements.

Day 1 — Lessons on Simple Machines

Depending on the instruction that has occurred previously, students should review/learn the types of simple machines. (The ILS Core Curriculum lists four: lever, pulley, wheel and axle, and inclined plane. Some textbooks or instructors may include others.) Knowing how frequently we utilize simple machines in our daily lives is important to students' appreciation and understanding of simple machines.

The AIMS levers activities include actual and ideal mechanical advantage. It is not important for the students to understand the difference between the two. Students should understand, however, that mechanical advantage is the number of times that a simple machine multiplies the force (effort) needed to move something (resistance/load).

You may want to consider these online resources for instruction prior to the MiSP unit or for day 1:

http://edtech.kennesaw.edu/web/simmach.html
http://www.science-class.net/Physics/simple_machines.htm
http://www.uark.edu/depts/aeedhp/agscience/simpmach.htm

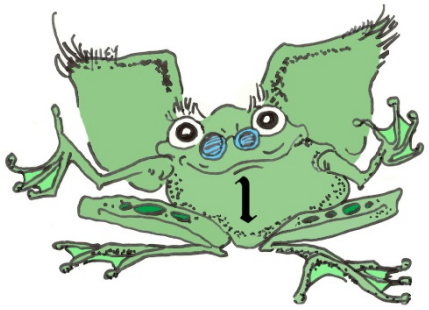
Part of day 1 should be used to introduce or even begin the day 2 activity: Clever Lever 1.

Question of the Day:

Archimedes said, "Give me a lever long enough and a fulcrum on which to place it, and I shall move the world." Is that possible?

Day 2 — Clever Lever 1: *Machine Shop*, pages 38–44

Depending on overall plans, the class, and the students, and in consideration of the five-day MiSP unit length, this activity may be conducted as a student lab or teacher demonstration, or the teacher may choose to present only the data.



Introduction, materials, background information, and procedures for the activity are on pages 38–40. Student instructions are on pages 41–44. Students will utilize MiSP Worksheet #1.

For the purpose of analysis at Levels 1, 2, or 3, you will need to do only the four trials with a resistance of 3 pennies; 12 cm resistance arm length; and effort forces of 1, 2, 4, and 6 pennies. However, it is worthwhile doing and discussing all of the trials, if time allows.

Procedure notes:

Pennies minted after 1982 are recommended to provide uniform masses.
The balancing of the meterstick lever takes some patience and may prove to be frustrating for some students.

Question of the Day:

How could you use a lever to determine the weight or mass of an object even if the other, known masses you had were lighter than the object you wanted to determine the mass of?

Days 3 and 4 — Clever Lever 3: *Machine Shop*, pages 65–75

Introduction, materials list, background information, and instructions on how to set up and run the activity are on pages 65–67. Necessary student materials are on pages 69–70 and possibly page 72. Graphing and questions are on Worksheet #2.

The MiSP activity consists only of Part One: Distance. If time allows, classes may do Part Two: Force. Help the students notice that the shorter the effort arm length, the greater the force needed to move the resistance 4 cm.

If possible, the setups should be done before the students arrive. Directions on page 70 mention making a bar graph of the ideal mechanical advantage, but the bar graph is not necessary. Also, the instructions on Worksheet #2 direct the students to graph the mechanical advantage and the distance the effort moves. The AIMS instructions ask the students to use the effort arm length instead of the mechanical advantage. Both should produce a straight line.

Day 5

Administer the appropriate level assessment.