

Subject: Science

Grade: Seventh

Standard: #7 The Mathematical World

**Key Concept:** Mathematical statements can be used to describe how one quantity changes when another changes. Rates of change can be computed from differences in magnitude and vice versa.

**Generalization:** Work, mechanical advantage, and efficiency can be calculated to determine how a change in one quantity affects other quantities in the equation.

**Background:** Students have been studying a unit on force, motion, and energy. They have covered the definition of work and how to calculate work. They can identify six simple machines. The teacher has given a short quiz on this material and has grouped the students according to their scores on the test and their math ability. Pairs, triads, or quads work well.

This lesson is tiered in *process* according to *readiness*.

**Tier I: *Basic***

**Materials:** spring scale, meter stick, a variety of objects. Students practice finding the amount of work done when each object is lifted, using the formula,  $\text{Work} = \text{Force} \times \text{Distance}$ . Students may also be given a worksheet of problems that use the calculation of work as the focus.

**Tier II: *Grade Level***

**Materials:** Students should be given simple machines or pictures of simple machines and asked to determine whether the machines have the mechanical advantage of force, of distance, or of changing direction. Also give students a worksheet for practice in calculating mechanical advantage ( $\text{MA} = \text{Output force}/\text{input force}$ ). Students should choose one of the problems or one of the machines and set up an investigation to illustrate one of the forms of mechanical advantage.

Tier III: *Advanced*

Students should choose a particular type of compound machine (lawn mower, electric mixer, etc.) and research the output and input forces. From those figures, they can calculate the efficiency of the machine ( $E = \text{output force}/\text{input force} \times 100\%$ ). Students should plan an experiment to determine the efficiency of their machine.

Assessment:

Teacher observation and student interviews during the investigation will serve as formative assessments. Each group's calculations will be assessed for accuracy. Experimental design should be assessed with a rubric.