The Mechanical Advantage of Ramps

Annotation
In this group lab students will be studying how inclines, friction, and the force applied to a block affect the ideal and mechanical advantage. Applications can be made in a physical science or a physics classroom, and the level of difficulty can be easily changed by changing the factors of the equation.

Primary Learning Outcome
Students will understand the concepts of and relationships between inclines, friction, force, and the two types of mechanical advantage.

Assessed GPS
SCSh3: Students will identify and investigate problems scientifically
SCSh4: Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5: Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations
SPS8: Students will determine relationships among force, mass, and motion
SP1: Students will analyze the relationships between force, mass, gravity, and the motion of objects

Total Duration
20 minutes lecture on topic
5 minutes lab intro and explanation
30 minutes to conduct the lab

Materials
Ramp
Spring to measure Newton's of force
Block to be pulled by spring
Meter stick
Student data page (attached)

Procedure
- Each group sets up a ramp and measures the length and height. Record.
- Pull with, even force, a block of wood up the ramp. Have one team member pull and another lean over and watch the Newton reading to ensure an even force and an accurate reading. Record the force used.
- Repeat two times, using the same person to pull each time.
- Answer the questions on the student data page.

Assessment
Assessment of understanding is based off correctness of calculations and ability to communicate the relationships studied. Similar questions can be asked on a unit test.

Mechanical Advantage Student Data Page

Name: _____

DATA

Length of Plane (Effort Distance) _____cm _____m

Height of Plane (Resistance Distance) _____cm _____m

Weight of Block (Resistance Force) _____N

Force used to Pull Up Plane (Effort Force) _____N

CONCLUSIONS

1. What simple machine is the ramp? How does it make a job easier?

2. Does it take more or less force to lift the block using the ramp?

3. Which Mechanical Advantage is greater: Ideal or Actual?

4. What force causes a difference in the ideal and actual mechanical advantage? (It is a force that always works against motion.)

5. In this lab, what could you do to reduce the force that works against motion?

OBSERVATIONS

1. Calculate the work done in lifting the block without the ramp. To do this, multiply the weight of the block (F) time the height of the inclined plane (d). Be sure to change cm to m when measuring the height of the ramp.

2. Calculate the work done in lifting the block with the ramp. To do this, multiply the effort force (F) times the length of the inclined plane (d). Be sure to change cm to m when measuring the length of the ramp.

3. Calculate the ideal mechanical advantage using the formula:

IMA = length of ramp/ height of ramp

4. Calculate the actual mechanical advantage using the formula:

AMA = weight of block/ effort force