

George & Artie Martin

Macomb County Elementary Science Olympiad Simple Machines

The Simple Machines covered by this competition will be:

Lever Inclined Plane Pulley Screw Wheel & Axle Wedge

The competition will consist of ten (10) stations. Students will have two (2) minutes at each station.

Each station will present examples of one or more simple machines. These may be physical objects, photographs, drawings, scale models, or a shop constructed apparatus.

Objects at the station may be compound machines consisting of two or more simple machines. A station may consist of two different sizes of the same simple machine for comparison purposes.

Students will answer 10 questions at each station. All questions will be multiple-choice. Questions may be valued as one-point or two-point questions.

The first five questions at each station will test the student's ability to identify simple machines using the objects, photographs, drawings, models, or apparatus provided. THESE QUESTIONS WILL BE USED AS THE TIE BREAKER.

We will use the terms "Effort" and " $Force_{IN}$ " for the input, and "Load" and " $Force_{OUT}$ " for the output of any simple machine.

"Effort arm" refers to the straight-line distance between the point where effort is applied and the fulcrum or pivot point. Likewise, "Load arm" is the distance between the fulcrum and the load.

Students should know and understand the following relationships:

$$\text{Work} = \text{Force} \times \text{Distance}$$

$$\text{Work}_{IN} = \text{Work}_{OUT}$$

$$\text{Force}_{IN} \times \text{Distance}_{IN} = \text{Force}_{OUT} \times \text{Distance}_{OUT}$$

$$\text{Mechanical Advantage} = \text{Force}_{OUT} / \text{Force}_{IN}$$

Students should know and understand the concept of Mechanical Advantage and be able to estimate the mechanical advantage by comparing the ratio of forces or distances. Friction and other losses will be ignored. Any calculations will use whole numbers or simple fractions. Calculators are not required nor permitted.

Any measurements required will be made with devices provided by the event supervisors. DO NOT bring rulers or other measuring devices. Units will be specified (i.e. cm, grams, inches, pounds, etc.) at each station.

Identifying Simple Machines

There has been some confusion on how to identify the simple machines in a compound machine. This is due to the different way in which simple machines are classified and taught. For example, some texts describe

a screw as an inclined plane wound around a shaft,
a wedge as two back-to-back inclined planes, or as a moving inclined plane,
a wheel and axle as a round (or rotating) lever,
or a pulley as a special case of the wheel and axle.

For our purposes, the six simple machines listed above shall be considered unique. No simple machine can be more than one machine at the same time.

That said, a compound machine is an object that combines two or more different simple machines. Objects used in the competition may be compound machines.

So...if the object at station #1 is a screw, DO NOT select inclined plane for that object. (You might select wedge if the screw has a sharp point, though not all screws do.)
If the object at station #2 is a pair of scissors, then DO select lever AND wedge.
If the object at station #3 is a pulley, DO NOT also select wheel and axle unless there is a separate and distinct wheel and axle as part of the object.
If a wheel turns, but the axle does not, DO NOT select wheel and axle. The wheel merely reduces friction.

Sample Questions

Measure the distance between the Fulcrum and the Load (or Effort).
Measure the length of the Effort Arm (or Load Arm).
Is more force applied to the Effort or the Load?
Which moves farther, the Effort or the Load?
Which moves faster, the Effort or the Load?
If the Effort moves "X" inches, how far will the Load move?
How many rotations must the Effort make to move the Load X cm?
Identify the labeled points on the object (Effort, Load, Fulcrum, etc.).

Frequently asked questions

Q: What is the difference between an inclined plane and a wedge?

A: Simply put, an inclined plane is stationary and the effort is applied directly to the object being moved. A wedge (and also the load) moves when the effort is applied to the wedge.

Q: Will the students be asked to identify first, second, and third class levers?

A: YES

Q: Will the students be required to calculate Newtons or Joules?

A: NO