

Finding Mechanical Advantage (MA) of a Simple Machine: The Wheel and Axle System

LEARNING AREA: Inquiry and Research

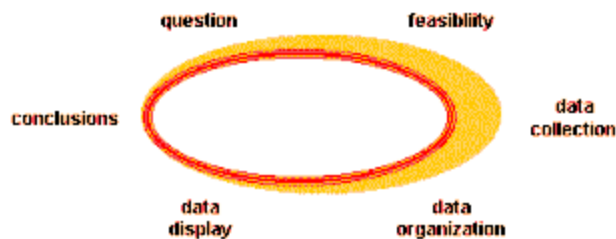
EDUCATIONAL LEVEL: 9th Grade Physical Science

CONTENT STANDARD: Math Research

A student shall design and conduct an investigation on a mathematical topic by:

1. selecting and refining a topic through research;
2. formulating generalizations about the topic;
3. documenting insights gained during the investigation;
4. connecting new concepts to familiar ideas in mathematics;
5. using mathematical properties to support conclusion.

LARGE PROCESSES/CONCEPTS:



ASSESSMENT TASK:

DESCRIPTION: In this activity, students will identify both the wheel and axle components of a wheel and axle system. The students will then use measurements of the wheel and axle components of a tractor, train, plane, and car in order to calculate the mechanical advantage (MA) of each mode of transportation.

PRODUCTS/EVIDENCE OF LEARNING:

- *Identification of wheel and axle components of a wheel and axle system
- *Analyze wheel and axle data.
- *Analyze MA
- *Predict MA

ASSESSMENT TASK: Finding Mechanical Advantage (MA) of a Simple Machine: The Wheel and the Axle

OVERVIEW:

OBJECTIVES:

The student will be able to:

- *Identify the wheel and axle components of a wheel and axle system of various types of modes of transportation including a tractor, a train, a plane, and a car
- *Measure the radius of the wheel and axle components of the above mentioned systems
- *Analyze data concerning MA of wheel and axle systems
- *Compute MA of wheel and axle systems using a given equation
- *Make predictions regarding data concerning MA of wheel and axle systems.

STATEMENT OF THE PROBLEM:

How do the wheel and axle of different modes of transportation such as tractors, trains, planes and cars increase the vehicle's MA?

SOLUTION TO PROBLEM:

By using the following equation, MA can be measured. The radius of the wheel and axle need to be measured in the same units, millimeters (mm) for example.

radius of wheel = r_w

MA =

radius of axle = r_a

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Name _____

PROCEDURE:

1. Collect field data recording both the radius of the wheel and the radius of the axle of a tractor, a train, a plane, and a car. Use the data table below to record data. To collect this data, you will have to go out into your community. **Note to teacher:** The teacher can provide the data if it is not feasible for the students to collect the data.

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TABLE 1

MODE OF TRANSPORTATION radius of wheel (divided by) radius of axle = MA

Tractor _____
Train _____
Plane _____
Car _____

2. Compute the MA of each mode of transportation by using the given equation.
Then record it into Table 1.

ANSWER THE FOLLOWING QUESTIONS:

1. Which wheel and axle system has the greatest MA?

2. Which wheel and axle system has the lowest MA?

3. Which mode has the smallest axle?

4. Which mode has the largest axle?

5. Which mode has the smallest wheel?

6. Which mode has the largest wheel?

7. If the radius of an axle is increased, but its wheel size stays the same, does will the MA increase or decrease?

8. If the radius of the wheel is increased, but its axle size stays the same, does the MA increase or decrease?

9. Is a high or low MA desirable in transportation? Explain.

10. What can be done to create the desirable MA? List several examples.

CHECK LIST: FINDING MECHANICAL ADVANTAGE (MA) OF A SIMPLE MACHINE:
THE WHEEL AND AXLE

STUDENT	TEACHER	
_____	_____	1. Correct identification of wheel on tractor, train, plane and car
_____	_____	2. Correct identification of axle on tractor, train, plane, and car
_____	_____	3. Accurate measurement of wheels
_____	_____	4. Accurate measurement of axles
_____	_____	5. Precise analysis of wheel and axle measurements
_____	_____	6. Precise calculations of mechanical advantages
_____	_____	7. Accurate manipulation of wheel/axle sizes to predict new MA