Machine Mania

Students are presented with the problem of making four simple machines to make the work of moving an object easier. To solve this problem, students must apply the concepts they have learned about simple machines and work.

◆ Expected Outcome

Students must make their machines using only the available materials. Expect them to come up with a wide variety of solutions to this problem. Some possible machines are as follows. Students can make a first-class lever by placing a rectangular block on a triangular block. An inclined plane can be made by propping one block against another block. Students can poke a pencil through two circular pieces of cardboard to make a pair of wheels and an axle. The object can be tied to the pencil with string. The object will move when the wheels are turned. Students can make a fixed pulley by holding a dowel in place horizontally and running the string over it. One end of the string can be tied to the object and the other end can be pulled to lift the object.

Students are also asked to name the benefit provided by each of their machines. Of the machines listed above, the inclined plane and the wheels and axle multiply force. The fixed pulley changes the direction of the force. The first-class lever multiplies force if the distance from the fulcrum to the input force is greater than the distance from the fulcrum to the output force. If not, it multiplies distance. In either case, a first-class lever changes the direction of the force.

◆ Content Assessed

This Performance Assessment assesses students' understanding of simple machines and the concept of work.

◆ Skills Assessed

applying concepts, making models

◆ Materials

- A set of wooden blocks can be divided among several students.
- Each student should be provided with a small object to move with his or her machines. Consider taping four or five large washers together to make an "object." Be sure that the objects can be tied to a string.
- Cut circles out of thick cardboard for students to use as wheels. Alternately, give students scissors and compasses and let them cut out their own circles.
- Also provide students with small wooden dowels, a pencil, and lengths of string.

◆ Time

40 minutes

◆ Monitoring the Task

- Tell students that they do not have to use all of the materials they have been given. In addition, they may use some materials more than once.
- Encourage students to be as creative as possible in making their machines. Other materials you may wish to provide include ring stands, rubber bands, rulers, and straws.
- You may want to have a contest to see which student can come up with the greatest number of machines.
- When students are determining the benefit provided by their lever, remind them to consider what class of lever it is.

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In assessing students' performance, use the following rubric.

	4	3	2	1
Making and Describing Machines	Student makes at least four machines. Student correctly identifies each type of machine and how each makes work easier. Students' sketches and descriptions are complete and easy to understand.	Student makes four machines. Student correctly identifies each type of machine. Student correctly tells how three of the machines make work easier. Student includes a sketch and description of each machine.	Student makes three machines. Student correctly identifies the type of each machine. Student correctly tells how two of the machines make work easier. One or two of student's sketches and descriptions are missing or incomplete.	Student makes fewer than three machines. Student correctly identifies the type of only one or two machines. Student correctly tells how only one or two of the machines make work easier. More than two of student's sketches and descriptions are missing or incomplete.
Concept Understanding	Student demonstrates a mastery of the concepts of simple machines and work.	Student demonstrates a good understanding of the concepts of simple machines and work.	Student demonstrates a partial understanding of the concepts of simple machines and work.	Student demonstrates minimal understanding of the concepts of simple machines and work.

Name _____ Date _____ Class _____

PERFORMANCE ASSESSMENT

Machine Mania

◆ Problem

How can you make four simple machines (a lever, an inclined plane, a pulley, and a wheel and axle) to make the work of moving an object easier?

◆ Suggested Materials

small object
2 small wooden dowels
2 cardboard circles
2 rectangular wooden blocks of different sizes
sharpened pencil
triangular wooden block
length of string

◆ Devise a Plan

1. Study the materials provided and think of different ways they could be used to make simple machines.

2. Experiment with the materials and use them in different combinations to move the object.

3. On a separate sheet of paper, draw a sketch of each of the machines you make. Then copy and complete a table like the one shown below. In the column headed Benefit of Machine, tell whether the machine multiplies input force, multiplies input distance, or changes the direction of the exerted force.

Description of Machine	Type of Machine	Benefit of Machine

◆ Analyze and Conclude

After completing your table, answer the following questions on a separate sheet of paper.

1. If you had to choose just one of your machines to move the object, which would you choose? Explain the benefits of that machine in terms of input force, input distance or direction of force.

2. Calculate the ideal mechanical advantage of your lever and your inclined plane. Show your work. Which of these two machines has the greater ideal mechanical advantage?

3. How could two of your machines be combined into a compound machine?