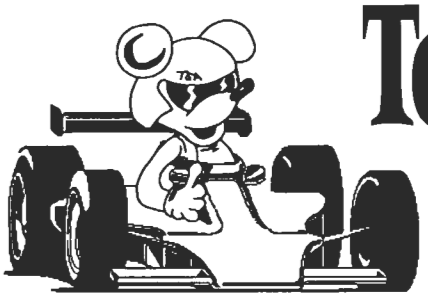

Technology Challenge: Mousetrap Vehicle

Introduction

In this activity, you will design and build a mousetrap powered vehicle that will demonstrate how power can be transmitted mechanically to accomplish some work. The mousetrap vehicle is propelled when the arm of the mousetrap is released, converting the **potential energy** stored in the spring of the mousetrap to **kinetic energy**. The movement of the arm (**work**) is transmitted to the axles of the vehicle. The power generated during the movement of the arm can only do a certain amount of work. Using **simple machines** in your design will not increase the amount of work, but can change the amount of force needed to propel the vehicle and the distance it will travel. The change in force and distance is called **mechanical advantage**.

This activity will be different from many of the other activities you have completed. You will not be given all of the procedures for designing and building your vehicle. Rather, you will have to use your own creativity and problem-solving abilities to complete this activity. Before you begin work on your design, you should do some research on simple machines and mechanical advantage.

Job Description

In this activity, you are going to design and construct a mousetrap powered vehicle for possible entry in a local competition. You will first build a **test vehicle** to determine how you can improve the vehicle's design and efficiency. You will then build your first **prototype**, constructing the vehicle to meet the criteria for a specific contest in which your vehicle may be entered. The final product will depend on your understanding of mechanical advantage and your ability to apply what you have learned. The test vehicle, your research, and experimentation are important factors that will determine your success.

Materials and Supplies

To complete this activity, you will need the following materials:

graph paper
ruler
Victor mousetrap (See Figure 1.)
hand tools
cotton fishing line
    or monofilament
aluminum rod, 3/16" diameter (for axles)
set of four wheels
balsa wood
    or bass wood, 1/4" x 3" x 36"
white glue
cardboard
    or foamcore board scraps

NOTE: The nature of this activity relies on your creativity; the above list is just a guide or starting place. Based on your design requirements, additional construction materials may be needed. Always refer to the contest rules when attempting to use new materials.

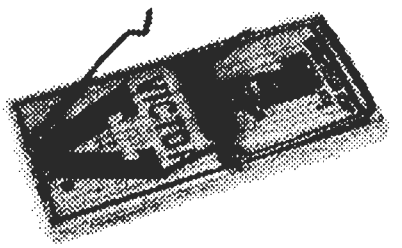

Figure 1 - Victor Mousetrap

Building the Test Vehicle

1. The first vehicle you will build will be a test vehicle. This vehicle will be a starting point in your discovery of power transmission principles, the application of simple machines, and mechanical advantage.

2. Study the drawing in Figure 2. Notice that the vehicle shown consists of a mousetrap, four wheels attached to two axles, and a **flywheel** or **transmission** attached to the rear axle. Note also that a line is attached to the arm of the mousetrap and is wound around the flywheel.

3. The mousetrap is set and the arm is in the locked position. When the arm is released, the force of the spring will cause the arm to move forward. As the arm moves, the string will start to unwind, causing the flywheel and axles to turn, thus moving the vehicle forward.

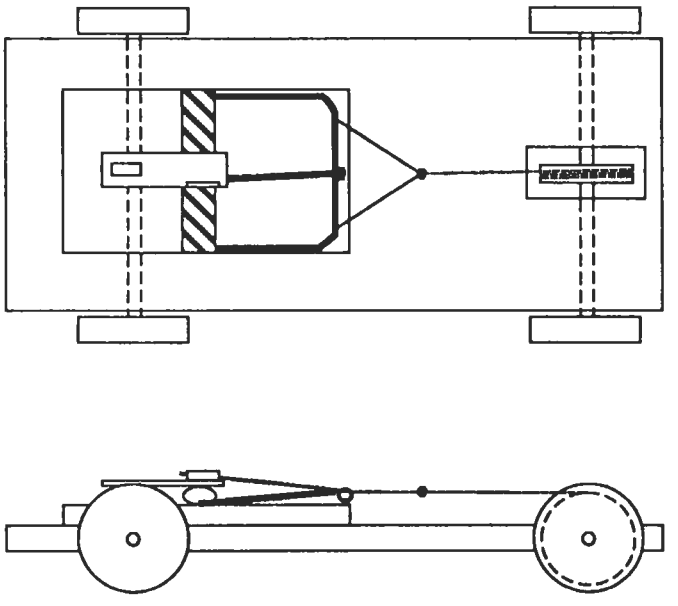

Figure 2 - Sample Mousetrap Vehicle Design

4. Using the materials provided, construct a test vehicle. Your design may be similar to the example in Figure 2.

Note: You will use this model to conduct test runs. Remember to experiment with simple machines to improve mechanical advantage.

Research and Development

Another step in the **design loop** is **research and development**, more commonly referred to as R and D. Doing research is an integral component in the design of new products. Knowledge is one of the most important **resources** that you will use in the design of your vehicle.

1. Go to the library and begin a search of the data bases that are available to you. Before you begin your data search, make a list of some key terms or phrases that will assist you in research.

2. Write down everything that you think will be helpful in designing your vehicle.

3. Make a series of **thumbnail sketches** of possible design ideas. (See Figure 3.) You will have to select one of your design ideas to use in building your prototype.

4. After you have decided which design you will use, you must begin to gather the materials with which you will build your model.

Note: Carefully read the rules and specifications of the competition you are entering to make sure you are using only the proper materials.

5. You are now ready to begin construction of your prototype. There is no set procedure for building the prototype. You must de-

pend on your own creativity and resourcefulness to complete the activity.

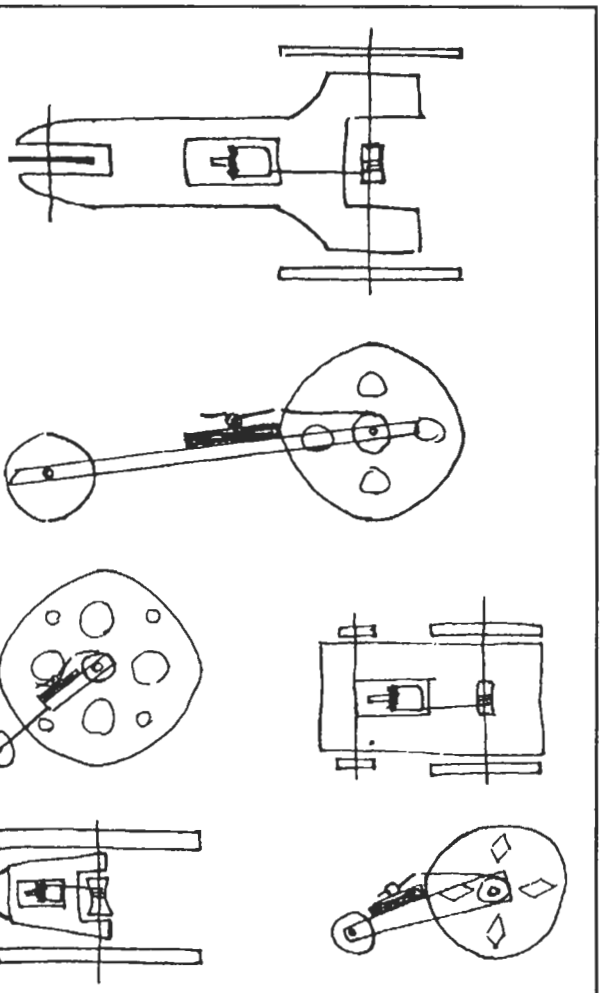

Figure 3 - Sample thumbnail sketches

Helpful Hints for Engineering a "Better" Mousetrap Vehicle

- Axles need to spin freely.
- Wheels need to be attached firmly to the axles.
- The vehicle needs to travel in as much of a straight line as possible.
- You need to slow down the drive axle so it does not spin too rapidly.
- Wheels need good traction with the road surface.
- You need to keep the mousetrap arm from moving too quickly. A slow, continuous pull is required.
- The greater the diameter of the drive wheel to the actual diameter of the axle, the greater your mechanical advantage will be.
- The string or fishing line needs to be stretched tightly before releasing the mousetrap.
- The string or fishing line needs to be attached to the axle; however, as the mousetrap arm comes to rest after it is released, the string or fishing line needs to release itself from the drive axle.
- Any method of reducing friction between moving parts will increase efficiency. Use bearings on axles!
- Total vehicle weight will have an important effect on the distance attained; the less weight per unit of power, the greater the efficiency.

Entering Your Mousetrap Vehicle in a Competition

If you plan on entering your mousetrap vehicle in a competition such as the Dade County Youth Fair, obtain a copy of the rules and read them carefully. After reading the rules can you answer the following questions? What maximum size is the car allowed to be? Are you permitted to use bearings? What materials are **not** allowed to be included in the mousetrap car?

Here are some basic rules; however, you should read your specific contest rules very carefully before you begin construction.

1. The mousetrap itself cannot be altered in any way.
2. Only the mousetrap can be used to propel the vehicle. No additional power gener-

ating materials can be used. No rubber bands or elastic materials may be attached to the arm.

3. Either axle can be the drive axle.

4. No part of the vehicle can be across the starting line before the mechanism is released.

5. The swing of the arm is considered as part of the overall size of the vehicle.

6. Both the height of the wheels and the height of the swinging arm are considered as part of the overall height of the vehicle.

7. Wheels must be made. Commercial wheels are not permitted on the contest vehicle. However, commercial wheels can be used as wheel hubs and attached to the axle.

8. Friction reduction bearings are permitted.

9. The arm can be extended by adding to the original arm; however, the original arm can not be altered in any way.

The Fair
Dade County Youth Fair & Exposition

Summary of Dade County Youth Fair Specifications

1. Only one entry per student.
2. The spring must remain on the trap.
3. The spring cannot be wound tighter.
4. Rubber bands, elastic cords, or additional springs may not be used.
5. No commercially produced wheels may be used.
6. All power for the vehicle must be delivered from the movement of the trapbar.
7. The trapbar can be extended.
8. The vehicle must meet the following specifications before and after being raced:
   Maximum Length - 24"
   Maximum Width - 12"
   Maximum Heigth - 12"

Safety

When working with your mousetrap, be careful when pulling back the arm. It can easily slip and catch your fingers, causing serious injury. The arm should not be pulled back until the mousetrap is attached to either a test stand or the vehicle body. When using tools in the laboratory, you must follow all the safety rules posted.

Vocabulary

engineering
energy
prototype
kinetic
power
resources
mechanical advantage
machine
potential energy
work
design loop
flywheel

Ecology

Many of our natural resources are becoming scarce and, as a result, more expensive. When working on your design, be careful not to waste materials. Try to recycle whenever possible. What might be waste to you may be of value to someone else.

Vehicles in the future must be energy efficient as well as environmentally friendly. The use of alternate energy, such as solar or wind power, may offer such possibilities.

On Your Own

1. Visit the library and research some recent invention or innovation. Look up how it was designed and how it has impacted society.

2. Experiment with different kinds of wheels for your mousetrap vehicle. Try such things as records, compact disks, pie plates, or coffee can lids.

dcp
Office of Vocational, Adult, Career, and Community Education
Technology Education
Dade County Public Schools
Miami, Florida

TEACHER GUIDE
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE

OBJECTIVES: Upon completion of this assignment, students will be able to:

- Design and build a system using a common mousetrap as the power source.
- Test and conduct experiments to improve the mechanical advantage of the system.
- Design a prototype vehicle to enter into a specific competition, and insure that the vehicle meets all of the design criteria for the contest.

Helpful Hints:

1. Begin this activity with a movie or video on simple machines, mechanical advantage, mechanisms, and/or power transmissions.

2. Find examples of simple machines in your classroom; have your students demonstrate each machine.

3. Start a "scrounge box" of anything that could be used in the construction of a vehicle and ask students to contribute.

4. The following is a partial list of vendors who carry mousetrap vehicle supplies.

Hearlihy & Co.	1-800-622-1000
Kelvin Electronics	1-800-535-8469
Midwest	1-800-831-5904
Modern School Supplies	1-800-243-2329
Pitsco	1-800-835-0686

Local hobby shops:	
Orange Blossom	633-2521
Pan American International	635-3134

LANGUAGE ARTS APPLICATION
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE

_____
Student Name

In all types of jobs you will find that you need the ability to communicate your ideas effectively. Writing skills are necessary in all occupations.

In this activity package, you will be exposed to some new vocabulary related to power and energy transmission. An important skill you will need throughout your life is the ability to find out what a specific word or technical term means. In the space below, write out the meaning of each of the terms.

1. Flywheel: _____

_____

_____

2. Friction: _____

_____

_____

3. Kinetic Energy: _____

_____

_____

4. Mechanical Advantage: _____

_____

_____

5. Power: _____

_____

_____

LANGUAGE ARTS APPLICATION
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE (Cont'd.)

6. Potential Energy: _____

_____

_____

7. Torque: _____

_____

_____

8. Transmission: _____

_____

_____

9. Perpetual Motion: _____

_____

_____

10. The Law of Conservation of Energy states that energy can be transformed from one form to another, but can never be created or destroyed. How does this law apply to your mousetrap vehicle?

_____

_____

_____

_____

_____

MATH APPLICATION
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE

_____
Student Name

In all types of jobs and occupations, you need the ability to apply mathematics effectively. Here are a few examples of how math skills are used in relation to this activity.

After completing your mousetrap vehicle, your class may decide to have a competition. Students could have distance races to determine which design travels farthest. The mousetrap vehicles would need to be raced several times. After calculating the average of each racer, a winner could be determined.

To find the average distance a mousetrap vehicle travels, add the totals from each race then divide the sum by the number of races.

Total distance of all races ÷ number of races = average distance traveled

Example: Tanya's mousetrap vehicle raced three times and recorded the following distances, 37 feet, 45 feet, and 51 feet. What was the average distance Tanya's mousetrap vehicle traveled?

Solution:

Step 1 - Find the sum of the three races.

37 feet
45 feet
+ 51 feet
133 feet

Step 2 - Divide the sum by the number of races.

average distance traveled = 133 ÷ 3

average distance traveled = 44.33 feet

Try these:

_____ 1. Wally raced his mousetrap vehicle in four races. The distances recorded were 62 feet, 71 feet, and 82 feet. What was the average distance Wally's mousetrap vehicle traveled?

_____ 2. The total distance traveled by a mousetrap vehicle racing five times was 318 feet. Calculate the average distance traveled by the mousetrap vehicle?

_____ 3. Calculate the average distance traveled by Mary's mousetrap vehicle. The following distances were recorded, 59 feet, 67 feet, 41 feet, and 70 feet.

MATH APPLICATION
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE (Cont'd.)

Calculate the averages for the following recorded distances:
(Use area provided to calculate your answers.)

_____ 4. 83 feet, 77 feet, 68 feet, 59 feet.

_____ 5. 61 feet, 55 feet, 73 feet.

_____ 6. 96 feet, 88 feet, 93 feet, 85 feet.

_____ 7. 58 feet, 47 feet, 63 feet, 48 feet, 60 feet, 59 feet.

_____ 8. 73 feet, 78 feet, 68 feet.

_____ 9. 107 feet, 122 feet, 116 feet, 109 feet.

_____ 10. 93 feet, 85 feet, 81 feet, 90 feet.

QUIZ
TECHNOLOGY CHALLENGE: MOUSETRAP VEHICLE

_____
Student Name

True or False:

_____ 1. Work is defined as weight multiplied by height (work = w x h).

_____ 2. Potential energy is stored energy.

_____ 3. When potential energy is used it is changed to magnetic energy.

_____ 4. Work is measured in foot-lbs.

_____ 5. Power is energy per unit of work.

_____ 6. Energy cannot be created or destroyed.

_____ 7. Motion that results in something useful being done is called work.

_____ 8. Work is defined as weight multiplied by distance (work = w x d).

_____ 9. Mechanical advantage is a change in force or direction.

_____ 10. A simple machine only does simple work.