Mousetrap Vehicles  Grades 3-12  90 mins

LEARNING GOALS: After the completion of this workshop, students will understand:

1. What is kinetic energy (energy of motion-KE)?
2. What is potential energy (energy of position-PE)?
3. Which part of the vehicle accounts for each type of energy (released spring for KE, held spring accounts for PE)
4. What are some forces that work against motion (friction, loss of torque)?

CONCEIVE – What do I wish to accomplish through this project?

This stage involves guiding students in defining the goals of the project, then helping them develop conceptual, technical and action plans to meet those goals while considering the technology, knowledge, and skills that apply. This guidance is provided in the form of Essential Questions that use student’s preconceptions, and misperceptions then move them toward a deeper and more realistic understanding of the process and skills needed to complete the project.

ESSENTIAL QUESTIONS:

1. Did your design take advantage of the most kinetic energy that the mousetrap could provide?
2. How would you change your design in order to maximize the energy available and minimize the friction?
3. What other types of vehicles or transportation that use the same type of energy?

DESIGN - How will I accomplish the project?

This stage focuses on creating the plans, drawings and algorithms that describe the product, process or system that will be implemented.

A mouse trap-powered racer is a vehicle that is powered by the energy of a wound-up mousetrap's spring. The car works when one end of a string is tied to the arm on the mousetrap and the other end is wound around an axle. By winding the string around the axle the mousetrap's spring is stretched providing stored energy. As the mousetrap is released it pulls the string off of the axle causing the wheels to turn and making the car move.
Objective:
Build a vehicle powered solely by the energy of one standard-sized mouse trap, (1 3/4" X 3 7/8"), that will travel the greatest linear distance.

Let students come up with their own design as much as possible, giving design help when needed

Review with students
1. What is kinetic energy (energy of motion)
2. What is potential energy (energy of position)
3. Which part of the vehicle accounts for each type of energy (released spring accounts for KE, held spring accounts for PE)
4. What are some forces that work against motion (friction, loss of torque)

NOTES:  :  http://auto.howstuffworks.com/auto-parts/towing/towing-capacity/information/fpte9.htm  or  http://hyperphysics.phy-astr.gsu.edu/hbase/ke.html

IMPLEMENT - From an idea to a product!
This stage refers to the transformation of the design into a product. It includes hardware, manufacturing, software coding, testing and validation.

These directions can be passed out to the students or placed on a powerpoint

How To Build A Mouse Trap Car

There are many ways to build a mouse trap car depending on the requirements of the designer and purpose of the car. Even the materials of the parts that you will use may vary depending on your mouse trap car’s needs.

Remember that there is no single correct way to create this type of contraption. There are many right ways as much as wrong ways. But for the purposes of providing beginners and Physics class students who are in desperate need of help, we will provide the basic parts and steps needed to build your own mouse trap car.
Instructions:

1. The first thing you have to do is attach the four eye hooks on the mouse trap’s base. Two eye hooks are placed on short end of the mouse trap. Be careful to make sure that the holes of the eye hooks are aligned.

2. Measure the axles. Make sure that the axles fit the eye hooks. There should be enough space for the rods to turn. The length of the axles must be longer than the mouse trap to avoid friction. Make sure that the axles are parallel to each other.

3. Put the rubber washers. Position them near the eye hooks. This will keep the axle in position and prevent it from moving or sliding sideways when moving. Remember to leave some space between the rubber washer and the eye hook to allow movement of the axle.

4. Glue the wheels on the axle. The wheels should be firm and secure to be sure that no energy will be wasted when it starts moving. Be aware of your wheels’ traction capability as well. Smooth materials like plastic may require additional traction.

5. Tie the string on the jaw of the mouse trap. Make sure that it is secure and tied tightly. To keep it from sliding, you could tape it or glue it in place.

6. Coil the other end of the string to the rear axle. The direction of the coil should be opposite the direction of the mouse trap car’s intended movement direction.

7. Test it. Adjust the arts if necessary to make sure that the contraption would move as far or as fast as you intend it.

These are just the basic steps in building a mouse trap car. But, as we said, there are various ways in making your own. You can be creative by adding or improving the car’s parts. Remember that by changing the size or length of certain parts of your car, you may achieve different results which may be better or worse than the results of our basic mouse trap car.
Do not limit your mouse trap car design with the steps that we have provided. You can make your mousetrap car as complicated as you want with additional gears or pulleys for additional power or you could incline the body of the car with the front loser than the back portion for aerodynamics.

Now, start making your mouse trap car.

**OPERATE – Does it work the way I planned?**

This stage uses the built product, process or system to satisfy the intended goal.

Set-up race a course with stop watches and have the students race their cars and tweak their designs to try to improve their speed (torque) and reduce their friction.
RESOURCES NEEDED – What equipment and supplies do I need?

Materials:
- 1 wooden mouse trap
- string
- 4 wheels
- 2 axles (preferably light but hard, cylindrical rods)
- 4 eye hooks
- 4 metal washers
- 4 rubber washers

Tools:
- tape
- epoxy or super glue
- scissors
- graphite powder (optional)
- stop watch (optional)

SET-UP

Give each student one set of the above materials and this is an open inquiry project. Have them build their car, test it and make improvements as time allows. Allow a little time at the end to discuss their designs and what they learned about kinetic energy and explain the physics behind the project.
### Colorado State Standards - High School

| Concepts and skills students master: |
| 1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion - but have limitations. |
| 5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined |

### 21st Century Skills

| Inquiry Questions: |
| 1. What factors can be measured to determine the amount of energy associated with an object? |
| 2. What are the most common forms of energy in our physical world? |
| 3. What makes an energy form renewable or nonrenewable? |
| 4. What makes some forms of energy hard to measure? |

### Colorado State Standards – 8th Grade

| Concepts and skills students master: |
| 1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object’s change of motion |

### 21st Century Skills

| Inquiry Questions: |
| 1. What relationships exist among force, mass, speed, and acceleration? |
| 2. What evidence indicates a force has acted on a system? Is it possible for a force to act on a system without having an effect? |

#### Relevance & Application:

| 1. Engineers take forces into account when designing moving objects such as car tires, roller coasters, and rockets. |
| 2. Vehicles and their propulsion systems are designed by analyzing the forces that act on the vehicle. |

### Colorado State Standards – 7th Grade

N/A

### Colorado State Standards – 6th Grade

N/A

### Colorado State Standards – 5th Grade

N/A

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<td><strong>1. Physical Science</strong></td>
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* 2 staff recommended