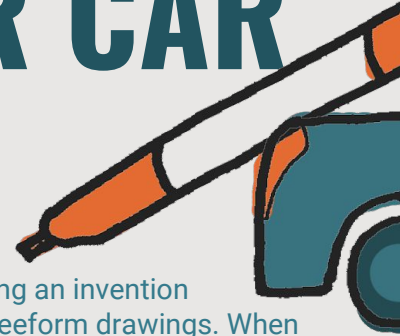


MOTORIZED MARKER CAR

MIDDLE SCHOOL LEVEL 1



Motors are a surefire way to spark interest in your students. Everybody loves watching an invention come alive. In this project, we will motorize a toy car and attach markers to create freeform drawings. When we counterbalance the motor and attach a power supply, it charts a random path that's recorded by markers. Try switching markers to add new colors. Layers on layers will make for a great piece of art.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

COMMON CORE CONNECTION:

ELA/Literacy

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS3-5)

WHST.6-8.1 Write arguments focused on discipline content. (MS-PS3-5)

Mathematics

MP.2 Reason abstractly and quantitatively. (MS-PS3-5)

6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-5)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS3-5)

8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-5)

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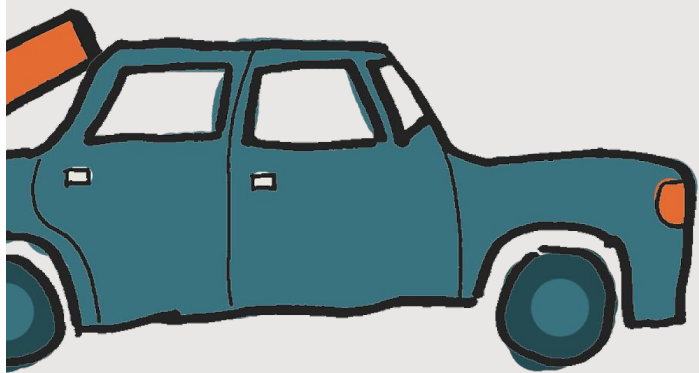
Level 3: Strategic Thinking
Level 4: Extended Thinking

MATERIALS NEEDED:

- Toy car
- 1.5v hobby motor
- A dime
- Washable marker
- Electrical tape
- AAA Battery
- Wire
- Paper
- Glue guns

DIRECTIONS:

1. Attach wires to the positive and negative terminals on the motor.
2. Hot glue a quarter to the end of the motor arm. This will provide the counterweight that vibrates the motor. Glue the coin off-center to create the vibration.
3. Glue the motor to the top of the toy car with the dime facing the front of the car. The position of the motor will also impact the movement of the car.
4. Glue your marker to the back of the car with the point of the marker touching the ground underneath.
5. Attach a battery to the motor terminals using electrical tape, then tape the battery to the car.
6. Put the car down on a large piece of craft paper and let it rip!



OBJECTIVE:

Students will be able to use their toy car to construct an argument that change in kinetic energy is caused by energy transferring into or out of the object.

ESSENTIAL QUESTIONS:

- What causes the car to start moving or to stop? Speed up? Slow down?
- What factors cause the car's motion to change?

ENGAGE / EXPLORE

1. Students are provided a car to study what causes the cars to move
2. Task students with experimenting to construct an argument on energy
3. Students may use the marker set up and counter balances to add additional variables to test
4. Or they may use the marker set up as a measuring tool
 - a. Determine what factors (energy change) affect the rate of motion of the car (length of drawn lines in time)
5. Evaluate
 - a. Students experiment
 - b. Argument
 - c. Misconceptions

EXPLAIN:

1. Review conservation of energy with students; they may use PhET skate park simulator.
2. Practice identifying energy and types (gravity, electrical, kinetic, thermal)
3. Supplemental research from text and internet may be used.

ELABORATE:

1. Students revise their experimental model and arguments to support a claim about the effects of changing kinetic energy
2. Students should discuss the available potential energy to affect the kinetic
 - a. Type of battery
 - b. Amount of charge left
 - c. Number of batteries
3. Evaluate
 - a. Students experiment
 - b. Argument
 - c. Misconceptions

