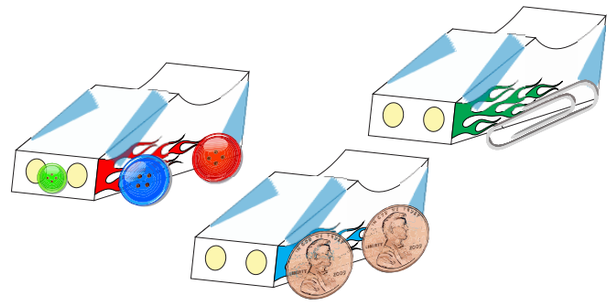
Pizza Racers



ENGINEERING AND DESIGN PROJECT THAT EXPLORES ENGINEERING CONCEPTS OF ENERGY, MASS, FRICTION AND SCIENTIFIC PROCESS.

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Scope and sequence

- Step 1: **Design Challenge** – Design a cardboard racer that gets to the bottom of the Pizza Box ramp first.
- Step 2: **Discussion and reflection** – Discuss and define engineering concepts explored in design challenge.
- Step 3: **Controlled experiment** – Identify variable to test further through experiment following scientific process.

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Racer Engine: Shake It mini

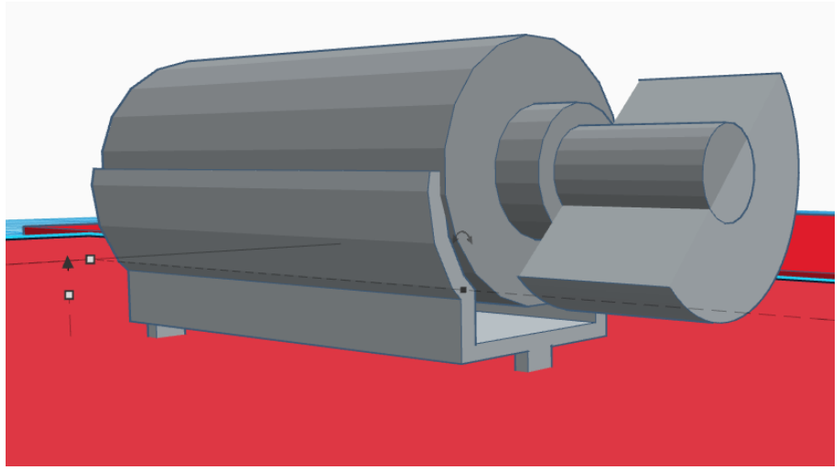
Vibrating Motor

Battery Pack with On/Off Switch

Place it on a hard surface and use the on/off switch to turn it on. Notice how it vibrates and moves.

Why does it vibrate?

ERM Motor (Eccentric Rotating Mass)



Vibrations are created by **centripetal force** on an **unbalanced mass**

Additional information at this video: https://vimeo.com/128603396

Design Challenge

Build a **Pizza Box Ramp**. Use painter's tape to make a race track on the pizza box. You can decide on the design or race constraints.

For example, the winner must stay in their lane or must win by touching front of car to end of ramp.

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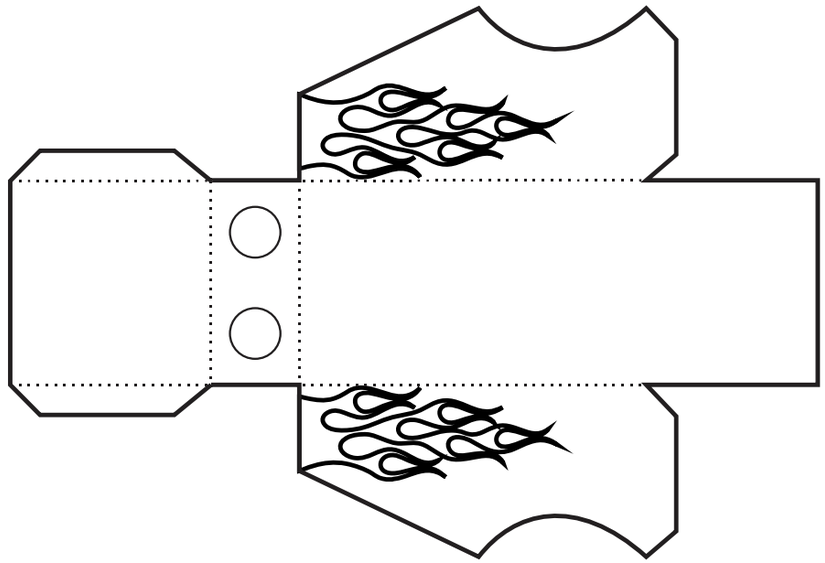
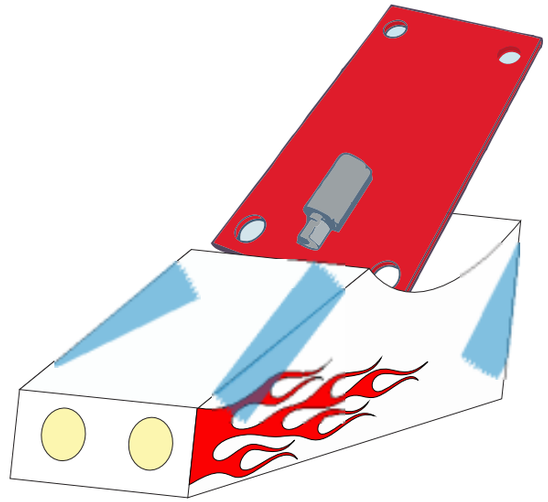
Design Challenge

Start by cutting out car outline, taping it together.
Then insert a **Shake It mini** and observe how it goes down ramp.





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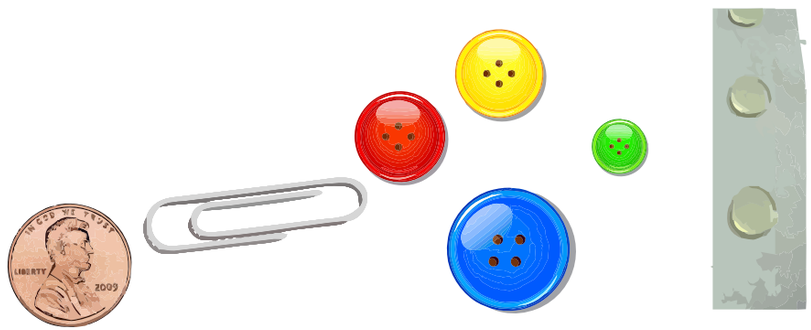
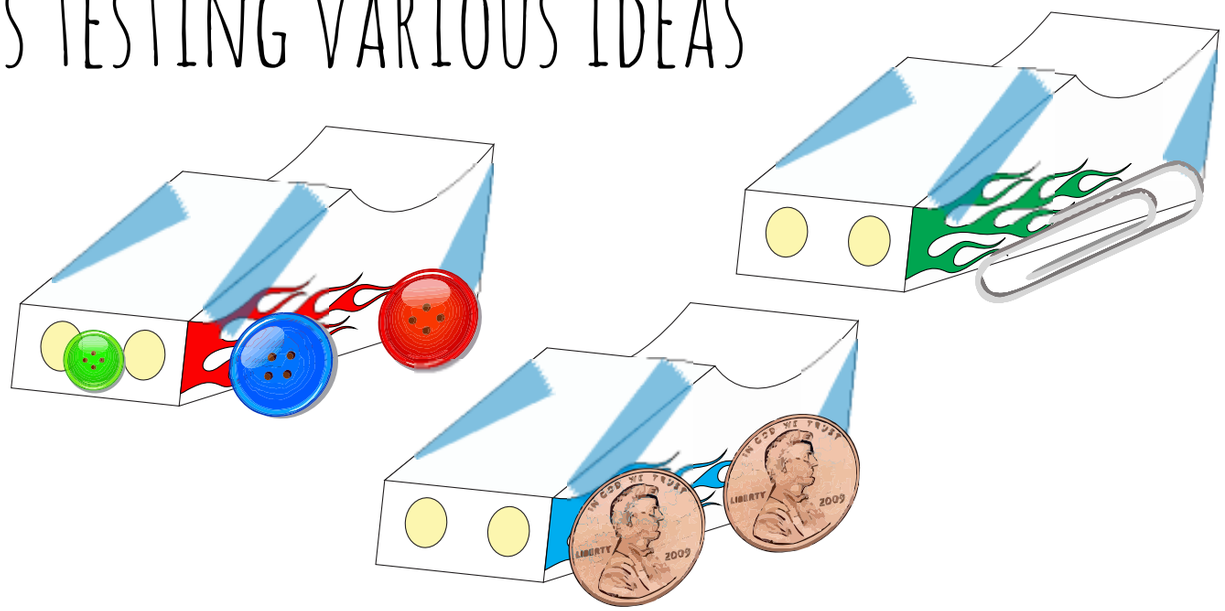
Design Challenge

How can you improve the car? Brainstorm ideas.
test different modifications to car using materials provided.
Build and iterate multiple cars testing various ideas





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Discussion and Reflection

Why did some designs move faster than others?

Why were some designs more predictable than others?

What are the most important variables that you should consider when building a car?

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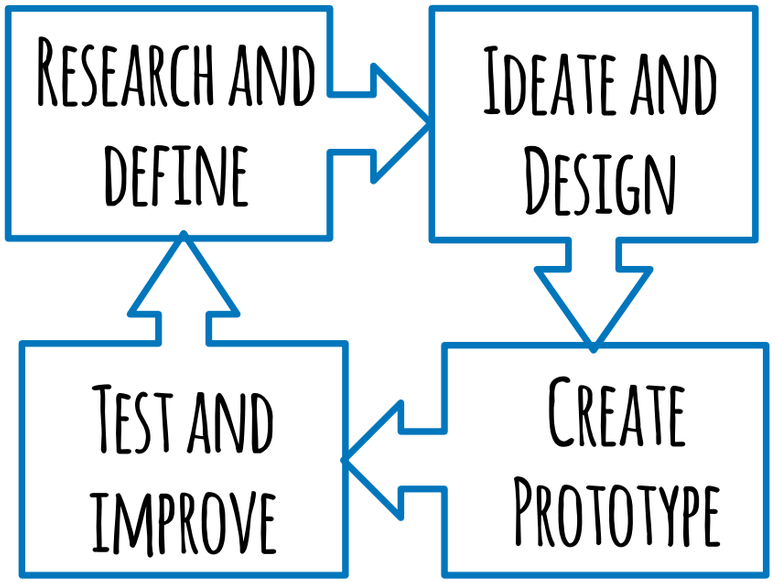
Engineering Concept:

Design Process



Engineering Concept:

Relationship of Mass and energy

Newton's 2nd Law F=MA

F is constant since it is generated by the motor.

What does that mean happens to acceleration as the mass changes (what happens when the car is heavier)?

Engineering Concept:
Friction

friction

noun fric·tion \ ˈfrik-shən \

“the force that resists relative motion between two bodies in contact”

Where is friction in this system?

What causes friction in this system?

How can we influence friction in the car design?

Engineering Concept:

Potential energy

lectrify

Merriam-Webster

potential energy

“the energy that a piece of matter has because of its position or nature or because of the arrangement of parts”

Where Does the car have more potential energy (top or bottom of ramp)?

Does a heavier car have more potential energy than a lighter car?

Can we use potential energy to make car go faster?

Engineering Concept:

Transfer of Energy

- Where does the vibrating energy go when the car is going down the ramp?
- Which cars did the best job transferring energy?
- Which cars did the worst job transferring energy
- How can design influence the transfer of energy?

Controlled experiment

- Identify variable to study further
- Design experiment to test that variable alone
- Formulate hypothesis of outcome prior to experiment
- Perform experiment
- Evaluate outcome