



Challenge #3 Motor Building

Due Tuesday, April 21

On November 23, 2019 Occidental College hosted the First Technical Workshop. During the Motor Building Workshop, students built a motor out of a battery, magnets, wire and some paper clips. This challenge is based on that workshop, and focuses on electromagnetic and electrical forces, with the goal of understanding how an electric motor works.

Challenge details:

- **Utilize the Pasco Scientific website:**
 - For this challenge, you need to use the link below to access materials from Pasco Scientific, which are made available free to students during this time of shutdown.
 - [Student Access - Essential Physics 3rd Edition](#)
Student Access Code: NGSS58653-EP3-SB-0720-M5UJJ
- **Complete the attached worksheets:**
 - After you sign in, select the "Video" icon.
 - Select Chapter 19, Electromagnetism
 - Use the information from that video and other materials in that section to answer the questions in the attached worksheets.

This activity is worth 100 points. You will earn points based on the percentage of answers you get correct.

While you're on the Pasco website feel free to look at the other chapters, there is so much good information which may help you with your regular school classes.

Responses can be emailed to Julie Miller Kalbacher at jamiller@mwdh2o.com Make sure to include your name and school name on your responses.

Good luck with this challenge and with all of your schoolwork.

Challenge #3 Worksheets

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The winner of this challenge will be the person that gets the most questions correct.

To begin, follow the link and use the code below to log on to the Pasco website:

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After you sign in, go to the “Video” section and use the materials from Chapter 19 to complete the following questions:

- How can we use a current-carrying wire to create a *powerful* magnetic field?

- What do you call a device which uses electric current through multiple loops of wire to create a magnetic field? _____
- Where is this device found on your boat? _____
- How do you make an electromagnet? _____
- What is the “Right Hand Rule” _____

- What controls the direction of a magnetic field of a wire with electrons flowing in it?

- What does this equation mean: $F_B = ILB$ _____

- What is the difference between a generator and a motor? _____

- Define these four basic parts of a DC motor:
 - Stator _____
 - Rotor _____
 - Commutator _____

○ Brushes _____

- Why does the polarity of the magnet in the stator alternate? _____

After you have gone through the material in section 5 “Physics behind the Electric Motor” click on the “Interactives” button on the top of the page. Click on “Electric motor simulation”, it’s the only choice you have.

Bring up the electric motor simulation window. Play with it a while to get the feel for how it works, then answer the following questions:

- With the electromagnet at its weakest setting, press the reset button. How can you get the rotor moving? _____
- Move the electromagnet force slider up a bit. What is the best time to reverse the field to maximize the angular velocity? _____
- Is it possible to make the motor move continuously without changing the field direction? _____
- What is the highest angular velocity and score you can get?
 - Highest Angular Velocity: _____
 - Highest Score: _____
- When you recorded these values was the magnet at its highest setting? _____
- Why? _____
- Draw a sketch of the forces acting on the rotor at the instant the field is reversed.

- In a real motor, what makes the field reverse direction to keep the motor spinning? _____

- In a real motor does increasing the field strength to its maximum result in the highest angular velocity? _____