Creating Education and Outreach Resources for Physics Undergraduates

Amanda Williams

SPS SOCK Outreach Intern

Mentored by Brad Conrad and Danielle Weiland

Outreach can take many shapes…


EVERYTHING HAPPENS FOR A REASON

SPS is a vehicle for outreach

Online Demos

SOCK

Online Demos

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All | Optics | Astronomy | Electricity & Magnetism | General Physics | Mechanics | Acoustics

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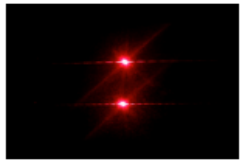
Pinhole Projector

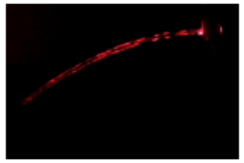
Fabric of the Universe



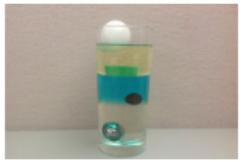
Hair Diffraction

Composition of the Universe

Eclipses: Earth-Moon-Sun Model

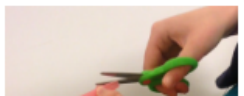


Light Fountain



Density Column

Reflection & Refraction



Online Demos

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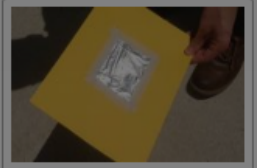
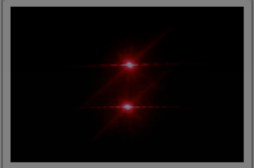

Pinhole Projector


Fabric of the Universe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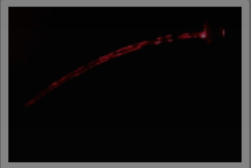
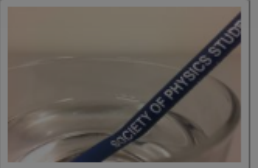
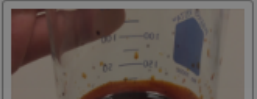
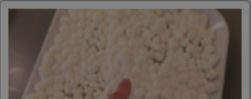

Light Fountain

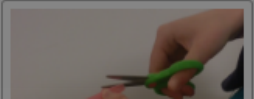

Density Column

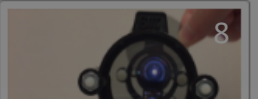


Reflection & Refraction









Online Demos

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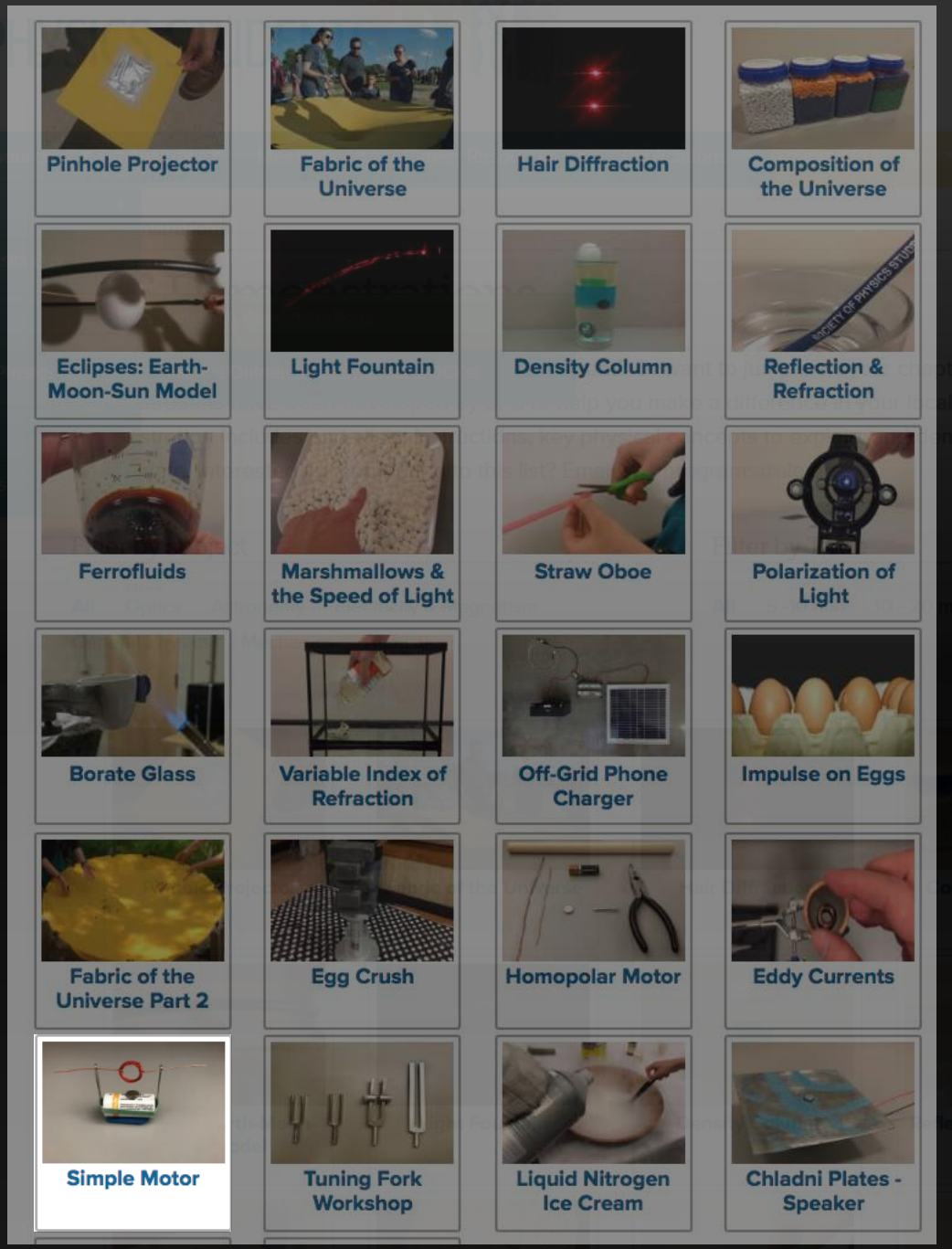
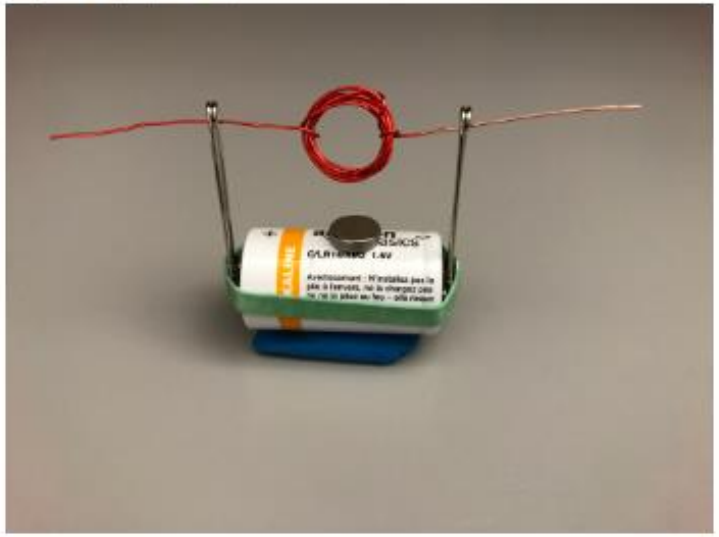


Online Demos

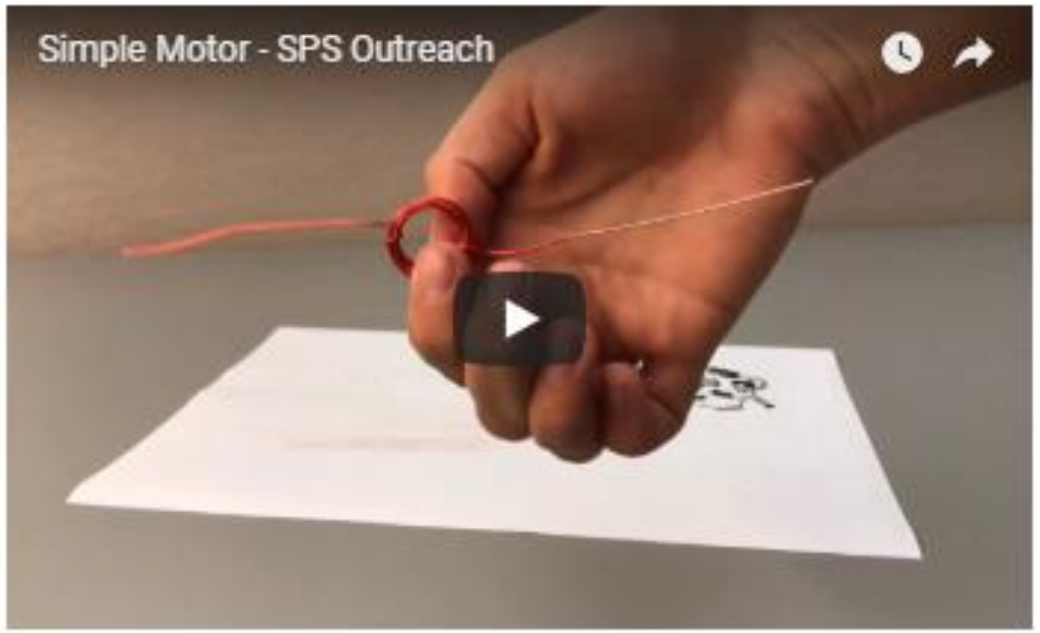
Simple Motor

View | Edit



By: Amanda Williams

Construct a simple motor out of everyday materials in this workshop. Particpants learn first hand how to leverage the science of electricity and magnetism to create useful tools that we use every day.



Download instructions

sps-demo-simple-motor.pdf (474.08 KB)

Science Subject	Time
Electricity & Magnetism	20 - 30 min
Level of Difficulty (1-5)	**Audience**
Level 3	High School (ages 14+)
	Middle School (ages 11-13) & General Public

Electricity and Magnetism

SIMPLE MOTOR

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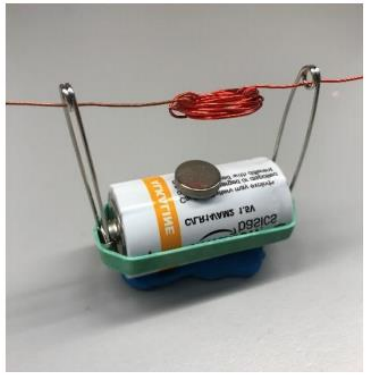
Simple Motor



Workshop

Build a simple electric motor out of everyday materials. Participants will learn about current, magnetic fields, and other physical phenomena that make motors work.

Number of Participants: 2 – 30

Audience: Middle (ages 11-13) and up

Duration: 20-30 mins

Difficulty: Level 3

Materials Required (per participant):

- One C battery
- 2 metal safety pins (large, 5" tall)
- Small magnet (neodymium or equivalent strength, ½ inch diameter)
- ~70 cm of 22 AWG magnet wire
- 1 wide rubber band
- A small piece of sandpaper (3cm x 3cm)
- Sticky putty / tack (optional)

Setup:

1. Make a 10-loop coil of magnet wire. This can be done by wrapping it around a circular object (such as an appropriately sized pen or dry erase marker). Slide it off to create a small coil with diameter of about 2 cm, leaving two ends sticking out a few inches, as in Figure 1. Participants can also do this step themselves, if age appropriate and time permits.

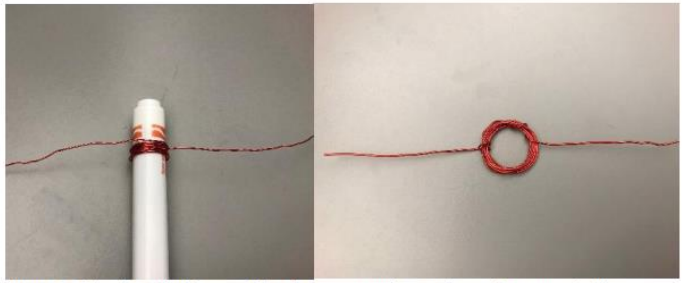


Figure 1 Make the coil of 2 mm with a dry erase marker, and wrap it symmetrically.

nd Magnetism

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American Institute of Physics

Simpl

Workshop

Build a simple
materials. Pa
magnetic field
make motors

Number of P

Audience: M

Duration: 20

Difficulty: Le

Materials Re

- One C
- 2 meta
- Small
- ~70 cm
- 1 wide
- A sma
- Sticky

Setup:

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   off to c
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   age ap

Figure 1 M

2. Distribute materials to each participant.

Figure 2 Materials needed for the simple motor.

3. Have each participant sand the end of the coil in the following way: one end gets sanded down all the way around, exposing the copper wire. **On the other end, sand the bottom side *only*.**

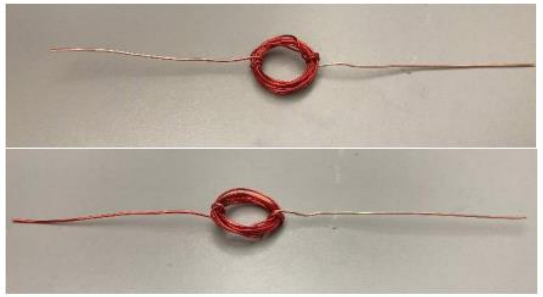

Figure 3 The copper is exposed on 3 out of 4 sides of the coil ends.

Presenter Brief:

Introductory electricity and magnetism topics are key to this workshop. Be familiar with how current flows, electromagnetic induction, circuits, and forces.

Vocabulary:

agnetism
OTOR
ACH
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of Physics

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3. Have each participant s sanded down all the wa **sand the bottom side**

Presenter Brief:

Introductory electricity and ma how current flows, electromag

Vocabulary:

Walk around and help participants assemble the motor as in Figure 4.

Figure 4 Assembled simple motor. Give it a spin.

This demo may take patience to get working. Some troubleshooting tips:

- Make sure the safety pins have good contact with the battery terminals.
- If the coil is leaning too far to one side, you may need to rewrap it so it's more symmetrical.
- Make sure you didn't sand off too much of the wire insulation—one end needs to have enough insulation on one side that the circuit is broken for a moment and keeps the magnetic field changing.
- If using a different gauge wire, adjust the number of turns for the coil; remember in general the induced magnetic field is linearly proportional to the number of coils.

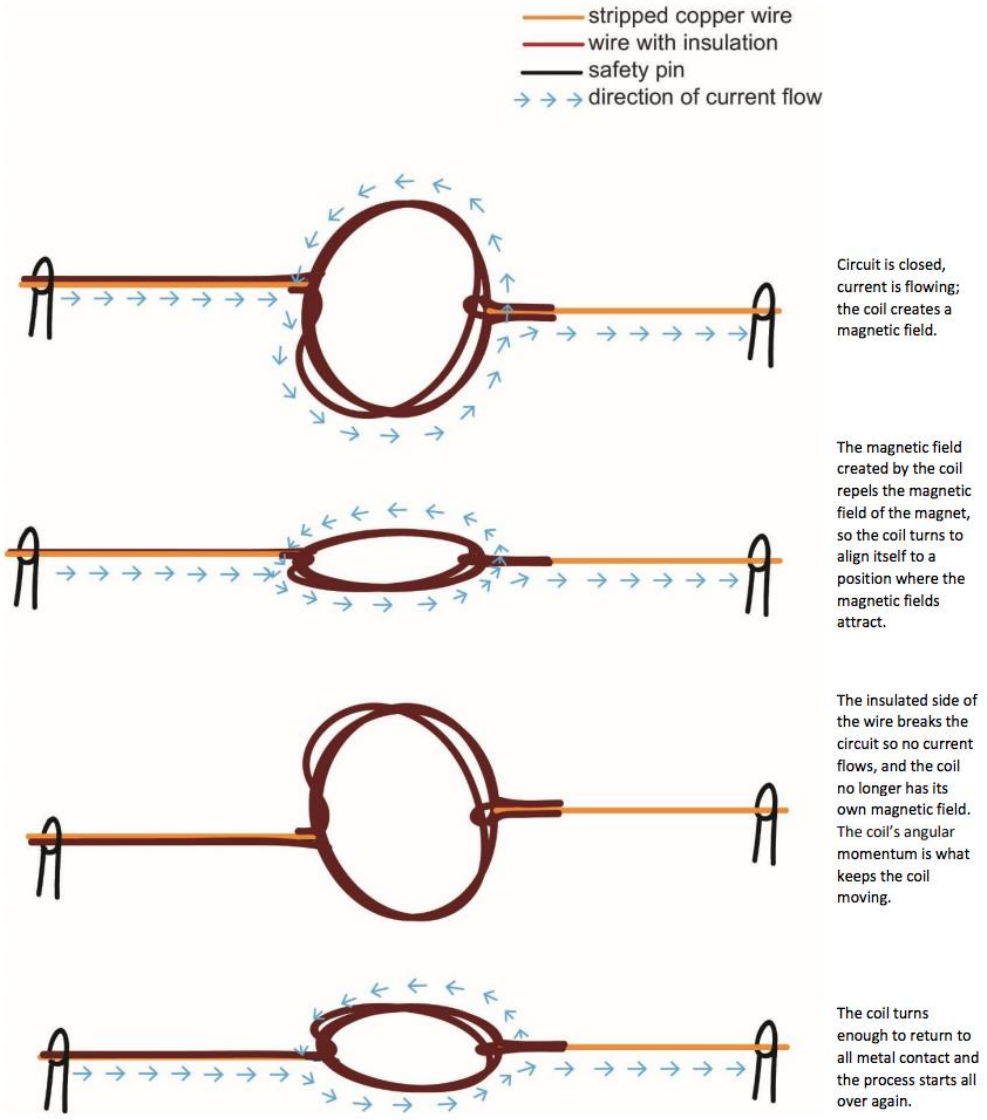
Highschool and up (14+):

An initial current is pushed through the coil from the battery. When you get electric current flowing through a wire, the wire will create a magnetic field. And once you put this coil in an external magnetic field (created by the magnet), the two magnetic fields interact and the coil will spin. These concepts were realized in the 1800's by scientists like Amperé and Faraday and are the basis of many modern-day motors and generators.

🔑 When electric current flows through a wire, it produces a magnetic field. A changing magnetic flux will induce an EMF in the coil, causing current to flow through the coil.

If current was constantly flowing through the coil, then there would be a permanent magnetic field between the coil and the magnet. (If you put a compass close by the

wire, you can detect the magnetic field). This permanent magnetic field would cause the coil to stay still, suspended in the magnetic field; it is only a *changing* magnetic field that will induce a force on the coil. The insulation on the coil is what breaks the circuit and keeps the magnetic field of the coil changing, and thus moving. The angular momentum the coil has gained while trying to align itself is what continues to rotate the coil at the moment the circuit is broken by the insulation.



Astronomy	Acoustics	Optics	General Physics	Mechanics	Electricity & Magnetism
Eclipse Model	Straw Oboe	Variable Index of Refraction	Borate Glass	Density Column	Ferrofluids
Composition of the Universe		Polarization of Light		Egg Drop	Cell Phone Charger
Fabric of the Universe		The Speed of Light		Egg Crusher	Homopolar Motor
Fabric of the Universe 2		Reflection & Refraction			Eddy Currents
Pinhole Projector		Light Fountain			
		Hair Diffraction			

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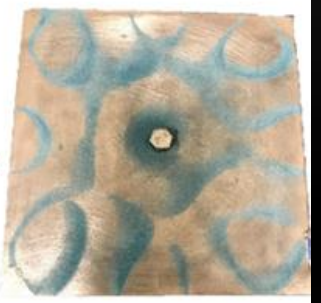
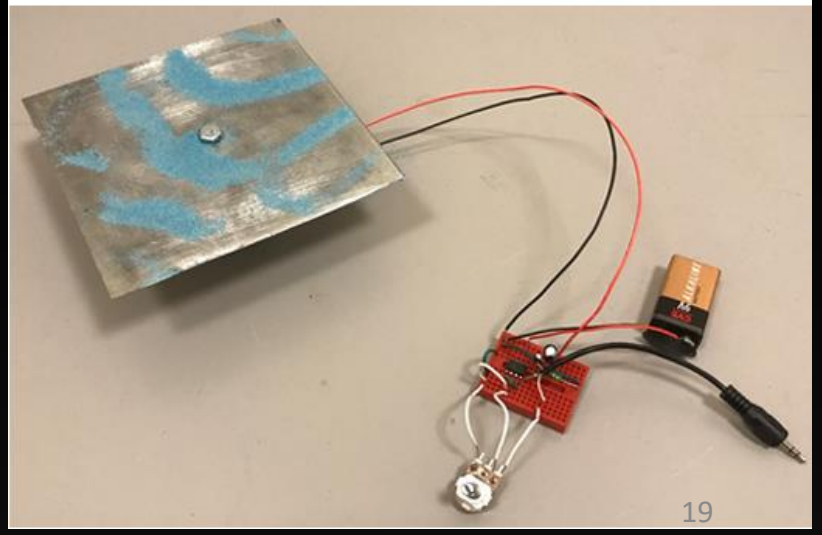
Eclipse Model	Straw Oboe	Variable Index of Refraction	Borate Glass	Density Column	Ferrofluids
Composition of the Universe	Tuning Fork Workshop	Polarization of Light	Liquid Nitrogen Ice Cream	Egg Drop	Cell Phone Charger
Fabric of the Universe	Chladni Plates Violin Bow	The Speed of Light		Egg Crusher	Homopolar Motor
Fabric of the Universe 2	Chladni Plates Speaker	Reflection & Refraction			Eddy Currents
Pinhole Projector	Ruben's Tube	Light Fountain			Simple Motor
	Rijke Tube	Hair Diffraction			Audio Amplifier

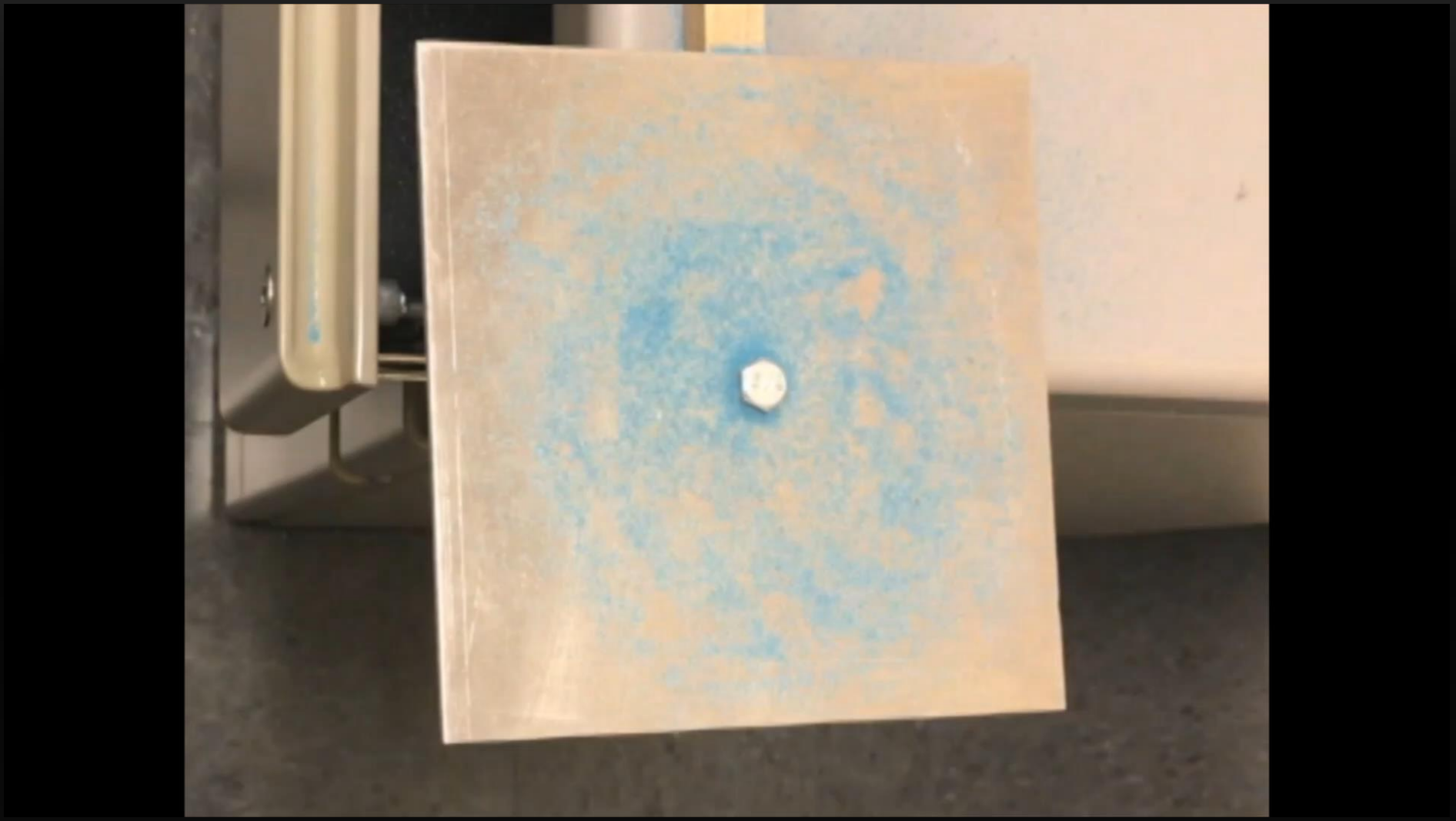
SOCK

S.O.C.K.
science outreach catalyst kit



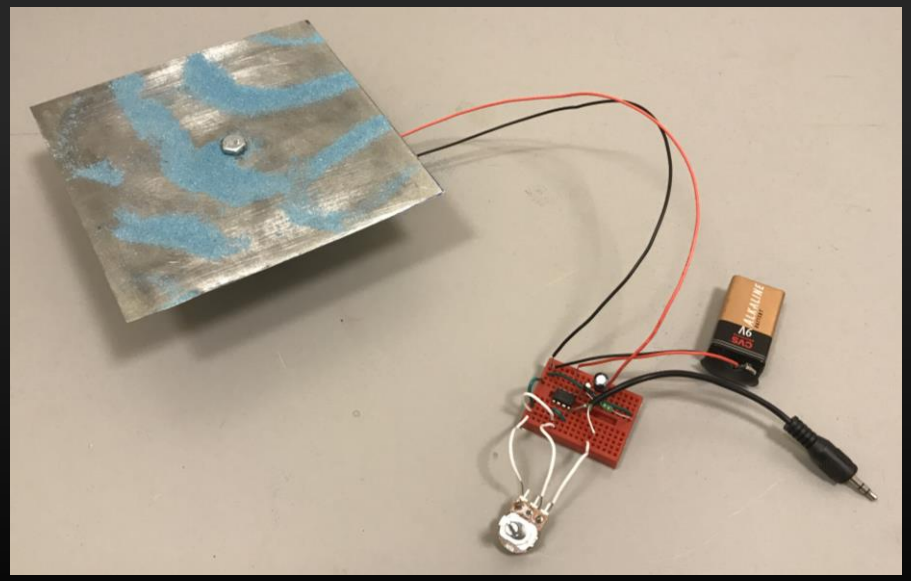


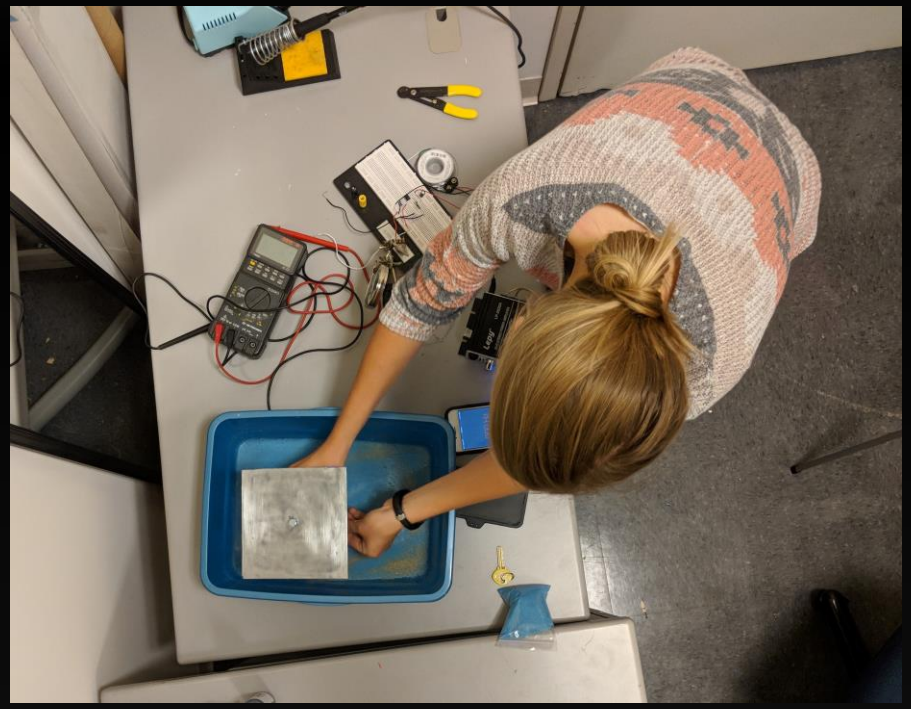
Why Chladni Plates?

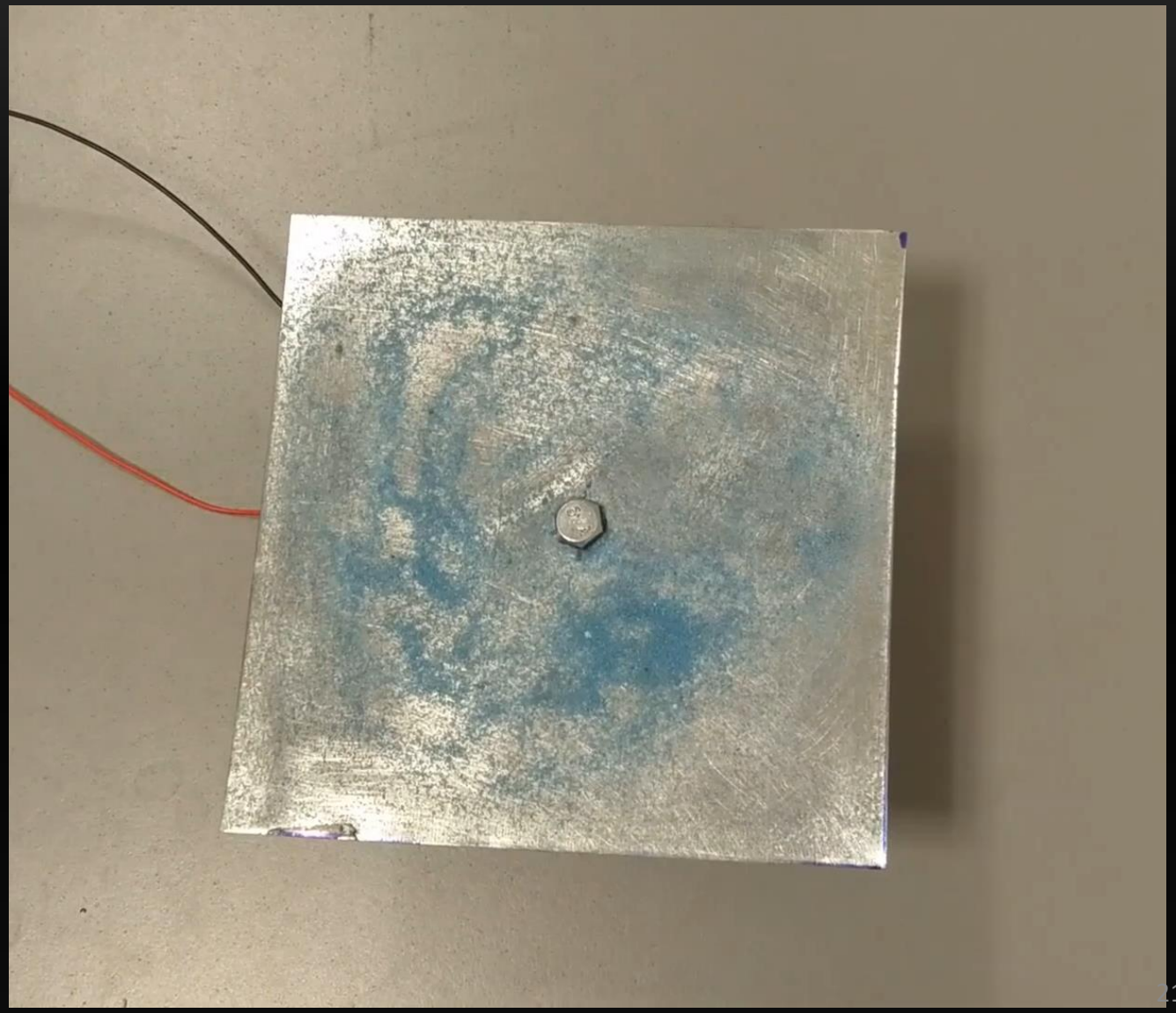


Razzle dazzle!

Encourage play for everyone







Thank You

SPS National
Brad Conrad
Danielle Weiland
James Merrick
Kerry Kidwell-Slak
Michael Welter
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Weber State University

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Questions?