

A Summer of Outreach: Captivating Kids with Physics



Noah Johnson, SPS SOCK Intern, New York University
Brad Conrad, SPS Director, American Institute of Physics



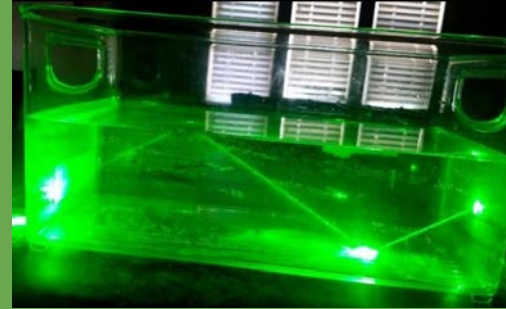
NEW YORK UNIVERSITY

SPS: Outreach

1: SOCK



2: Demos



3: Psi*



4: Chapter Activities



1: Science Outreach Catalyst Kits (SOCK)

Purpose: start or expand an outreach program

2020-2021: Acoustics and Sound

Partnership: Acoustical Society of America (ASA)

Expanded 2020 SOCK:

- Doppler Ball Demonstration
- Elastic Waves Demonstration
- Vocal Folds with Videos
- Soundscapes Examples



2021-2022 SOCK



How Do We Hear?

Sound waves enter the ear from the outer ear (pinna) and travel through the ear canal to the eardrum (tympanic membrane). The eardrum vibrates and causes the ossicles (malleus, incus, and stapes) to vibrate. The stapes vibrates against the oval window of the cochlea, creating sound waves in the cochlear fluid. These waves cause the hair cells in the cochlea to vibrate, which sends signals to the brain.

Figure 1: Diagram of the human ear from "The Science of Sound" by Resnick, Walker, and Halliday.

Introduction to Sound (8-12)
SPS Outreach
Holly Fortner, SPS SOCK Intern

What is Sound?
Sound waves are vibrations of particles that travel from one place to another. They are longitudinal waves. Longitudinal waves are waves in which the particles of the medium vibrate parallel to the direction of the wave's travel.

How Does Sound Travel?
Sound waves are longitudinal waves that travel from one place to another. As shown in Figure 1, longitudinal waves travel in the same direction as the wave's travel.

What is an Echo?
An echo happens when a sound wave reflects off a surface. The reflected wave travels back to the listener, which is why we hear the sound again. The time between the original sound and the echo is called the echo time.

Longitudinal and Transverse Waves
Longitudinal waves are waves in which the particles of the medium vibrate parallel to the direction of the wave's travel. Transverse waves are waves in which the particles of the medium vibrate perpendicular to the direction of the wave's travel.

Reflection and Refraction
Reflection is the bouncing back of a wave when it hits a surface. Refraction is the bending of a wave when it passes from one medium to another.

Figure 1: Diagram of sound waves traveling in a tube.

Figure 2: Diagram of sound waves reflecting off a wall.

Figure 3: Diagram of sound waves reflecting off a wall.

Introduction to Sound (K-7)
SPS Outreach
Holly Fortner, SPS SOCK Intern

What is Sound?
Sound waves are vibrations of particles that travel from one place to another. They are longitudinal waves. Longitudinal waves are waves in which the particles of the medium vibrate parallel to the direction of the wave's travel.

How Does a Shark Hear Underwater?
Sharks have a special sense called lateral line. The lateral line is a series of small organs that help sharks sense vibrations in the water. This helps sharks sense vibrations in the water like a fish's fins.

How Does Sound Travel?
Sound waves are longitudinal waves that travel from one place to another. As shown in Figure 2, longitudinal waves travel in the same direction as the wave's travel.

What is an Echo?
An echo happens when a sound wave reflects off a surface. The reflected wave travels back to the listener, which is why we hear the sound again. The time between the original sound and the echo is called the echo time.

Figure 1: Diagram of sound waves traveling in a tube.

Figure 2: Diagram of sound waves reflecting off a wall.

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2: Demos

Purpose: affordable, engaging, and educational demonstrations for outreach

- Each demo is less than \$20
- Over 40 demos
- Designed for undergrads



Setup:

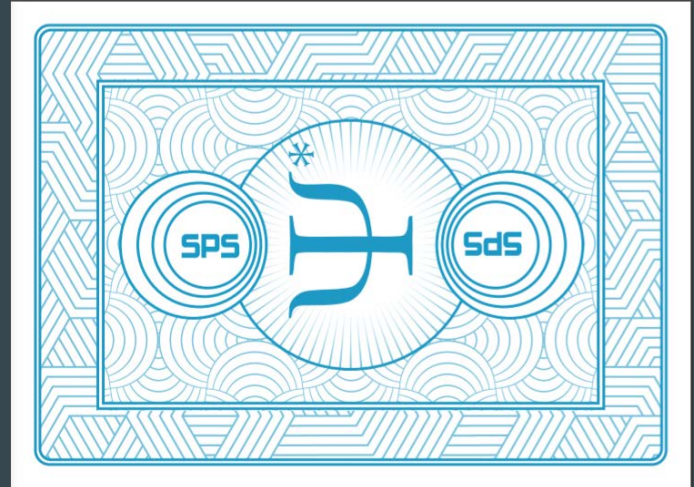
1. There are 3 different phases that can be setup: subcritical, critical, supercritical.
2. Prior to setting up the mousetraps, move the bin to the desired location.
3. To set up the mousetraps, first arm the mousetrap. Carefully place the ping pong ball on the mousetrap. See Figure 1 for an example.
 - a. One way to effectively move a large number of armed mousetraps is to place them on a board and then slide them into the box that the demo will take place in.
 - b. Note that this can take a significant amount of time to setup.
4. Subcritical:
 - a. In the large box, place only a couple of mouse traps (2-5 depending on the size of your box)
 - b. Place ping pong balls on the mousetraps.
 - c. Once those ping pong balls are set, you can throw a ping pong ball into the box in any random spot. This may set off one or two of the mousetraps, but most likely not all of them.
5. Critical
 - a. In the large box, place a decent number of mouse traps (7-15 depending on the size of your box)
 - b. On those mousetraps, *carefully* place ping pong balls
 - c. Once those ping pong balls are set, you can throw a ping pong ball into the box in any random spot. This will likely set off a slow chain reaction of ping pong balls flying around.
6. Supercritical
 - a. In the large box, place as many mouse traps as you can(15-30 depending on the size of your box). See Figure 2.
 - b. On those mousetraps, *carefully* place ping pong balls
 - c. Once those ping pong balls are set, you can throw a ping pong ball into the box in any random spot. This will set off a fast, almost instantaneous, chain reaction of ping pong balls flying around.

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	Tuning Fork	Polarization of Light	Liquid Nitrogen Ice Cream	Egg Drop	Cell-Phone Charger
Fabric of the Universe	Chladni Plates Bow & Speaker	The Speed of Light	Vortex Cannon	Egg Crusher	Homopolar Motor
Fabric of the Universe 2	Ruben's Tube	Light Fountain	Passive Pasta	<i>Racing Cylinders</i>	Eddy Currents
Pinhole Projector	Oscilloscope & Microphone	Hair Diffraction	Slimy Spaghetti and Meatballs		Simple Motor
Gravitational Waves	Longitudinal & Transverse Waves	<i>Reflection and Refraction</i>	Ice and Salt Slushies		Audio Amplifier
Cakeraters	<i>Doppler Ball</i>		<i>Rodent Reactor</i>		
<i>Straw Landing</i>	<i>Elastic Wave</i>				
	<i>Vocal Folds</i>				

3: Psi*

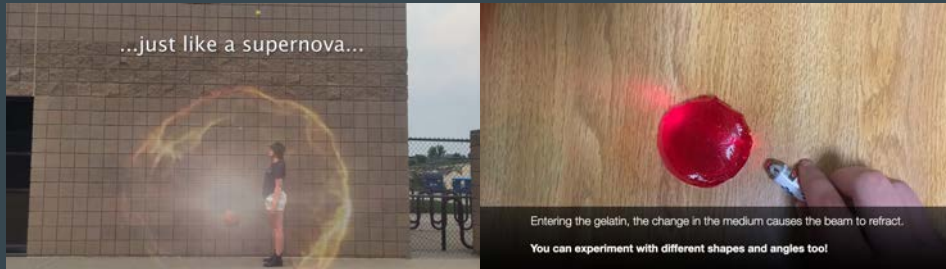
Goal: Physics students use what they learn to save the world

- Created by Randy Tagg (UC Denver)
- Manufacturing version created by Casey Roepke (NIST Intern)
- Audience: Undergraduate students



4: AAPT Summer Meeting Demo Competition & Jeopardy

Organized and Compiled AAPT
Demo Competition



Created and Revised 3 Jeopardies

- Elementary Physics
- General Physics
- Acoustics



The Future

- 2 Years of college remaining
- SPS E-Board
- Focus on outreach in the NYC area
- Pursue a career in education and outreach

