NS 596/732: The Physical Science of Living Systems

Overview

In this course, we will explore and develop an understanding of physical phenomena and physical principles, ranging from the electromagnetic spectrum to the conservation of energy. We will use the knowledge and insights obtained to discuss living systems, from the electrical nature of nerve conduction to the mechanics of moving in air, in the water, and on the land.

This course is intended for current or future K-12 teachers who teach science, or who will teach science, at elementary, middle, or high school level.

Details

The course will be taught over Zoom: https://zoom.us/j/97944234804

Dates: July 14, 15, 16
Times: 9:00 AM - 3:00 PM daily [This includes a 1-hour working lunch]
Credit: 1 credit

To receive credit, participants must attend all daily sessions, complete a daily writing assignment, and create a final lesson plan.
Outline of Topics

Day 1: Electromagnetic Waves & The Electromagnetic Spectrum

9:00  Introductions, Zoom Etiquette, Prep
  • Prep: Get chlorophyll solution ready

9:15  Course & Content Overview
  • Details
    ‣ Overview of course structure / assignment / credit / instructional approach / questions and suggestions

9:30  Engage / Explore: The Electromagnetic Spectrum
  • Rainbow Glasses
  • Writing With Light
  • Infrared Goggles / Infrared Photos

10:15 Break

10:30 Explain: EM Spectrum
  • Scales of energy and wavelength
  • Interaction of electromagnetic waves with matter

11:00 Engage / Explore / Explain: Color Vision
  • Fluorescence of Eye Lens
  • Mixing Colors
    • Look at the spectrum of the different bulbs / created white light
    • Different Visions: How do different animals see the world?

12:00 Lunch

1:00  Engage / Explore: Properties of Electromagnetic Waves
  • Polarization (including tape thing)
  • Bee Vision: Navigating By The Sky

1:45  Engage Explore: Chlorophyll & Photosynthesis
  • Why Are Plants Green?
    • Extracting chlorophyll
    • Chlorophyll fluorescence
    • Chlorophyll chromatography

2:30 Extend / Evaluate
  • Question: How would vision / plant colors be different under different suns?

3:00  Prep & Closing
  • PREP: Get app for the EKG

Assignment
  • Write and upload answers to the following questions:
    ‣ What are the main lessons from this session’s activities and discussions?
    ‣ What questions or uncertainties about this material do you still have?
    ‣ What did this session make you wonder about—what questions did it raise?
Day 2: Sensing Sound & The Body Electric

9:00  Engage / Explore: Wave Properties
• Waves & Interference
• Standing Waves & Standing Wave Modes

10:15  Break

10:30  Explain: Speech, Sound & Hearing
• How your ears sense sound
• Vowels and formants
• Different animals & range of hearing

11:00  Engage / Explore: Electricity
• Forces Between Charges

11:30  Explain: Electrical Quantities
• Field, potential, and voltage
• Circuits

12:00  Lunch

1:00  Engage / Explore: The Body Electric
• Electrocardiogram
• Electromyogram

1:45  Explain: The Body Electric

2:15  Break

2:30  Extend / Evaluate
• What makes electricity dangerous?

3:00  Closing

Assignment
• Write and upload answers to the following questions:
  ‣ What are the main lessons from this session’s activities and discussions?
  ‣ What questions or uncertainties about this material do you still have?
  ‣ What did this session make you wonder about—what questions did it raise?
Day 3: Form & Function / Moving Through the World

9:00 Engage / Explore: Making Things Move, Making Things Rotate
• Measuring Motion
• Torque

9:45 Explain / Extend: Force, Motion, Torque, Rotation
• Where does the force come from?
• Simple machines & simple tools
• Muscles & Bones

10:30 Break

10:45 Extend / Evaluate: How Form Follows Function
• Who is a digger / who is a jumper?

11:45 Evaluate
• What joints in your body are most subject to problems, and why?

12:00 Lunch

1:00 Engage / Explore / Explain: Energy
• What is Energy?
• Energy & Power
• How Much Energy Does It Take?
• Energy conversions and energy conservation

2:15 Break

2:30 Extend / Evaluate
• Why do animals move as they do?

3:00 Closing

Assignment
• Write and upload answers to the following questions:
  ‣ What are the main lessons from this session’s activities and discussions?
  ‣ What questions or uncertainties about this material do you still have?
  ‣ What did this session make you wonder about—what questions did it raise?

Final Assignment
• Write a lesson plan for one of your classes based on this material