

The Science of Weather and Climate: Detailed Outline

MONDAY: Energy in and energy out on a global scale

Morning

8:00 Refreshments

8:30 Course Overview

- Introductions / Teacher stats / Course presenters
- Pre-tests and questionnaires
- Content overview/ Keep on questioning/What is a model? / Overview of course structure / assignment / credit / instructional approach / mixing / Different Voices / Historical Scientist / question and suggestion box (sticky notes)
- Practical details: stipends, meals, credit, parking, etc., plus time for questions

9:15 Engage / Explore / Explain: Energy & Radiation, Part I

- Engage/Explore/Explain: Energy concepts: *What is energy?*
- Explore/Explain: Conservation of energy: *Can energy be created or destroyed?*
- Engage/Explore: A bit about the electromagnetic spectrum: Scales of energy and wavelength, different physics of the different kinds of radiation.
 - Rainbow Glasses: *Rainbow Glasses*
 - Sunburn Beads: *Would you get a sunburn on Mars?*
 - IR Goggles: *Can you see beyond the rainbow?*

10:15 Break

10:30 Engage / Explore / Explain: Energy & Radiation, Part II

- Explore: Writing with Light - *What is the difference between red light and blue light?*
- Engage: Way out in the EM Spectrum - *Thermal Camera Activity*
- Explain: Understanding the EM spectrum and energy balance
- Explore: Radiation as a means of energy transfer: *Can you “see” thermal radiation?*

11:20 Evaluate: “My form of energy is the best.”

11:55 “Get to know a table host”

12:00 Lunch

Afternoon

12:45 Different Voices - Diversity Cubes

1:00 Engage/Explore/Extend: Radiation and Energy on Earth

- Kinesthetic activity: *What makes a gas a greenhouse gas?*
- Extend: Glass plates: *How does the atmosphere keep the Earth warmer?*
- Kinesthetic activity: *Long and Short of It*

1:45 Engage/Explore/Explain: Radiation and Energy on Earth

- Engage: *Why is it tropical in the tropics?*
 - Angle Variation with Cars or Insects, Solar Cells & Basketballs
 - Bonus material: *In an Alaskan summer, the sun is up 24 hours a day. Why isn't it hotter?*
- Explain: Seasons and Days
- Explore: *How does the Earth cool itself off?*
- Explain: Atmospheric greenhouse effect
- Explore: *Why does it get colder on clear nights than on cloudy nights?*
 - Bonus material: *What is the "greenhouse effect"?*

3:15 Break

3:30 Extend: Energy & Seasons

- Heating temperature lags - Real world examples
- Discuss included materials Peak Radiation vs. Peak Temperature

3:45 Evaluate

- Energy Cubes

4:00 Question Time / Planning / Processing

4:25 "Get to know a table host"

4:30 Adjourn

Evening The Light, The Dark and the Stars

TUESDAY: Air & water & clouds

Morning

8:00 Refreshments

8:30 Air & water & clouds

- Demos
 - Weighing air - *Does air weight anything?*
 - Pouring air - *Can you “pour” air like you can pour water?*
- Does air have mass?
 - Weather balloon filled with fog demo
 - Volley ball with 8’ beach ball
- How does pressure relate to the mass of the atmosphere?
- Kinesthetic activity: Molecules in a box - *What causes pressure?*
 - Ideal gas law
- Marshmallow mashers (observe and discuss) - *Marshmallow mashers*
- Temperature changes on compression/expansion - *If hot air rises, why is it cold in the mountains?*
 - “Let’s just go out and measure it!” - Sounding
- Demos
 - 55 gallon drum crush
 - Launch solar-powered hot air balloon
- What are a stable or unstable systems? What is buoyancy?
- Tipping point - *Why do clouds tend to form in the afternoon?*

10:20 Before break break (bring back your coffee or tea before you add your cream in special cups)

- Convection demos

10:30 Break

10:40 More with convection

- Parcels, buoyancy, vertical motion, and convection
- Play the Parcel

11:10 Evaluate

- Discuss the sounding and tropopause

11:30 Question Time / Planning / Processing

11:55 “Get to know a table host”

12:00 Lunch

Afternoon

12:45 Different Voices - Quotes

1:00 Discovery of the stratosphere

1:15 Water, Energy and Phase Transitions

- Transferring energy with water vapor
 - Cooking with condensation - *What is the opposite of sweating?*
 - Heating and cooling the skin - *How can clouds help keep the air warmer?*
- Transpiration (fish tank over grass) - *Do plants “sweat”?*
- Heat packs - *How can freezing make something warmer?*
- Clouds part I
 - Bonus materials: *Why are clouds white?*
 - Demo: *Why are clouds white?*

2:15 Break

2:30 Engage / Explore / Explain: More Water, Energy and Phase Transitions

- Cloud in a bottle - *Do cities affect the weather?*
 - Clouds part II
- Kinesthetic activity: Vapor pressure - *Why can warm air “hold” more moisture than cold air? - Activity 1*
- Explore: Hand boiler - *Why can warm air “hold” more moisture than cold air? - Activity 2*
- Where is all the heat hiding?
- Ice cream!

3:40 “Get to know a table host”

3:45 Question Time / Processing / Planning

4:00 Evaluate: Clouds in a Glass of Beer

4:15 Adjourn

Evening More clouds in a glass of beer at Tap N Handle!

WEDNESDAY: Global weather and climate

Morning

8:00 Refreshments

8:30 Forces and Moving Air

- Start Cold Front, Hot Front tanks: *Why do storms often form along fronts?*
- Large scale spin tank [part I - not spinning]
- Come back to Cold Front, Hot Front tanks
- Thermal driven circulations
- Forces, pressure differences, gravity - *Centripetal Critters Coaster*
- Kinesthetic Activity: *Why do hurricanes go counterclockwise in the northern hemisphere?*
- Kinesthetic Activity: *Why doesn't the wind blow from high to low pressure?*
- Video clips
 - Large-scale weather [spin tanks, part II] - *How does the spin of the Earth lead to the spin of a storm?*
 - Force balance
- Small scale spin tanks

10:05 Break

10:20 More Forces and Moving Air

- Kinesthetic activity: Arm tug-of-war
- Trade winds, westerlies, role of mid-latitude storms
 - Angular momentum activity with Hoberman Spheres
 - Demo with spin tank and temperature differences

11:30 Question Time

12:00 Lunch

Afternoon

12:45 Weather vs. Climate

- Weather vs. Climate: *What is the difference between weather and climate?*
- Explain past climates (ice ages)
- CO₂ demos
 - Tailpipe vs. blow dryer
 - How much CO₂ comes out of your tailpipe?
- Climate change: Why it's simpler than you think.
- Feedback demo with the Nerf guns
- How much change?

2:00 Break

2:15 Climate modeling

- Simple Climate Model - *What is a model?*
- Computer climate modeling
- The long tail

3:05 Solutions

- Wedges (two versions)
 - Wedges light
 - Wedges “personal edition”

3:45 Evaluate

- Skeptics and deniers: Discussion

4:00 Question Time / Processing / Planning / Post Test

4:15 Closing / Next Steps

4:30 Adjourn

Evening Retro 80's at the Lagoon