

Monday Morning

8:00 – 8:30 Breakfast

8:30 – 9:15 Course Overview and Pre-Test

- Introductions / Teachers / Course presenters (10 minutes)
- Photo (5 minutes)
- Mixer (Cubes)
- Overview of course structure / assignment / credit / instructional approach (5 Es) / mixing / suggestion box / ducks (Brian, Sheila, Nisse — 10 minutes)
- Practical details: stipends, meals, bathrooms, etc. (Melissa – 5 minutes)
- Pre-test (10 minutes)
- Overview of syllabus (Scott – 10 minutes)

Energy & Radiation

9:15 – 9:45 Engage / Explore / Explain (“Mixer”) (LSOP)

- Forms of energy / Energy toys
- Energy transfers & transformations
- Conservation of energy activities

9:45 – 10:00 Break - Ask for commitment for New Belgium

10:00 – 11:00 Engage / Explore / Explain (LSOP)

- Hot objects emit radiation (Feel the Heat)
- Thermal radiation (Camera)
- Thermal radiation (Thermometers)
- Radiation as a means of energy transfer, Part I
- Radiation as a means of energy transfer, Part II
- Activity / question: *Why does it get colder on clear nights than cloudy nights?*

11:00 – 11:45 Extend (Scott)

- Follow the Energy
- Planetary Energy Balance

11:45 – 12:00 Evaluate: Cubes

12:00 – 12:45 Lunch

Monday Afternoon

Radiation and Seasons

12:45 – 1:00 Different Voices

- Diversity activity (Melissa)

1:00 – 2:15 Engage / Explore / Explain (LSOP)

- Making rainbows
- Rainbow glasses
- Rainbow glasses and filters
- Sunset eggs
- Near IR goggles
- Infrared Insects (block visible, block IR)
- Near infrared vs. thermal
- Writing with light
- Sunburn beads
- Seasonal variations
- Final question: *Why do the filters not absorb the near infrared?*

2:15 – 3:15 Explain (Scott)

- Electromagnetic waves & energy
- Spectrum of emitted radiation
- Angles, gradients and seasons

3:15 – 3:30 Break

3:30 – 4:15 Extend (Rachel)

- Variation of radiation with angle, time of day, season.
- Temperature lags radiation—graphs from real data.

4:15 – 4:30 Evaluate (Cubes & Questions)

Tuesday Morning

Pressure, Density, Temperature, Buoyancy

8:00 – 8:30 Breakfast

8:30 Answer Questions

8:30 – 9:45 Engage & Explore (LSOP)

- Weighing air
- Pouring air
- Launch hot air balloon
- Ideal gas laws (Molecules in a box)
- Marshmallow masher
- Peep poofer
- Tipping point
- Question: *If hot air rises—why is it cold in the mountains?*

9:45 – 10:45 Explain (Scott)

- Gas laws, buoyancy
- Temperature structure of the atmosphere
- Parcels & the environment
- Lapse rates & stability

10:45 – 11:00 Break

11:00 – 12:00 Extend / Evaluate (Parker)

- Matching game with story of the changes in the atmosphere.
- Graphing temperature structure of the atmosphere.

12:00 – 12:45 Lunch

Tuesday Afternoon

Phases of Water, Latent Heat, and Clouds

12:45 – 1:00 Different Voices

- Diversity activity (Melissa)

1:00 – 2:15 Engage & Explore (LSOP)

- Transferring energy with water vapor
 - Double boiler
 - Heating and cooling the skin
- Transpiration
- Super-cooled liquids
- Cloud in a bottle
- Vapor pressure, *Why can hot air hold more moisture than cold?*
- Hand boiler
- Liquid Nitrogen Ice Cream

2:15 – 2:30 Break

2:30 – 3:30 Explain (Scott)

- Phases of water & latent heat
- Saturation, relative humidity, dew point
- Fog and clouds
- Moist vs. dry lapse rates and vertical motion
- Conditional stability

3:30 – 4:15 Extend (Katie)

- Measure wet bulb / dry bulb temperature, compute relative humidity.

4:15 – 4:30 Evaluate (Clouds in a glass of beer, Part I)

- Final Question: Clouds in a glass of beer
- *Why does the cloud form? Why do the bubbles start where they do, why do they grow? Why do the glasses sweat? Does this warm your beer up or cool it down?*

Wednesday Morning

Convection and Precipitation

8:00 – 8:30 Breakfast

8:30 – 9:00 Balloon Launch (Todd & Company)

We'll start the day somewhat differently—by launching a weather balloon. The Launch Team will answer off all your questions before releasing the balloon right at 9:00.

9:00 – 9:15 Balloon Data

As the balloon rises, we'll watch data come in. It will keep going... We'll analyze the data later.

9:15 – 10:00 Engage & Explore (LSOP)

- Why are clouds white?
- Wax block mystery
- Terminal velocity vs. water drop size
- Convection and convection cells / cloud in bottle with laser slice

10:00 – 10:15 Break

10:15 – 11:00 Explain (Scott)

- Precipitation processes
- Structure of clouds
- Rain and storms

11:00 – 11:45 Extend (Rachel)

- Analyzing data from balloon

11:45 – 12:00 Evaluate

12:00 – 12:45 Lunch

Wednesday Afternoon

Forces and Winds

12:45 – 1:00 Different Voices

- Diversity activity (Melissa)

1:00 – 2:00 Explore (LSOP)

- Friction tug of war
- Forces in circular motion
- Angular momentum
- Pressure force line dance
- Why do hurricanes go counterclockwise (in the northern hemisphere)?

2:00 – 3:00 Explain (Scott)

- Pressure gradient, gravity, friction
- Forces due to the earth's rotation
- Balances: Hydrostatic, geostrophic, gradient
- Flows around highs and lows at the surface and aloft

3:00 – 3:15 Break

3:15 – 4:00 Extend (Isaac)

- Force balance diagram & resulting winds

4:00 – 4:15 Evaluate (Cubes)

4:45 - 6:30 Clouds in a glass of beer, Part II

- At New Belgium Brewery

Thursday Morning

Rotation and Global Circulation

8:00 – 8:30 Breakfast

8:30 – 9:15 Explain (Scott)

- Review ideas of the poleward energy transport and the forces due to the earth's rotation
- How the rotation of the earth affects the motion of air, water and energy in the atmosphere

9:15 – 10:00 Extend (LSOP)

- We'll see these ideas in action by looking at the motion of fluids in a spinning tank.

10:00 – 10:15 Break

10:15 – 10:45 Explain (Scott)

- How the motion of air, water and energy in the atmosphere explains the earth's climate zones

10:45 – 11:45 Extend (Isaac)

- We'll extend this treatment by looking at how global winds lead to climate zones on earth.

11:45 – 12:00 Evaluate (Cubes)

12:00 – 12:45 Lunch

Thursday Afternoon

Fronts and Storms

12:45 – 1:00 Different Voices

- Diversity activity (Melissa)

1:00 – 1:15 Engage & Explore (LSOP)

- Warm and cold fronts

1:15 – 2:00 Explain (Scott)

- Temperature gradients
- Life cycle of a midlatitude cyclone
- Convergence and divergence

2:00 – 2:15 Break

2:15 – 3:00 Explain (Scott)

- Warm and cold advection
- Cold and warm fronts

3:00 – 4:15 Extend (Katie)

- Look at a station plot: Find lows and highs, find warm and cold fronts.
- Numerical weather prediction

4:15 – 4:30 Evaluate (Cubes)

Friday Morning

Climate Change & Global Warming, Impacts, Mitigation

8:00 – 8:30 Breakfast

8:30 – 9:45 Engage & Explore (LSOP)

- Radiative transfer and layers of the atmosphere
- Making a model / graphing
- Feedback tracks (Make and take)
- Weather vs. Climate, Part I
- Weather vs. Climate, Part II
- Chaotic pendulum

9:45 – 10:45 Explain (Scott)

- Simple physics of increased CO₂
- Positive and negative feedbacks
- Climate observations
- Climate models
- Climate predictions
- Dealing with skeptics

10:45 – 11:00 Break

11:00 – 11:45 Extend (Parker)

- ENSO and global temperature measurements
- Interpreting global temperature graphs
- Radiation vs. CO₂: Which affects global temperature more?

11:45 – 12:00 Evaluate (Post Test)

12:00 – 12:45 Lunch

Friday Afternoon

Mitigating and Adapting to Climate Change

12:45 – 1:00 Different Voices

- Diversity activity (Melissa)

1:00 – 1:30 Engage & Explore (LSOP)

- How much energy things use
- Energy & efficiency
- Why is CO₂ so important?

1:30 – 2:30 Explain

- Carbon cycle and greenhouse gases
- Economics of energy and CO₂
- Alternative energy and energy conservation

2:30 – 2:45 Break, Cake, Goodbyes

2:45 – 3:30 Extend (LSOP)

- Carbon mitigation initiative activity

3:30 – 4:00 Closing

- Next Steps