

## Weather and Atmosphere Lesson Plan

### Slide 1

- Title page
- Inform students we'll be discussing the function of our atmosphere and causes of various weather phenomenon

### Slide 2

- Open up with the topic of air
- Ask them for its composition (on next slide) and where it comes from
- Trying to get at the fact that air is simply the gases in our atmosphere (but explain this in two more slides)

### Slide 3

- Discuss the composition, go over each element and its importance
  - Nitrogen absorbs light and then scatters it resulting in the blue color
  - Oxygen important for cellular respiration
  - Carbon dioxide is a greenhouse gas that absorbs sunlight and keeps earth warm
- Purpose of air: provide oxygen for energy and to warm earth

### Slide 4:

- What is it? : Layer of gases surrounding the Earth
- Gases don't escape into space because of gravity. Gases are particles that experience the force of gravity just like you and me.
- Three main purposes: Protect organisms by absorbing ultraviolet light, warming surface by heat retention (green house effect), and reducing temperature extremes between day and night
- Air is just lower part of atmosphere

### Slide 5:

- We're going to discuss the layers of the atmosphere now.

### Slide 6:

- Exosphere is top most layer.
- Lower boundary is known as exobase or exopause.
- Interesting: Since such low density, particles very far apart and hardly ever collide. Not considered a fluid anymore
- Quick discussion question to get students thinking: How do you determine end of exosphere and beginning of space? Brainstorm ideas

### Slide 7

- Thermosphere is biggest layer
- UV light causes ionization of gas particles resulting in the ionosphere.
  - Ask students what they think this allows for? Answer is for radio waves to be transmitted beyond the horizon.
- International space station orbits here
- Can see Auroras in this layer
- Temperature rises with altitude in this layer because of massive solar radiation absorbed. Interesting point: can't feel heat because so near vacuum that few atoms of the gas can transfer heat.
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### Slide 8

- Just a picture of the aurora borealis
- Due to collision of charged particles

### Slide 9

- Temperatures interestingly decrease with height in this layer. Due to decreased solar heating and increased cooling by carbon dioxide radiative emission
- Pictured are Noctilucent clouds, basically ice clouds caused by water vapor freezing

### Slide 10

- Here we'll discuss ozone layer.
- Ozone (O<sub>3</sub>) is present in this layer and absorbs ultraviolet light. Broken down into monoatomic oxygen (O) and diatomic oxygen (O<sub>2</sub>).
  - Monoatomic oxygen is prevalent in the upper layer of the stratosphere, and ultraviolet light is responsible for heat
  - Less UV hits mid-stratosphere, and O and O<sub>2</sub> combine to form ozone giving off heat as a byproduct
  - Hardly any UV or monoatomic oxygen in lowest part, so much cooler than rest of the stratosphere

### Slide 11

- Troposphere is where most weather occurs
- Layer we live in and consists of the air we discussed about earlier
- Pressure decreases as you go up because density decreases, this will be explained in next slide
- Temperature decreases as you go up because sunlight is absorbed by ground heating bottom and radiation of energy occurs at top cooling the earth.

### Slide 12

- Temperature activity

### Slide 13

- Just a quick refresher on pressure and density
- Pressure is defined as force per area
- Density is the mass that takes up a given volume
- As altitude increases, the amount of gas particles decreases. This decreases density. The decrease in density decreases the force per area since the force is just the weight of the gas overlying a given area.

### Slide 14

- Try and get the students to give some examples of weather: wind, clouds, rain, snow, fog, dust storms, tornadoes, hurricanes, blizzards
- Try and get them to give a good definition of weather: **Weather** is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy.

### Slide 15

- Differences in density and pressure result in weather.
- Both due to temperature changes from sun
  - Change in turn because of changes in sun's angle

### Slide 16

- Weather fronts
- Basically, a cold front carries denser air with higher pressure since the temperature makes the gas particles contract and take up less space with more mass.
- Weather patterns occur when you get fronts hitting each other

#### **Slide 17**

- Title page

#### **Slide 18**

- Hot surface heats air above it causing it to expand and decrease pressure and density
  - Horizontal pressure gradient causes air to move from high to low creating wind
    - Flow is created via the Coriolis effect via Earth's rotation

#### **Slide 19**

- Clouds are visible mass of water droplets or frozen ice crystals suspended in the atmosphere
  - Result of saturation: either cooling of the air (think of supersaturating a solution) or adding water vapor
  - Four ways of cooling
    - Adiabatic cooling
      - Cool air rises and expands due to convection or fronts on low pressure
    - Conductive cooling
      - Air comes in contact with colder surface
    - Radiational cooling
      - Infrared radiation given off by air or surface underneath
    - Evaporative cooling
      - When moisture is added to air via evaporation
- When this happens on the surface, you get fog
- Interesting: Bioprecipitation. It's been suggested there are rain-making bacteria, form ice nucleus to cause condensation
  - Rain happens when clouds get saturated enough that water is heavy and falls

#### **Slide 20**

- Basically, warm, moist air meets cooler, dry air and rushes upwards.
  - Massive thundercloud forms with very low pressure
    - The low pressure combined with variable winds results in the tornado

#### **Slide 21**

- Weather shapes the earth through erosion
- Just get ideas from the students

**End with cloud in bottle demo, egg in milk jug demo, and experiment if time permits**