



Carbon Dioxide Lesson Plan

Saturday, April 11, 2009



Slide 1:

Explain that the lesson deals with various topics concerning carbon dioxide's properties and roles

Slide 2:

Explain the basic properties of carbon dioxide. Indicate the double bonds and nonpolarity of the molecule due to its linear configuration.

Slide 3:

Go over some of the industrial and natural applications of carbon dioxide.

Slide 4:

Explain dry ice: solid frozen carbon dioxide at -78 degrees celsius. Caution students that due to its low temperature it will burn skin.

Deposition: The changing of a state of matter from gas directly to solid.

Sublimation: The changing of a state of matter from solid directly to gas.

Question them as to why they think carbon dioxide might skip a liquid phase while water does not.

Explain the reason we see the vapor from melting dry ice in water is due to the combination of water vapor and carbon dioxide.

Here we do a demo of dry ice plus water. Also, blow bubbles and have them float on top of the vapor. Due to the vapor being more dense than the air in the bubbles. Also, can put dry ice in soapy water and make cool bubbles.

Slide 5:

Quick discussion of phase diagrams. Run through states of matter. Explain that each line separates a different state of matter from another, that the x-axis is temperature and y-axis is pressure. Remark on the density of ice compared to water results in a line increasing to the left instead of right.

Each line represents either melting, freezing, boiling, sublimation, or deposition.

Triple point: where all three phases are present

Critical point: the temperature and pressure where a certain phase can no longer exist.

Slide 6:

Explain intermolecular forces. There are three types: dispersion, dipole dipole, and hydrogen bonding. Dispersion is weaker than dipole which is weaker than hydrogen bonding. Explain how these forces give molecular compounds their properties (boiling point, etc.).

Slide 7:

Talk about carbonation and how it is just the result of dissolving carbon dioxide in water. The fizzing one sees in sodas is a result of the carbon dioxide escaping.

Effervescence: when a gas escapes from solution

Here we do the Mentos and Coke demo. Explain that the carbon dioxide molecules get caught in the mint and then release rapidly building up pressure and causing a jet to shoot out.

Slide 8:

Discuss the fact that carbon dioxide is an acid anhydride. That is when added to water an acid is produced ("anhydride" = lacking water). Carbon dioxide plus water results in the weak acid carbonic acid.

Explain that stalagmites and stalactites form because carbon dioxide forms carbonic acid in water that seeps into the limestone of the caves. The calcium in the limestone reacts with the carbonic acid to form calcium carbonate.

Here we can add dry ice to water and use a litmus test to show that in fact the water is now acidic.

Slide 9:

Define pressure and go over the units. Discuss the ideal gas law.

Ideal gas: the molecules of the gas are treated as non-interacting point particles which are engaged in a random motion that obeys conservation of energy. Indicate no gas is an ideal gas, but we can make the assumption.

Slide 10:

Have the kids try and come up with hypotheses for the questions and then perform the demos and have them try and explain the observations.

-Dry ice with water in a balloon will inflate the balloon due to pressure buildup from the vapor released.

-The soap layer should start to expand due to pressure buildup from the vapor. Because of surface tension it shouldn't break and we should see a large bubble form.

-Dry ice with water in a closed bottle should cause the bottle to explode due to buildup of pressure

-The pressure of this gas pushes the spoon away from the dry ice, and without contact, the dry ice stops sublimating. The spoon falls back into contact again, and the cycle repeats. This all happens so quickly that the spoon vibrates, causing the singing sound you hear.

Slide 11:

Hero's engine refers to a vessel allowed to rotate on its axis with openings to allow for expulsion of some gas usually steam. The expulsion results in thrust that causes the vessel to spin.

Show video.

We can make a miniature Hero's engine with string and a film canister. Poke two off center holes at the bottom of the canister and add water and dry ice. Close the lid with a string attached. The canister should start spinning.

Slide 12:

Ask the students to list out some gases they've heard of.

First link goes to sulfur hexafluoride video

Second link goes to helium beatbox video

Ask about atmospheric gases

Slide 13:

Go over the layers of Earth's atmosphere

Troposphere: The troposphere is the lowest portion of Earth's atmosphere. It contains approximately 75% of the atmosphere's mass and almost all (99%) of its water vapor and aerosols. The troposphere is constantly convecting air.

Stratosphere: The stratosphere is the second major layer of Earth's atmosphere, just above the troposphere, and below the mesosphere. It is stratified in temperature, with warmer layers higher up and cooler layers farther down. This is in contrast to the troposphere near the Earth's surface, which is cooler higher up and warmer farther down.

Mesosphere: The mesosphere (from the Greek words mesos = middle and sphaira = ball) is the layer of the Earth's atmosphere that is directly above the stratosphere and directly below the thermosphere. The mesosphere is located from about 50 km to 80-90 km altitude above the Earth's surface. Within this layer, temperature decreases with increasing altitude due to decreasing solar heating and increasing cooling by CO₂ radiative emission. The minimum in temperature at the top of the mesosphere is called the mesopause, and is the coldest place in the atmosphere.

Thermosphere: The thermosphere is the layer of the earth's atmosphere directly above the mesosphere and directly below the exosphere. Within this layer, ultraviolet radiation causes ionization.

Feel free to highlight different aspects of the atmosphere.

Slide 14:

Define ozone as three oxygen atoms bonded together. Highlight its importance in filtering out harmful ultraviolet radiation. Discuss its depletion due to CFCs.

Slide 15:

Discuss global warming. Possible causes: greenhouse gases and ozone depletion.

Slide 16:

Greenhouse effect: The process by which absorption and emission of infrared radiation by atmospheric gases warm a planet's lower atmosphere and surface.

List out major greenhouse gases: water vapor, carbon dioxide, methane, and ozone.

Indicate that it's not a bad thing; we need the greenhouse effect to survive.

Slide 17:

Discuss how human activity has resulted in an enhanced greenhouse effect by increasing certain gases such as carbon dioxide.

Here explain that the gases absorb the infrared and re-emit it in a random direction. However, the many molecules result in a complicated path that usually redirects the radiation towards the surface.

Slide 18:

Discuss hypothesized effects of global warming: change in precipitation, glacial retreat, sea level rising, species extinction, and increase in diseases

Stress the fact that evidence indicates a “global warming” however there are two sides to the story.

Some believe these negative effects will occur while there are many who believe that the problem of global warming has been exaggerated.

Slide 19:

Have the students try and figure out ways to fix global warming. i.e. planting trees, cutting back on gas emissions, etc.