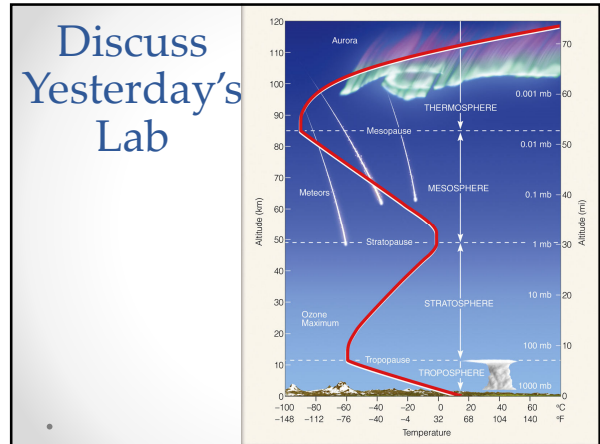


March 3, 2015

Warm-Up

Today you will need your notebook , pencil and whiteboards.
HW due Friday.

- Attach the Ozone Table into your notebook
 - Pick up ozone table in the red box ← ← ←
- Complete the Predictions Column



Ozone Layer

 March 3, 2015

What Do We Know?

Attach Your Chart Into Your Notebook

Questions on the Ozone Layer	Predictions	Discovery
<ol style="list-style-type: none"> 1. What is it? 2. Where is it? 3. How is it helpful? 4. How could it be harmful? 5. What is ozone depletion? 6. What is the ozone hole? 7. What causes the ozone hole? 	Make Your Predictions! Share with your group your ideas.	Fill this out as we go along.

Funny Ozone Video

- As you watch the video, make notes in the discovery column on your table!
- <https://www.youtube.com/watch?v=WKrPd-8CJBM>
 Government of Barbados: Ozzy Ozone 10 minutes

Ozone Layer – Defined!

- **Ozone Layer**
- A region of Earth's stratosphere that absorbs most of the Sun's UV radiation.

Homework

Ozone is three oxygen atoms bonded together

O_3

Ozone: Good Up High, Bad Nearby

UPPER ATMOSPHERE
90% of ozone is in the STRATOSPHERE

GOOD ozone in the stratosphere

OZONE (O₃)

LOWER ATMOSPHERE
10% of ozone is in the TROPOSPHERE

BAD ozone in the troposphere

Ground-level ozone is a GHG and a major component of smog

EARTH

- GHG = Greenhouse Gas

Benefits of the Ozone Layer

- How is the ozone layer beneficial to life on Earth's surface? Which layer of the atmosphere is it located?

The ozone layer blocks some of the sun's Ultra Violet (UV) radiation which otherwise would cause extreme harm.

The Sun's Rays: UVA vs UVB vs UVC

UVA
Aging, wrinkling, skin cancer & eye damage

UVB
Sunburn, skin cancer, aging & eye damage

UVC
Most Dangerous
Stopped by ozone layer

Ozone Layer

Earth's Surface

Prevalent year round at all times of day and penetrates untreated glass

Strongest Spring to Fall between 10 AM and 4 PM but still an all day year round risk

Clouds do not offer significant protection against UV radiation.

Protection: Broad Spectrum Sunscreen, Clothing, Shade, Sunglasses & More

UV Radiation Isn't All Bad...

- UV Radiation is needed for...
 - Our body to produce vitamin D
 - Used as a disinfectant to clean water
 - Bees use reflection of UV off of flower petals to guide their pollen collecting

Harm from Ozone

- **Ground level or "bad" ozone is not emitted directly into the air**
 - It is created by chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs)
 - Motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC
- **Danger:**
 - Breathing problems (young, elderly and those with asthma)
 - Lungs become more susceptible to infection

Counties Where Measured Ozone is Above Proposed Range of Standards (65 – 70 parts per billion)

33/100 counties in NC including Durham County with 68 ppb

Perspective, ozone layer is 2000 to 8000 ppb

358 counties would violate 70 parts per billion (ppb)
200 additional counties would violate 65 ppb for a total of 558

Based on 2011 – 2013 monitoring data

Ozone Hole

- 1985 – British scientists discovered a “hole” about the size of the U.S. in the ozone layer over Antarctica
- The hole was not completely empty of ozone, just has a lower concentration than normal allowing more UV radiation to reach Earth’s surface
- Ozone thinning was seen in Canada and northern United States and Europe in 1991

Assimilated GOME total ozone
 22- 9-01 12h
 KNMI/ESA

What’s the Difference?

- What is the difference between ozone depletion and the ozone hole?

Homework

Ozone depletion is the steady decline in ozone (4% per decade) seen since the late 1970s.

The ozone hole is a much larger decrease in ozone over Earth’s polar regions.

Ozone Layer Reactions

- Activity:** Marshmallow Mash Up!
- Whiteboard Set-Up. One marshmallow is one oxygen atom

Ozone Layer Reactions

- Activity:** Marshmallow Mash Up!
- Draw incoming UV radiation from the sun

Ozone Layer Reactions

- Activity:** Marshmallow Mash Up!
- Oxygen molecule O_2 splits into two oxygen atoms O and O

Ozone Layer Reactions

- Activity:** Marshmallow Mash Up!
- Bonds to form ozone, O_3

$O + O_2 \rightarrow O_3$

- Ozone is also naturally broken down in the stratosphere by sunlight and by a chemical reaction with natural compounds containing nitrogen, hydrogen and chlorine.
- In an unpolluted atmosphere there is a balance between the amount of ozone being produced and the amount of ozone being destroyed

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- Make three more ozone molecules

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- Add six single oxygen atoms

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- Introduce one chlorine (your marker cap)

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- Chlorine hits ozone

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- Chlorine pulls on oxygen atom away

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- A free oxygen hits the chlorine-oxygen molecule

Ozone Layer Reactions

- **Activity:** Marshmallow Mash Up!
- The chlorine is free to attach to another ozone!

Depletion of Ozone

CFC: chloro-fluoro-carbons

Stratosphere

1. UV causes a chlorine atom to break way from the CFC molecule.
2. The free chlorine atom hits an ozone molecule.
3. The chlorine atom pulls one oxygen atom away.
4. A free oxygen atom hits the chlorine monoxide molecule.
5. The result is another free chlorine atom.
6. Free chlorine will continue to deplete ozone in the stratosphere.

Causes for the Ozone Hole

- **What causes the ozone hole?**

One group of gases is particularly likely to damage the ozone layer are called CFCs (chloro-fluoro-carbons).

Sources of Chlorofluorocarbons (CFCs)

- Most countries have now stopped using new CFCs that can be released into the atmosphere.
- Bromine and Chlorine cause deterioration of the ozone layer

Apply!

Global CFC Production 1952-2000

Year	Production (Thousands of Tons)
1952	~50
1956	~100
1960	~150
1964	~250
1968	~450
1972	~750
1976	~950
1980	~750
1984	~900
1988	~1200
1992	~600
1996	~100
2000	~50

When were the most chlorofluorocarbons (CFCs) produced?

- 1) 1972
- 2) 1978
- 3) 1988
- 4) 2000

Ozone Hole - Recovery

- <https://www.youtube.com/watch?v=1Bu3vltczRw>
- **Thought to Ponder:** How much of the ozone's hole recovery is due to rising temperatures versus decreasing levels of manufactured chemicals?

What Do We Know?

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Practice!

Ozone is made of _____ oxygen molecules.

- 1) one
- 2) two
- 3) three
- 4) four

Practice!

Ultraviolet light (UV) light _____ ozone molecules.

- 1) makes
- 2) weakens
- 3) destroys
- 4) does not affect

Practice!

Sources of chlorofluorocarbons include aerosol cans, old refrigerators and _____.

- 1) batteries
- 2) plants
- 3) car engines
- 4) old air conditioners