

SCIENCE CLASS CHALLENGE



INSTRUCTION GUIDE: OUR ATMOSPHERE AND THE OZONE LAYER

OBJECTIVE: After reading “Ozone Q&A for Instructors,” lead students through questions, using one or more of the activities below to demonstrate the lesson.

Training Materials (All materials can be found on the www.nocfcs.org website.)

- **Instruction Guide: Our Atmosphere and the Ozone Layer** (this document)
- **Ozone Q&A for Instructors**
- **Student Activity Sheets:**
 - Activity: Our Atmosphere and the Ozone Layer
 - Activity: Ozone Depletion Worksheet
 - Activity: Whole Body Ozone Chemistry
 - Activity: “It’s Atmospheric!” Crossword Puzzle
 - Activity: Atmosphere/Ozone Layer Poem/Rap
- **Activity Sheet Answer Keys**

Questions for the Classroom

1. What is the atmosphere?

- A very thin layer wrapped around Earth.
- Two gases make up most of the atmosphere: N₂ (78%) and O₂ (21%). Trace gases make up the remainder.
- Made up of 4 layers: troposphere, stratosphere, mesosphere, and thermosphere.
- The troposphere is the lowest layer of the atmosphere. This is where weather occurs.
- The stratosphere is the second lowest layer. It is very stable, so jets often fly in the stratosphere. This is also where the protective ozone layer is located.
- The mesosphere is above the stratosphere. This is where most meteors burn up as they enter the atmosphere. If you look at the Earth in a photograph from space, you can often see the mesosphere as a dark blue line around the planet.
- The thermosphere is above the mesosphere. The air is very thin in the thermosphere and temperatures can be as high as 1500 degrees Celsius.

For more information on the atmosphere, visit the Environmental News Network at http://www.enn.com/features/2000/08/08082000/atmosphericssciencequiz_14852.asp

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2. What is the ozone layer and why is it important to us?

- It is a naturally occurring concentration of ozone molecules (O₃) in the stratosphere.
- Ozone is blue in color and has a strong odor.
- Ozone filters ultraviolet (UV) radiation from the sun.
- Too much UV exposure can lead to skin cancer, cataracts, weakened immune systems, reduced crop yield.

Activity Option: Have students color and label “Our Atmosphere and the Ozone Layer,” the printable picture of the atmosphere and its layers.

3. Is there a problem with the ozone layer?

- There is too little ozone in the stratosphere because naturally occurring and manmade chemicals have caused ozone to break down in the stratosphere.
- This is called ozone depletion
- Scientists have been monitoring ozone layer conditions, particularly over Antarctica and have measured both seasonal and long-term thinning and thickening of the ozone layer.

For more information on ozone depletion, visit the U.S. Environmental Protection Agency’s website at <http://www.epa.gov/ozone/science/index.html>

4. What harms the ozone layer?

- CFCs or chlorofluorocarbons harm the ozone layer. Also, other compounds containing chlorine: methyl chloroform (a solvent), carbon tetrachloride (an industrial chemical), and compounds containing bromine: halons (fire-extinguishing agents), and methyl bromide (produce and soil fumigant).
- All of these ozone-depleting substances are very stable, which is why they were used in certain products and processes. They rise slowly to the stratosphere; strong UV radiation breaks them down, damaging the protective ozone layer.

Activity Option: “Whole Body Ozone Chemistry” or “Ozone Depletion” worksheet.

5. Why did we start using CFCs? Do we still use CFCs?

- CFCs were popular because they are stable, nonflammable and low in toxicity. In the past, CFCs were used as refrigerants, solvents and in aerosol products.
- In the 1970s, researchers speculated that the chlorine in CFCs could be hurting the ozone layer. As a result of this research, the U.S. Government banned CFCs as propellants in aerosol products in 1978 except for their use in medical applications such as asthma inhalers. And even these “essential use” products are being switched to non-CFC alternatives. Aerosol cans now use chemicals that do not deplete the ozone layer. Many other countries became concerned that CFCs were harming the ozone layer, and in 1987 the Montreal Protocol was signed by nations committed to a reduction in CFCs and other ozone-depleting substances. Later, these countries banned all CFC production after 1995. More than 160 countries have signed the treaty.

5. Is the ozone layer healthy today?

- Because of international bans against CFCs and other ozone- depleting substances, there are fewer and fewer of these produced.
- Since CFCs and other ozone-depleting substances are slow to move into the stratosphere, it will take a long time for the ozone layer to recover fully.
- However, because of the actions of the international community, the ozone layer will heal itself in about 50 years¹. This is an environmental success.

¹ See www.epa.gov/ozone/science/sc_fact.html

Follow-up Activities:

- “It’s Atmospheric” crossword puzzle
- Watch “Another Awesome Aerosol Adventure” video
- Students can write an atmosphere/ozone layer poem/rap