Gumdrop Molecules

Overview:

Students learn about the atoms and molecules that make up Earth's atmosphere and interact with particles from the sun to create the aurora.

Objectives:

The student will:
- build molecule models;
- understand the structure of nitrogen and oxygen molecules in Earth's atmosphere; and
- identify auroral colors associated with gases in Earth's atmosphere.

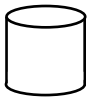
Materials:

- 3 small gumdrops per student
- 2 large gumdrops per student
- Toothpicks
- TEACHER INFORMATION SHEET: "Gumdrop Molecules"
- STUDENT WORKSHEET: "Gumdrop Molecules"

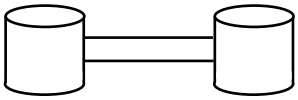
Answers to Student Worksheet:

1. *atoms*
2. *see diagram of oxygen atom at right*
3. *oxygen*
4. *see diagram of oxygen molecule at right*
5. *two*
6. *nitrogen*
7. *see diagram of nitrogen molecule at right*
8. *three*
9. *red*
10. *green*
11. *purple*
12. *O_2 molecules at middle altitudes and N_2 molecules in the lower atmosphere*

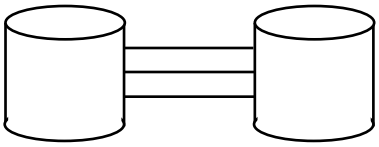
Oxygen Atom (O)



Oxygen Molecule (O_2)



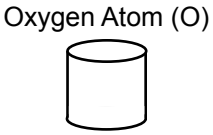
Nitrogen Molecule (N_2)



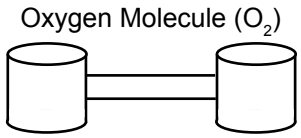
Gumdrop Molecules

Activity Procedure:

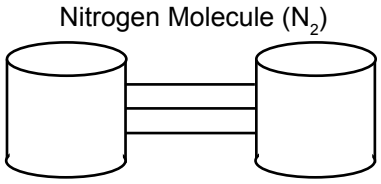
1. Provide an overview of molecules and molecular bonds using TEACHER INFORMATION SHEET: "Gumdrop Molecules." Explain that seeing Earth's aurora depends on four things: (1) particles from the sun must travel to Earth's atmosphere on the solar wind; (2) the magnetic field surrounding Earth must draw in these particles along magnetic field lines; (3) gases made up of oxygen and nitrogen atoms and molecules in Earth's atmosphere must be present; and (4) night skies must be relatively clear of clouds, moonlight and city lights.
2. Distribute three small gumdrops, two large gumdrops, five toothpicks and the STUDENT WORKSHEET: "Gumdrop Molecules" to each student. Explain that students will build two gumdrop molecules.
3. Ask students to set aside one gumdrop to represent the single oxygen (O) atoms found in the upper atmosphere. Explain that these atoms are responsible for the red glow of the aurora high in Earth's atmosphere.



4. Ask students to build an oxygen (O_2) molecule using two small gumdrops to represent oxygen atoms and two toothpicks to represent the two bonds that hold O_2 together. Students can construct this molecule by poking the tip of each toothpick into one gumdrop and then poking the other tip of each toothpick into the second gumdrop. Explain that O_2 molecules create the green glow of the aurora at middle altitudes.



5. Ask students to build a nitrogen (N_2) molecule using two large gumdrops to represent nitrogen atoms, and three toothpicks to represent the three bonds that hold N_2 together. Students can construct this molecule by poking the tip of each toothpick into one gumdrop, then poking the other tip of each toothpick into the second gumdrop. Explain that nitrogen molecules create the purple glow of the aurora at low altitudes.



6. Ask students to complete the questions on the worksheet using what they learned about oxygen atoms, oxygen molecules and nitrogen molecules.

Gumdrop Molecules

Teacher Information:

A molecule is the smallest unit of a compound or substance that can exist and still retain the properties of that substance. A molecule is made up of two or more atoms. Molecules can contain atoms from the same element, like the oxygen humans breath, which is made up of two oxygen atoms (O_2), or molecules can contain atoms from two or more elements, like water, which is made up of two hydrogen atoms and one oxygen atom (H_2O). All molecules, even those made up of many atoms, are too small to see without a powerful microscope. It takes more than a sextillion water molecules to form a single drop of water.

The bonding between two or more atoms comes about when the atoms collide and end up sharing one or more electrons. O_2 has a double bond, so two oxygen molecules share two electrons. N_2 has a triple bond, so two nitrogen atoms share three electrons.

The molecules in Earth's atmosphere are found in the greatest concentration just above Earth's surface. At sea level, oxygen in the form of O_2 makes up 21% of atmospheric gases, and nitrogen in the form of N_2 makes up 78% of atmospheric gases. At the lower reaches of the aurora, N_2 is still more common than O_2, but as we move closer to outer space, nitrogen levels decrease and O_2 becomes the dominant gas. High in Earth's upper atmosphere, oxygen levels decrease so much that collisions and subsequently bonding between oxygen atoms are rare, so free oxygen (O) is the gas at the upper reaches of the aurora.

When the particles from the solar wind bump into the atoms and molecules found in Earth's atmosphere, these atoms and molecules take up some of the particles' energy, and then release that energy along with a burst of color. If enough atoms or molecules release this energy simultaneously, the aurora lights up the night sky.

The colors of the aurora tell us how far into the atmosphere particles from the solar wind are penetrating. In the upper reaches of the atmosphere oxygen (O) gives off a red glow when it releases energy. O_2 gives off a green light at middle altitudes, and N_2 gives off a purple light at lower altitudes.

Name: _____ **Student Worksheet**

Gumdrop Molecules

Directions: Build molecules, then answer the questions below.

1. A molecule is made up of two or more _____.

2. Using the gumdrop model as a guide, draw an oxygen atom in the space below.

3. Two _____ atoms combine to form an oxygen (O_2) molecule.

4. Using the gumdrop model as a guide, draw an oxygen (O_2) molecule in the space below.

5. How many bonds does O_2 have? _____

6. Two _____ atoms combine to form a nitrogen (N_2) molecule.

7. Using the gumdrop model as a guide, draw a nitrogen (N_2) molecule in the space below.

8. How many bonds does N_2 have? _____

9. If particles from the solar wind excite oxygen atoms, what color will the aurora be?_____

10. If the particles from the solar wind excite oxygen (O_2) molecules, what color will the aurora be?
    _____

11. If the particles from the solar wind excite nitrogen (N_2) molecules, what color will the aurora be?
    _____

12. What gases are present in a green aurora with a purple tinge along the bottom?
    _____

