SN EDUCATOR GUIDE

May 6, 2023 & May 20, 2023

Climate Change Spikes Baseball Homers

Student Discussion Worksheet

Directions: This discussion activity can help you understand and apply the ideal gas law. Before beginning this work, you should know the ideal gas equation and its components. Then discuss the first two sets of questions with a partner. You should then read the *Science News* article "Baseball's home run boom is due, in part, to climate change" and answer the last set. A version of the article, "Climate change spikes baseball homers," appears in the May 6, 2023 & May 20, 2023 print issue of *Science News*.

Defining relationships from an equation

1. What is the ideal gas law equation, and what does it state? Name the components in the formula. Which of the components are variables?

2. What is a direct relationship between two variables? How is an indirect, or inverse, relationship between variables different? Give examples.

3. Write the equation with all variables on one side and the ideal gas constant (R) on the other. Explain the relationships between the variables in the equation. How do the variables in the numerator relate to each other, if those in the denominator stay the same? What about the variables in the denominator, if those in the numerator stay the same? What happens when you change one variable from the numerator and allow one from the denominator to change? Hint: If these questions are difficult, put in numbers for each variable to test what happens.

Explaining relationships using a simulation

1. Click the "Gas Properties" PhET simulation. Determine how changing P, V, n or T will influence other gas properties. Then change one variable and hold the other three constant to see what happens. What do you observe?

2. What happens to the speed of the gas particles when you increase the temperature of the gas in the simulation? If you can, use an equation to explain this relationship.

3. Gas pressure is defined as the force exerted by a gas per unit area on the surface of a container or another substance. Higher-velocity and more frequent collisions of gas particles with another substance increase the pressure of the system. Pick two variables from the ideal gas equation and *explain* their relationship, stating how changing one will affect the environment and lead to a change in the other, when all other variables are constant. (Don't just state the relationship like you did above.)

Applications of the ideal gas law

1. The article "Baseball's home run boom is due, in part, to climate change" focuses on the relationship between rising temperatures and increases in the number of home runs hit each year during the Major League Baseball season. The writer explained the roles temperature and air density played in increasing the number of home runs hit during the MLB season. Explain the relationship between temperature and air density using the ideal gas law.

As an extension, explain the relationship using the ideal gas law equation. Hint: Substitute mass of gas/molar mass of the gas (this fraction is the number of moles of the gas) for *n* and solve for mass of the gas/volume (this fraction is density). You should arrive at an expression that has temperature in the denominator.

2. What other factor decreases when air density drops? What principle explains that direct relationship?