BLOSSOMS Interactive Video Lecture:
Temperature, Pressure and American Football: Introduction to Gay-Lussac's Gas Law

Student Worksheet

(Activity 2)

Define: what is temperature?

Define: what is pressure?

Write Gay-Lussac's Gas Law and explain briefly what it means:

(Activity 3) Three footballs (A, B, and C) are inflated to 12.5 PSI relative pressure in a laboratory that has a temperature of 74 degrees F. Football A is moved to a cooler with dry ice that is held at -13 degrees Fahrenheit; Football B is kept in the laboratory at a temperature of 74 degrees Fahrenheit; and Football C is moved to an oven that is lightly heated to a temperature of 102 degrees Fahrenheit. Use Gay-Lussac's Law to predict the relative pressure for each of the three footballs after sufficient time has elapsed for them to equilibrate to the new environments. Be careful to use absolute temperature and pressure values.

(Activity 4) In the 2015 AFC Championship game held on January 18th, 2015, the twelve footballs for the New England Patriots were measured before the game by the referee to be 12.5 PSI in a locker room that was approximately 71 degrees Fahrenheit. The referee used one of two different gauges to measure the footballs before the game – either the Logo gauge or the Non-Logo gauge. The field temperature that day was 48 degrees Fahrenheit.

Use Gay-Lussac's Law to predict the on-field pressure level for the Patriots' footballs for the game.

(Activity 5) After one of the footballs was intercepted by the other team during the first half of the football game, someone made an accusation of cheating – that the footballs may have been illegally deflated, allegedly giving the Patriots a competitive advantage. Therefore, at the start of halftime, the league decided to measure each of the remaining eleven Patriots' footballs with each of the two gauges (the Logo gauge and the Non-Logo gauge). Compute the mean of the eleven pressure values for the Patriots' footballs that were measured with the Logo gauge: 11.80, 11.20, 11.50, 11.00, 11.45, 11.95, 12.30, 11.55, 11.35, 10.90, 11.35 PSI

(Activity 6) Compare your prediction from Gay-Lussac's Gas Law for the Patriots' footballs with the mean of the eleven measurements from the Logo gauge. If the referee used the Logo gauge before the game to measure the Patriots' footballs, do you think that the Patriots' footballs were illegally deflated before the game?

(Activity 7) Compute the mean of the eleven pressure values for the Patriots' footballs that were measured with the Non-Logo gauge: 11.50, 10.85, 11.15, 10.70, 11.10, 11.60, 11.85, 11.10, 10.95, 10.50 and 10.90 PSI. If the referee used the Non-Logo gauge before the game to measure the Patriots' footballs, do you think that the Patriots' footballs were illegally deflated before the game?

(Activity 8) Discuss some of the sources of error and how this might affect your conclusions.

(Activity 9) Suppose that the difference between the measured pressures and the values predicted from Gay-Lussac's Law were due to tampering. What percentage of air would need to be removed from (or added to) the footballs to achieve the difference between the average measurement and the predicted pressure based on Gay-Lussac's Gas Law? Hint: use the Ideal Gas Law, PV=nRT, and assume that the Temperature and Volume are constant.