Lesson Plan Extension

Peabody Learning Academy
Peabody Public Schools

Created: June 2015

Class: PLA Math/Science (Geometry and Chemistry)

Topic (s): Finding Volume and Surface Area, Ideal Gas Law

This lesson extension is intended to introduce students to a 'real world' application of Geometry and Chemistry, more specifically finding volume and surface area of spheres, as well as the Ideal Gas Law. This lesson uses an industry application related to the design and use of a heart catheter manufactured by Medtronic.

Unit Level Thinking Objectives

The students will be able to:

- Find the surface area and volume for spheres and cylinders
- Use the Ideal Gas Law to calculate pressure

Common Core Standard (s):

CCSS.Math. Content. HSG-GMD.A.3 Use volume and surface area formulas for cylinders, pyramids, cones, and spheres to solve problems.

CCSS.Chemistry. HSC -6.6.2 Perform calculations using the ideal gas law.

Mastery Level Objectives

Students will first watch the short video to create interest and a general understanding of how the catheter works, as well as its purpose. Students will use the given diagrams of the heart and formulas for finding volume and surface area of spheres to calculate the surface area and volume of the Arctic Front Balloon Catheter. They will then use the ideal gas law to calculate the number of moles of gas present in the balloon at inflation.

Medtronic Lesson Plan Extension Name:

Read the article on the Arctic Front Cardiac CryoAblation Catheter. Make sure to click and read all three tabs – Overview, How it Works, and Specification. Watch both videos embedded in the article as well. (The company that makes these – Medtronic - is 5 miles down the road!!!)

Answer the questions below after reading and watching.

http://www.medtronic.com/for-healthcare-professionals/products-therapies/cardiac-rhythm/ablation-products-for-atrial-fibrillation/arctic-front/#tab3

1.) What disease is the CryoBalloon used to treat?

2.) How many people have been treated using this device to date?

3.) What are some of the advantages of using this device?

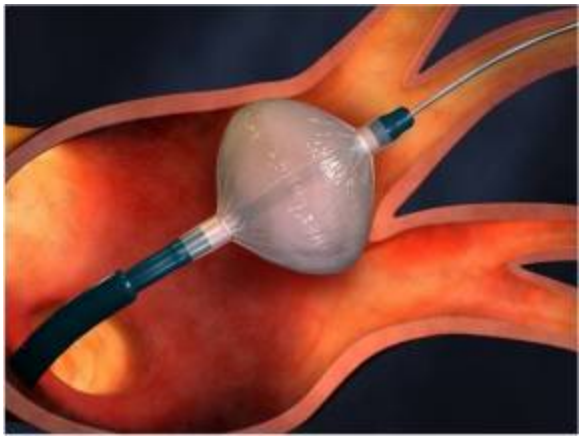
4.) What is the device's efficacy rate?

5.) Briefly explain in your own words how the catheter works (make sure to watch the video)

PART 1

Medtronic has an order for 20,000 large and 10,000 small Arctic Front Cardiac CryoAblation Catheters. We need to determine how much material to purchase in order to make the balloons. The company making the balloon material is located in the United States, and sells the material per square foot. Use the specifications in the article to determine the amount (in square feet!!!) of material needed to create enough large and small balloons for this order. (The balloon in spherical)

Formulas and conversion rates : $SA = 4\pi r^2$ 1 cm = .393701 in



PART 2

Medtronic is also currently running tests on a new material for the CryoAblation Catheter Balloon. They are only running these tests on the large balloon. We are trying to figure out how many moles of $N_2O$ will be in the balloon when it is fully inflated. The $N_2O$ reaches a temperature of -39$^o$ C in the balloon and the pressure in the new balloon will be standard at 101.3 kPa. The diameter of the large balloon remains the same from part 1. Use the ideal gas law to calculate the number of moles of $N_2O$ in the fully inflated large balloon. (Don't forget Volume must be converted to Liters, and the Temperature to Kelvin!)

Formulas and conversion rates: $V=4/3\ \pi r^3$ $PV = nRT$ $1000\ cm^3 = 1\ L$ $K = C + 273$