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A, C, E Detective: Calculating Percentages

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Rationale

"When will I ever use this?" The question echoes in 7 th grade math. My response is often a quick example of a job or situation where the specific type of math might be encountered. The example allows the math lesson to continue, however it does not give the students a tangible understanding of the use of mathematics in real life situations.

I teach math at August Boeger Middle School which is located in the foothills of East San Jose. We are a low-income district with 75% of our students on free or reduced lunch. The school faces many challenges and is under constant pressure to raise test scores. Gang life is influential on campus and in students' homes. Many of our students are English Language Learners struggling to understand content and develop English language skills. Math teachers struggle to fill in gaps for the students who are below grade level as well as cover the standards required for student success. In my opinion, the shift toward the common core standards will provide an opportunity for teachers to refocus on students' ability to understand and apply math concepts in context rather than rote memorization.

Research shows students who are strong in mathematical estimation excel in the math classroom as well as perform well on state tests. In my opinion this is due to a solid foundation in number sense. They are capable of estimating because they comprehend what is being asked and how it applies to real situations. Students' ability to estimate increases when given manipulatives or visual aides. I believe one of the problems in middle school math classrooms is the emphasis on memorization and calculation without context or understanding. Memorization and quick fixes will move students through curriculum and standards at a faster rate. The problem is that students will hit a ceiling. When students begin to move at a rate that allows them to grasp and internalize concepts they will be able to perform and excel in higher-level math.

Students in my district take Algebra as 8 th graders regardless of their math ability. This past year I had a student who could not multiply 8 x 3. I told him to draw and count to get the answer. He didn't even know what he could draw to get the solution. This same student knew 8 x 4 = 32. This is a tragic example of memorization without understanding. Now, don't get me wrong! I am obsessive about students memorizing their multiplication facts, but not at the cost of understanding what multiplication is. Memorization alone limits student access to success. This student will be placed in Algebra next year. I hope to continue to work with

teachers in our math department to increase student understanding and make a story like this the rare exception.

Percents are one of the most difficult concepts for 7th grade students to understand. The irony is that students rate percents as one of the easiest topics they learn. The disconnect? Students enjoy math problems they know how to "solve." Translation - they know where to get started. Frustration sets in when the student doesn't know where to begin or what to do. Students perceive the repetitive steps and calculations as simple and rarely realize they lack understanding of the concept. For example, a student misses 3 questions on a 20 question test and receives an 85%. The same student then misses 3 questions on an 8 question test and doesn't understand the drop in percentage. To most students missing 3 questions should be the same grade each time.

The percent problem persists when students mistake 7% to be 0.7. If asked to find 7% of 45, students often answer 31.5 (because they multiply 0.7 x 45) instead of 3.15 (multiplying 0.07 x 45). Students are often frustrated that their answer is incorrect. The common cry, "It is the same thing." When percents are put into contextual situations it clearly is not the same thing!

This vitamin unit is content focused. It gives background on the human body, explains the use and value of vitamins A, C, and E, and then looks at percentages in terms of recommended dosages and serving sizes. I hope to eliminate the question, "When will I ever use this?" by actually USING the math concept.

Objectives

This unit will enhance students' understanding of percents. It will use the body, vitamins, serving size, and recommended dosages to accomplish this objective.

California State standards expect students to "*convert fractions to decimals and percents and use these representations in estimations, computations, and applications,*" and "*calculate the percentage of increases and decreases of a quantity.*"[1] I believe students will succeed at this standard after learning and using percents in this unit.

Background

The Human Body

The average human body is composed of approximately 50 - 200 trillion cells. [2] There are about 5-6 liters of blood pumping through the body at a rate of 5 liters per minute. The body is about 70% water. It is possible to calculate the number of liters of water in your body. Take your weight in pounds and multiply by 0.7 (or 70%). This will give you the weight of the water in your body in pounds. Next divide by 2.2, since there are 2.2 pounds in 1 kilogram. The density of water is 1 kg/L (or 1 g/mL), so you now have the number of liters of water in your body. Here is an equation that describes this calculation: Bodyweight, lbs x 0.7 x kg/2.2lb x 1L/kg =

Bodywater,L.

Oxygen, carbon, hydrogen, and nitrogen together make up 96% of the mass of the human body. Oxygen (65%) and hydrogen (10%) are found mostly in water. The table below lists the elements that make up the human body and their percents in terms of body weight. [3]

Table 1: Percentage of Elements Found in the Human Body

table 12.05.05.01 is available in print form

There are 200 different types of cells in the human body. Cells are the basic structural and functional unit of the body. All cells are genetically the same but can be different in size, shape, and molecular makeup. Similar cells group together to create tissue. Two or more primary tissues grouped together for a specific function form an organ. Organs then work to form a system and our systems perform the functions we need to survive. [4]

The body is phenomenally intelligent and complex, however it is not invincible. Dysfunction in the body can lead to disease, illness, aches and pains. Through years of research - as well as trial and error - scientists have discovered many drugs to help treat and prevent diseases, illnesses, aches, and pains.

Principles of Drug Administration

What is worse, bad tasting medicine, swallowing pills, or painful shots? Why are different drugs administered different ways? Bioavailability, the fraction of drug absorbed into the blood stream, is different for each route of administration. There are advantages and disadvantages for the different routes of administration that must be considered. No single method of administration is best for all drugs.

Oral is the most common route of administration. There are numerous drugs available orally such as vitamins, antibiotics, painkillers and more. A drug taken orally is absorbed in the GI tract, which includes the stomach, small intestine, large intestine, rectum and anus. This method is popular because people are able to self-administer their medication. It is also cheaper than other routes and clearly more convenient. However, it doesn't work for every drug. Drugs administered orally have low bioavailability and they don't start working right away. Many drugs can irritate the GI tract and the acid and fluids within the GI tract can also destroy the drugs. It can be difficult to regulate patient compliance and not possible to administer to an unconscious patient. [5]

Inhalation is when the drug is absorbed through the lungs. Drugs for asthma and allergies are often administered through an inhaler. The metered-dose inhaler or MDI is pressurized and releases a fixed amount of drugs into the lungs. The lungs have a large surface area. There are approximately 300 million alveoli in the lungs. The alveoli are small air sacks with a diameter of about 0.25 millimeters. They give the lungs their huge surface area, almost 150 square feet. This is the size of a tennis court! [6] The large surface area allows the drug to enter the circulation system and begin working right away. This type of administration has its downfalls because it does not work for all drugs, particularly because many drugs can cause damage to the lungs. [7]

Intramuscular drugs are injected into the muscle. It is advantageous that the drug does not have to go through the digestive system and it is localized. However it is slow to take effect and can be painful. Vaccines, insulin, and epinephrine are intramuscular drugs. [8]

Subcutaneous drugs are injected into tissue between the skin and the muscle. They are localized but often are slow to take effect. Usually between 15 and 30 minutes. Anesthetics are administered in this way. [9]

Intravenous drugs are injected directly into the vein. There are two types of intravenous administrations. In intravenous injection, the drug is injected in the vein all at once. In intravenous infusion, the drug is continually being administered. The intravenous route allows for 100% bioavailability. Large quantities can be given and the effects are usually immediate. High-dose antibiotics, painkillers, and chemotherapy are often given intravenously. [10]

Vitamins

Vitamins are important organic compounds the body needs to grow and develop. The body is unable to produce most of these diverse sets of molecules; therefore it must acquire them through a vitamin rich diet or supplements. The body actually makes some vitamins like D and A, but it needs sunlight and precursors (like beta-carotene) to do so. Vitamins are usually administered orally, however high-doses administered intravenously have been used to treat certain diseases.

Vitamins are classified by their ability to dissolve in liquids. Fat-soluble vitamins such as A, D, and E dissolve in fat and then are absorbed into the bloodstream. These vitamins are stored in fatty tissue and the liver; therefore, they are not needed on a daily basis. Their standard unit of measure is the International Unit (IU), which measures potency. The potency changes from vitamin to vitamin so there is no formula to convert vitamins measured in grams to IU. For this unit we will use an online website that converts grams to IU for each specific vitamin (http://www.robert-forbes.com/resources/vitaminconverter.html). Water-soluble vitamins, like C and B dissolve in water. They are eliminated through urine; consequently they are needed on a daily basis. Milligram (mg) or microgram (mcg) are the units of measure.

Regardless of their classification or form vitamins are crucial to human health and development. Deficiency diseases have become rare in the United States, because of attention to the minimum daily doses of vitamins necessary to avoid deficiency. However, vitamins can help prevent degenerative diseases and slow the aging process, but the optimal dose for that effect is not always known.

Discovery of the Vitamin

In the 1800s chemists began studying the nutritional makeup of the human diet. They realized proteins, fats, starches, and sugars were necessary to provide usable energy. These elements were common in the average diet. However, through research of diseases such as scurvy, beriberi, and pellagra it became clear there were other nutrients in foods necessary for premium health.

Sailors who traveled for long periods of time often contracted Scurvy, a disease that causes weakness, pains in the joints, loose teeth, and death from the bursting of the main artery. However, even extremely sick sailors would recover if they made it to land and were given fresh fruit. It wasn't until 1765 when sailors began drinking lemon juice on long voyages that Scurvy was avoidable. From the 16 th to 18 th centuries Scurvy killed more sailors than all other diseases and wars combined.

Beriberi is a disease that causes weakness, loss of feeling in the feet and legs, difficulty breathing, and death from heart failure. In 1803, Thomas Christine, a British physician gave patients citrus fruits, hoping to see the same effects as were seen with Scurvy. The citrus fruits had no effect on the disease. Later in the 1890s Dutch military physician Eijkman infected chicks with the disease. He found that the symptoms of the disease were

only seen in chicks who ate white rice. The brown rice that was harvested went bad quickly unless the outer grain layer was rubbed off. The white rice lacked the outer bran layer known as the polishings. When Eijkman fed the polishings to the chicks they stopped suffering from the Beriberi symptoms. Interestingly, initially it was believed the disease was caused by a harmful amount of starch in the white rice. He believed the polishings were an antidote to the starch. More evidence for his findings came from Vorderman, a medical inspector at over 100 prisons. He was aware of Eijkman's findings. The disease was present in the prisons, but disproportionately. Upon closer inspection Vorderman found that prisons serving brown rice had less than 1 prisoner in 10,000 with Berberi where prisons serving white rice had 1 in 39.

In 1896 Gerrit Grijns, a doctor from the Netherlands, continued the research on the chicks but instead fed them only meat. Again, the chicks that were given the polishings did not show any Beriberi symptoms. This was important because it proved that the disease was not a result of the starch found in the white rice. Grijns was quoted with what came to be known as the Vitamin Statement, "there occur in various natural foods, substances which cannot be absent without serious injury to the peripheral nervous system. These substances are easily disintegrated. Which shows that they are complex substances and cannot be replaced by simple compounds." [11]

The goal was to find and synthesize the material in the polishings. Casimir Funk, a biochemist from Poland thought the material belonged to a chemical class called amines. He referred to these "vital amines" as "vitamine". It was later discovered that they were not "amines", so the word was shortened to vitamin. In 1929, with much debate over who deserved the credit, Eijkman was awarded the Nobel Prize for Physiology or Medicine for the discovery of the vitamin. [12]

The Roll of Vitamins as Antioxidants

Oxygen, the second most reactive element on earth, reacts with glucose in the body and converts to water and carbon dioxide. However, some oxygen molecules are only partly converted and therefore become free radicals. A free radical is an oxygen atom that has an unpaired electron. The oxygen's unpaired electron looks for a match and takes it from other molecules. It then becomes attached to the molecule and the molecule is oxidized. During this natural process, known as oxidation, free radicals cause damage to molecules, cells, and structures. One of the molecules that is susceptible to attack by free radical oxygen is DNA. In an individual, it is estimated that oxygen free radicals make 100,000 attacks on DNA every day. [13]

The cellular damage from free radicals leads to aging and degenerative diseases such as heart disease, cancer, arthritis, lung disease, diabetes, and eye diseases. The National Cancer Institute defines antioxidants as the substances that protect cells from the damage caused by free radicals. The antioxidants provide electrons for the free radicals before they do damage to other molecules. The body repairs itself by making a number of its own antioxidants. However, air pollution, cigarette smoking, stress, drugs, excessive exercise, and prolonged time in the sun can increase the level of free radicals in the body. This creates a need for additional antioxidants.

Vitamins A, C, and E have shown powerful antioxidant effects. In fact, 120 out of 130 clinical studies revealed people with high levels of vitamins A, C, and E had a lower risk of cancer.

Vitamin C

Vitamin C is an organic compound with the molecular structure of ascorbic aid. Hungarian biochemist, Albert Szent - Gyogyi isolated vitamin C and Norman Haworth made it available to the public by synthesizing it in

1937. It is the most commonly taken supplement and most important antioxidant.

Vitamin C has numerous functions. It is necessary for the production of collagen, which is the main structural protein found in the flesh and connective tissue. Collagen is vital for healthy teeth, bones, gums, cartilage, skin and blood vessels. Vitamin C is also known to heal cuts, fight infections, avert colds, and prevent scurvy. One of its most valuable rolls is as an antioxidant. Eight human enzymes take electrons from Vitamin C. [14]

Fredrick Klenner, an M.D. from Duke Medical School said, "If in doubt, give vitamin C." [15] He wrote 27 papers between the 1940s and 1970s describing the importance and uses of high levels of vitamin C. He died in 1984. The papers fell into the hands of Lendon Smith who summarized and published the information in "The Clinical Guide To The Use Of Vitamin C." Klenner felt that the recommendations for vitamin C were much too low. His passion followed the Puerto Rican Legend about the acerola fruit. *If there is an acerola tree in the backyard, a cold won't enter the front door*. The acerola fruit has 30 times more vitamin C than an orange. [16]

Klenner believed that vitamin C could be used to prevent or heal many serious diseases: polio, pneumonia, hepatitis, herpes, chickenpox, measles, mumps, arthritis, cancer, cavities, ruptured discs, sunburns, lead poisoning, and the list goes on. In some ways Klenner was a vitamin C fanatic. "Vitamin C will work in any problem. The negative results reported are only because an insufficient amount was used." [17]

He claimed enough vitamin C could destroy all virus organisms. For severe illnesses he recommended 350 mg per 1 kg of bodyweight to be given intravenously. In the case of chicken pox he claimed 250 mg per 1 kg would cause the pox to crust in 5 days and eliminate the virus. [18]

Fascinating stories about Klenner and his research are available. I recommend, "Vitamin C Cures" [19] and "Observations on The Dose and Administration of Ascorbic Acid When Employed Beyond the Range of a Vitamin in Human Pathology" [20] . Both articles are entertaining and informative about Klenner's research and use of high doses of vitamin C. This is something students might enjoy reading and comparing to current government recommendations.

Vitamin E

Vitamin E is a fat-soluble compound that comes in both natural (d-alpha-tocopherol) and synthetic (dl-alpha-tocopherol) form. Olives, avocados, oily fish, sunflower seeds, and spinach are all rich in vitamin E. It is used in many creams to increase healing of the skin and minimize the appearance of scars and burns, and is a powerful antioxidant.

The outer layer of every cell in the human body has a protective barrier against free radicals and other damaging molecules. This barrier is made mostly of fat and therefore absorbs the fat-soluble vitamin E. By penetrating through the cell membrane, Vitamin E distributes into the cell and works to protect the cell from free radicals.

High levels (150 IU daily) of vitamin E are necessary in order to experience its benefits. The foods that contain vitamin E are often high in fat and sodium as well. For example, 8 oz. of sunflower seeds would provide the necessary 150 IU along with 1,300 calories! So vitamin E is a great argument in support of supplementation. [21]

Vitamin A

Vitamin A is a fat-soluble vitamin that benefits the fatty tissue that protects the body. Deficiency in vitamin A

can lead to eye damage as well as blindness. It is good for the skin, important for cell growth, and helps maintain the immune system.

Vitamin A can be taken as a supplement or found in animal sources such as turkey, liver and eggs. When ingested as Vitamin A the excess is stored in the liver. It is toxic, so too much vitamin A can be dangerous. However, beta-carotene that is found in plant sources such as carrots, spinach, tomatoes, yellow vegetables, and kale is not toxic. Beta-carotene is known as the pre-cursor to vitamin A. The body is able to convert the beta-carotene into vitamin A on an as needed basis. The rest of the beta-carotene then becomes a powerful antioxidant. [22]

Recommendations

Vitamins are required and beneficial for normal body function. But, there is conflicting information available about necessary dosages. Continued research shows higher vitamin intake can help fight against degenerative diseases, slow the aging process, and improve overall health. When looking at recommended dosages it is important to keep in mind the intention and research behind the recommendation.

Recommended Daily Allowance (RDA) - During World War II the U.S. National Research Council developed the RDA to be used for people on rations. The RDA then became the standard or norm for vitamin and nutrient recommendations. This was never the intention or purpose of the RDA. The recommendations of the RDA are too low to induce high-quality health and prevent diseases like arthritis, cancer, diabetes, and heart disease. The truth is that necessary levels of nutrients are much higher than the RDA for optimal health.

The Reference Daily Intakes (RDI) - The Food and Drug Administration uses the RDI for nutrition labeling. Since the entire population uses nutrition labels the values were taken from the highest RDA for each nutrient in 1968.

Dietary Reference Intake (DRI) - The Food and Nutrition Board of the Institute of Medicine set up the DRI in 1997. They are the most current version of recommendations and are intended to replace the RDAs. The DRI will be the basis for updating the RDIs. The DRI has also led to the development of the Adequate Intake (AI) and the Tolerable Upper Intake Level (UI).

Over the years foods have been enriched with different nutrients. In the 1920's iodine was added to salt, in the 1930s vitamin D was added to milk, in the 1980s calcium was added to various foods, and in 1998 the FDA required folate to be added to grain. Even with nutrient rich foods, some have argued that it is impossible to get the necessary nutrients from food alone. Over processing, long storage periods, and modern growing methods have lowered nutrient levels in many foods. [23]

As research about the benefits of vitamins continues it is clear they are valuable compounds to help maintain optimal health. Nutrient rich foods as well as supplements supply the necessary vitamins and minerals needed to aide the body in fighting disease and staying strong.

Math Application - Teaching Strategies

Students will use the information learned in this unit to deepen their understanding of percents as well as compute percents and calculate percent increase and decrease.

The Human Body

Table 1: Percentage of Elements Found in the Human Body, will be used to help students understand the concept of 100%. I will give students a version of the table that does not have the elements in order. They will compare and order the elements from greatest to least. This will give students practice in ordering the percents that contain a decimal. Many students struggle to understand that 0.12% is less than 0.5%. Place value will be addressed at this point in time. With additional activities and discussions about the quantity of the elements I hope students will begin to understand the values.

Once students have compared and ordered the elements on the table they will then add the percentages to see that altogether it creates 100%. Students will use their body weight to calculate the weight of each element in their own body. For example, a student weighing 120 pounds would find the weight of oxygen in his or her body by multiplying 120 x .65 = 78. The students will continue finding the weight of each element. Some elements will require students to multiply correctly using decimals. The same 120 pound student will calculate the iron weight by multiplying 120 x .006 = 0.72. Once students finish calculating the weights of all the elements in their bodies they will add those weights up to hopefully get 100% of their body weight. This will be challenging for students because errors are made consistently when adding numbers with decimals. Many students forget to line up decimals when doing the addition. They usually don't pay much attention to the error. On a decimal worksheet the idea of a "reasonable answer" never crosses their minds. In this situation, I would imagine a student weighing 120 pounds is going to see a red flag if the total weight turns out to be in the thousands!

Vitamin C Recommendations

The metric system is a foreign concept to most 7 th grade students. They are not familiar with conversions and therefore Klenner's recommendation of 350 mg per 1 kg of body weight doesn't phase them. In order to help students understand Klenner's recommendations, students will convert their weight into kilograms. Students will calculate the recommendation for their weight. Using salt as a substitute for vitamin C, students will weigh the amount recommended by Klenner. They will compare that amount to the RDA for vitamin C. This will give students more exposure to the metric system as well as some fascination with Klenner's recommendations.

Supplement Facts

Multi-vitamins are a popular way for people to get their daily dose of vitamins and minerals. The serving information is a great way for students to practice calculating percents. The label for most vitamin supplements includes the vitamin, the amount, and the percent of the Recommended Daily Intake (RDI). It is interesting that in the multi-vitamin some quantities are below the RDI at 20% and other quantities are far over the RDI at 300%. Students will be able to use the serving information to calculate the amount and serving size to obtain exactly 100% of the RDI. Proportions are one method students are taught to solve percent problems. This information will work well using that method. Again, this will give students an opportunity to look at the "reasonable answer". For example, 1 multivitamin contains 150 mcg Biotin, which is

50% of the RDI. Students would calculate the number of servings (2) and amount (300 mcg) necessary to receive 100% of the RDI. Students who invert the numbers and get a solution like ½ a serving and 75 mcg would be able to re-think the solution in context. If a pill gives you 50% what you need, does it make sense to only take ½ of the pill? These questions will be more challenging when the serving gives over 100%. For example, Vitamin B6 5mg is 250% of the RDI. Students who calculate the serving size (2/5 or 0.4) will also be able to work with the conversion of fractions and decimals.

Percent Increase and Decrease

"Which number goes where?" Students are phenomenal at memorizing the process. This is because that is often what they are taught. This issue becomes a nightmare when it is time for students to learn percent change. If this topic is taught out of context students have no option other than to memorize a formula. They are great at setting up the formula but are never sure how to fill in the numbers. In context, it is clear, and students capable of solving percent problems will easily be able to apply those skills to percent increase and decrease.

The Council for Responsible Nutrition provides two great resources for learning about percent change. The first table entitled, *Comparison of Current RDIs, New DRIs, and ULs for Vitamins*[24] shows the dosages for the different recommendations. The second, *Historical Comparison of RDIs, RDAs, and DRIs, 1968 to present for Vitamins*[25] shows the change of dosage for each recommendation over time. Both tables give valuable data for students to calculate the percent change of the dosages. Graphing the data from the tables is valuable so students can see what percent change looks like on a graph. The idea is to give students a broad understanding and help them internalize the concept.

I have never taught a math unit focused on a science topic. I look forward to seeing my students engage in this unit and learn percents in an applicable way.

Classroom Activities

Activity One

Objectives: Students will be able to calculate the percent of a number. Students will understand 100% as the whole amount.

Direct Instruction: I will direct teach background information about the Human Body. This information will be given using a power point that contains pictures and descriptive explanations. Next, I will display Table 1: Percentage of Elements Found in the Human Body. Using a diagram of the human body students will look at how the weight of the body is made up by the different elements.

Guided Practice: Together we will calculate the weight of each element that makes up the class mascot Bevo, a Texas Longhorn Steer. Students will calculate this information by multiplying the percent in decimal form with the total weight of Bevo, which is 1,800 pounds. Students will fill calculations into a 3-column chart that displays the element, percent, and weight. At the bottom of the chart students will be able to add up the percents to see they equal 100% as well as add up the weight of each element to see that it equals 1,800 pounds.

Collaborative Practice: In their groups students will calculate the same information for Justin Beiber (122 pounds), Selena Gomez (110 pounds), The Rock (275 pounds), and one person of their choice.

Independent Practice: Students will calculate the weight of each element for their own body. (Students will be given an alternative if they do not want to use their own body weight.)

Extension: Students will be given a person's total body weight along with unidentified weights. Using the percents given in Table 1: Percentage of Elements Found in the Human Body, students will match the weight to the correct element.

Activity Two

Objectives: Students will use their knowledge of percents to determine the quantity needed of a vitamin to give 100% of the RDI.

Focus Lesson: I will project an image of Nutrition Facts for milk on the board. While students look at the board I will pour 1 serving (1 cup) of milk. Together as a class we will look at the RDI for Vitamin A, Vitamin C, and Vitamin D. We will then discuss how many glasses are necessary to get 100% of the RDI for each vitamin. Each serving will be poured into its own cup. So for example, if 1 serving of milk has 10% RDI of Vitamin A, we will pour 10 cups of milk to get the recommended 100% of Vitamin A. We will do this for vitamins A, C, and D.

Collaborative Practice: Each group will be given an empty vitamin supplement bottle filled with starburst. Students will identify how many vitamins are necessary to get 100% of the RDI for each vitamin. Students will fill in a chart with the information. The first 3 examples will be done together as a class. This is important because they will need to see what it looks like when the supplement contains over 100% of the vitamin (example Vitamin B = 250%).

Independent Practice: Students will be given a Nutrition Label from a new supplement. Students will determine the serving and quantity necessary to receive 100% of the RDI.

Activity Three

Objective: Students will calculate the surface area and volume of the lungs.

Collaborative Practice: I will give each group of students 4 balloons that are different sizes. The students will blow up the balloons and use a ruler to measure the diameter of each balloon in centimeters. Students will use the formula $4 \cdot pi \cdot r^2$; to calculate the surface area and $(4/3) \cdot pi \cdot r^3$; to calculate the volume of each balloon. Time will be spent discussing the difference between surface area and volume. Each group will report to the class. We will record all the solutions for each size balloon. As a class we will determine if there are any unreasonable answers. Students will then average the numbers. On chart paper the class will fill in average surface area and volume for each size balloon.

Focus Lesson: I will project a picture of the lungs with alveoli. I will explain how the alveoli work and how they increase the surface area of the lungs. This lesson will be taught while students are learning about the different routes of administration so they will make the connection of why Inhalation is an important route of administration.

Collaborative Practice: Students will look at a picture of alveoli that has a diameter of .25 mm [26] . They will use the formula $4 \cdot pi \cdot r^2$ to calculate the surface area of the alveoli and $(4/3) \cdot pi \cdot r^3$ to calculate the volume. We

will go over solutions as a class to make sure everyone has the correct answer. I anticipate some students will make calculation errors especially when squaring and cubing the radius. Students will peer tutor in groups to resolve any misunderstandings or errors.

Focus Lesson: I will project another picture on the board that shows a lung filled with numerous alveoli. Students will be told there are 300 million alveoli in each lung. They will work in their groups to determine the surface area and volume contained within both lungs. Students in the 7 th grade have the math skills to solve this problem, but will need some time working in groups to figure out how to do it.

Once students have worked out reasonable solutions for the surface area and volume of the lungs I will project pictures of things with similar surface areas (tennis court, lunch area, etc…).

Independent Practice: Students will do a math writing prompt response for the activity. They will answer the following questions: What did you do? Why did you do it? What math skills did you use? What did you discover? Why is it important?

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Appendix

Appendix A - California State Standards 7 th Grade

This unit focuses on California State Standards 7NS1.3 "Convert fractions to decimal and percents and use these representations in estimations, computations, and applications," and 7NS1.6 "Calculate the percentage of increases an decreases of a quantity." The unit gives students the opportunity to use percents in context.

Students who complete this unit will be exposed to a wide variety of CA State Standards. Lessons will incorporate 7NS1.1 scientific notation, NS1.2 operations with rational numbers, NS 2.0 exponents, 7AF1.2 order of operations, and MG1.1 converting between measurement systems. I believe students will benefit from seeing the numerous connections to mathematics throughout the unit.

Appendix B - Common Core 7 th Grade

The unit focuses on 7.RP.3 "Use proportional relationships to solve multi-step ratio and percent problems." This section of the common core incorporates percent calculations and percent increase and decrease. The unit also integrates 7.EE.3 "Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies."

The common core encourages in depth understanding and application of math skills. This unit allows students to learn mathematics in context and therefore reinforces the goal of the common core.

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