MODULE TOPIC: Surface Area to Volume Ratio

STANDARD(S) & INDICATOR(S):
NGSS:
7.G-6. Solve real-world and mathematical problems involving area, volume and surface area.
.
OBJECTIVE(S): Students will be able to:
Use mixtures of different sizes of salt particles to achieve a specific dissolution rate profile.

Explain why higher surface area to volume ratio leads to faster dissolution rate using the terms surface area and volume.

MATERIALS:
-Rock salt
-Table salt
-Powdered salt
-Beakers
-Spoons
-Multi-meters and connectors
-Digital balances

LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)
Drug Delivery
(https://docs.google.com/presentation/d/1eJEV_LP6Glj373Lz1jYJtlvuWPSL8yBuRe4oCz9lMNg/edit?usp=sharing)

BACKGROUND INFORMATION:
I will go over the concept of ratios, which should be review for most students. We will discuss what salt is and what happens when you put it into water. I will ask them what the difference is between the salts. I will guide them to the concepts of surface area and volume and talk about how to calculate these. I will then discuss why these concepts are important to society with specific focus on drug delivery.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:
Students will be trying to determine how particle size can be an important factor in dissolution. We will also discuss what happens when something dissolves, and expand into some examples of the applications (drug delivery, catalysis, etc.).
To accomplish this, students will be asked to dissolve 3 different types of salt: rock, table, and powdered salt into water. They will measure the rise in current as the salt dissolves and try to achieve a specific dissolution profile set by me.

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:
-What happens to the salt when it dissolves?
-What other factors might influence the speed at which the salt dissolves?
-Can you measure the surface area of one of the salt pieces? Can you estimate it?
-Which salt will dissolve the fastest and why?
-How does the data for the current trial inform what you should do for the next trial?
-What are some sources of error that you think might influence the results of this procedure? (stirring rate, water temperature, beaker size?, etc.)

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:
-Complete the worksheet and the post-activity questions

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:

	4	3	2	1
Group Achievement of Goals	Met all 3 benchmarks with an error of +/- 0.2 mA for the mark of 1.5 mA at 120 seconds	Met at least 2 benchmarks with an error of +/- 0.2 mA for the mark of 1.5 mA at 120 seconds	Met 1 benchmark with an error of +/- 0.4 mA for the mark of 1.5 mA at 120 seconds	Met no benchmarks with an error of +/- 0.4 mA for the mark of 1.5 mA at 120 seconds
Student Collaborates Effectively	Student communicates respectfully with all group members, participates but does not dominate, does a fair share of work, and holds group members accountable.	Student demonstrates strong overall collaborative skills, but may show minor difficulty with one aspect.	Student may show minor difficulty with two areas or significant difficulty with one aspect.	Student does not engage or does so with major collaborative issues to the point that student does not contribute productively

REFERENCES:
http://www.tryengineering.org/sites/default/files/lessons/sugarnano.pdf

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MODULE TOPIC: Introduction to Nanoscience

STANDARD(S) & INDICATOR(S):
CCSS-Math:
2.MD-1. Students will plan and carry out an experiment to measure the thickness of 3 materials, repeating the measurement 3 times for each, allowing for the calculation of an average thickness for each material.

OBJECTIVE(S): Students will be able to:
Measure the length of an object by selecting and using appropriate tools.

MATERIALS:
Paper, Al Foil, Plastic bags, Scissors, Calipers, Rulers, Micrometers, Balances, computer, Smartboard

LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)
-Slides
-IntrotoNanoscience.docx
-Groupwork Rubric

BACKGROUND INFORMATION:
After students collect their data, we will talk about averages and standard deviation. I will elicit students prior knowledge about these topics. I think most students will be familiar with averages, but most may not be with SD. So, I will give them the formula for calculating the average, and then go into what SD means. I will ask how we can tell which tool was better by using our data? We will look at the SD for each group depending on the SD they calculated for each material with their chosen instrument. We can compare that to the SD I got when I do my measurements with the most precise micrometer.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:
Students will assume the role of an employee who is in charge of assessing how thick three of their products (paper, Al foil, and plastic bags) are for quality control measures. They will be given a limited amount of each material (2 sheets) and access to the tools listed above in order to accomplish the task. They must work in groups of 3 and have a plan before starting. At the end, they will then present their approach to the class and each group will reflect on how well they think they did on the project.

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:
-Why did you select that tool?
-Why did your group decide on this approach?
-Do you think your measurements will be the same each time? Will it be twice as much if you measure twice as much paper/foil/plastic?
-What would make this activity easier?
-Is there a group role that you wish someone had?
-What does it mean to “take the average” of something?

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:
-Ask someone you know if they have any stories where they used the wrong tool for a job and it ended up costing them (time/money/etc). I will select a few students to share at the start of next class.

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
-Group work Rubric (on teacher notes page of worksheet)
-Students have 3 measurements for each material.
-Students correctly found the average thickness of each material with standard deviation
-Student discussed the importance of the tool that was selected.

REFERENCES:
-http://explore.museumca.org/goldrush/curriculum/we_accuse/tgrouprubric.html

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