**Lesson Plan for Volume of a Sphere (video)**

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Class: Math II

Class Size: 31 students

Topics:

* Volume of a Sphere

Objectives:

* EQ: How do you find the volume of a sphere?

Standards:

* MM2G4. Students will find and compare the measures of spheres.
  + a. Use and apply surface area and volume of a sphere

Instructional Tools/ Resources:

* internet, link to video
* Mobi, projector, interwrite
* handout for students

Initial Classroom Setup:

* groups of 4 (same groups as surface area activity)

Main Ideas/ Definitions:

* pyramid
* surface area (and formula)
* volume (and formula)
* base, height, radius

Connections to Previous Day:

* The video includes the surface area of a sphere so the students will have to remember that formula and incorporate it into the formula for volume of a sphere

Time Schedule:

* We plan to follow the surface area task with this so it will begin once we finish the practice problems for surface area.
* (15 minutes) The video is about 4 minutes long. We planned various stopping times with questions to ask.
* After the video we will work on the practice problems we set up. These problems should take up the remaining time left in class and might have to be completed for homework.
* If, for some reason, we get done with everything we have prepared a document for looking at the effect of changing the radius on the surface area and volume of a sphere. Regardless of whether or not we get to this, this will be the next topic that the class covers.

Questions:

* start at :09
* stop at :30 somebody explain to me what just happened.
* Stop at :58 does everyone understand how they got that formula?
* Stop at 1:31 if we add up the volume of all the pyramids, what do we get?
* Stop at 2:12 where did this formula come from? Can someone summarize where this formula came from/ what we've seen so far?
* Stop at 2:30 how can we write B1 + … + Bn in another way?
  + Stop at 2:42 so what does the area of all these bases represent?
* Stop at 3:17 what is another name for the circle with the largest possible circumference?
* Stop at 3:48 everyone simplify this expression and write down a final formula for the volume of a sphere. Have someone come write it on the board and explain it. Does everyone agree?

How to Monitor:

* Monitoring will occur through any visual clues that we are able to gather and through the questions we have designed to ask. For the large majority of the time, the students will just be watching the video and they will not have much to write down. Therefore, it would be impossible to monitor their thinking based on what they are writing. However, facial expressions or body language can give us some clues about their level of understanding during the video. Moreover, the questions we created are intended to keep the students on track to understand the video and therefore the volume formula. So, we will be able to monitor their progress through the answers they offer and who offers them.

Anticipated Student Responses (including representations, questions, and misconceptions):

* We imagined that the video would be difficult for the students to grasp if we just played it and let them see it the whole way through. So, we watched the video multiple times and decided where we thought we should pause the video and ask some questions. The questions are intended to ensure that the students are understanding what is going on in the video. Therefore, we hope to eliminate any questions or misconceptions that the students have by addressing them immediately and giving them the opportunity to ask any questions or to clarify anything that is happening throughout the video.

How to Select and Sequence Student Solutions:

* Because there is no real written component to this part of the lesson and because we will be calling on volunteers to answer our questions, we will not really be able to select or sequence responses for the majority of this lesson.
* However, there is one time that we stop the movie and ask them to finish finding the formula, mainly requiring them to do some algebra and manipulate the expression. We do expect different solutions at this point because we do not expect all students to simplify it the same way. Nonetheless, this has the potential to bring up a good discussion about equivalent expressions. If a large portion of the class comes up with a formula other than (4/3)πr² (for example, (4πr²)3 or (1/3)(4πr²)) , then we would call on one of those students to share their solution. Then we would ask for alternate solutions, getting to the one we see most often, (4/3)πr², and showing how they are equivalent. I do not expect this to be a problem.

Transitions:

* After we finish surface area, we will have finished one of the two measures of a sphere. We will ask students what the other measure is and if they know how to find it. We might even bring in a context to think of in regards to the surface area and volume of a sphere.

Formative Assessment:

* We think that the questions we ask while showing the video will serve as our formative assessment.

Tasks:

* task (video): <http://www.youtube.com/watch?v=xuPl_8o_j7k&feature=fvwrel>
* volume of a sphere practice or homework.pdf

Accommodations for students with disabilities

* The questions that we spaced throughout the video would be ever more crucial to the understanding of ELL's. Not only do the questions help to make sense of what is going on, they help to break up the video into smaller sections and slow it down. The video will be less overwhelming if given to them in small doses.
* For students with sight problems, it would be beneficial for them to sit as close to the screen as need (as it should be always) or have their own laptop or computer to view it with.

Plans to Extend/ Scaffold: What is the effect on the volume when you double the radius? Triple the radius? Generalize.

Alternative Plans:

* If we run out of time, the students can finish the let's practice problems for homework. There is no pressure there. If we finish earlier than expected we will begin to investigate the effect of changing the radius of the sphere on the surface are or volume. If technology does not work, we will have a big problem. The specific technology that would interfere with this lesson is the computer or the internet, preventing us from showing the video. If nothing I tried helped to fix it, I would try to explain what the video went through and walk the students through making sense of the formula. The following day, I would be sure to take time to watch the actual video. The animation is helpful in visualizing everything, especially since it is a 3-dimensional figure.

Closing: Let's practice problems/ review of formula

Homework: The homework will be whatever we do not finish in class. We have practice problems prepared to work through but we think we have a pretty ambitious schedule. So we will leave the students to complete whatever we do not complete in class.

Summative Assessment: end of unit assessment

Analysis of cognitive demand of each task (warm up, other problems done in class, main task)

1. Video/ development of formula for volume of a sphere
   1. It is hard to classify this activity because I am not sure that it even fully qualifies as a task. The students were not too active. The were having to follow along with the video. We did stop it however, before it would tell them the answer or next step and see if they could guess what would happen next. I would consider it, though short, a high cognitive demand task. They were using procedures for deeper levels of understanding, exploring mathematical relationships, and engaging in conceptual ideas.
2. Let's practice problems
   1. Again, these are procedures without connections. They are to be completed after the development of the formula to ensure that the students are able to use it properly and know the algebra to solve for the variable, whether that is the radius or the volume.