|  |  |
| --- | --- |
| **TEAM Lesson Plan Template** | |
| Teacher: Dr. Jason DeVito | |
| Subject/Grade: Fractions, grades 6, 7, or 8 | |
| Lesson Title: Fractions with power solids | |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| **SMP2**. Reason abstractly and quantitatively.  **SMP4**. Model with mathematics.  **SMP5**. Use appropriate tools strategically.  **6.EE.B.8** Interpret and write an inequality of the form *x > c* or *x < c* which represents a condition or constraint in a real-world or mathematical problem.  **7.EE.A.2** Understand that rewriting an expression in different forms in a contextual problem can provide multiple ways of interpreting the problem and how the quantities in it are related. *For example, shoes are on sale at a 25% discount. Howis the discounted price* P *related to the original cost* C *of the shoes?* C - .25C = P*.In other words,* P *is 75% of the original cost for* C - .25C *can be written as* .75C  **7.G.B.5** Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms  **8.G.C.7** Know and understand the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems. | |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledge  Student-Friendly (I Can Statement) |
| I can find the volume of a sphere, hemisphere, cylinder, or cone relative to one of the other solids.  I can use fractions to represent volumes of solids. | |
| **MATERIALS AND RESOURCES** | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook. |
| **Activities & Materials**  Set of Power Solids; Fractions with Power Solids worksheet; pencils; paper; pitcher of water; container to dump water in; paper towels  **What if the technology is not working?** Little technology is needed for this activity  **Routine for distributing materials** Pass out | |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners**  **Differentiation**  **----- Content** Some students may find it easier to work with cubes, prisms, and pyramids rather than the round solids.  **----- Process** Most students will calculate relative volumes by pouring water from one to another. Others may work with volume formulas.  **-----Product** Note that many different forms of answers are acceptable. For example, an explanation for question number 5 might involve formulas, pictures, or words. Any of these could provide a complete, correct explanation.  **----- Flexible Grouping**  **----- Learning Centers \_\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Accommodations**  **\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring**  **\_\_\_ Modified Assignments \_\_\_ Other**  **Early Finishers:** Early finishers should be asked to consider why the cone and hemisphere have such similar volumes. Would this relationship hold if the cone had a different height? Would the relationship hold if the base of the cone had a different radius? What is it about the radius (common to each solid) and the height of the cone which make its volume so close that that of the hemisphere? | |

|  |  |
| --- | --- |
| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Show the class a food can (soup, green beans, whatever) and ask them to name its shape. Ask them to consider a canning factory. The food has to be prepared in another container before being put into the can. If the factory has to fill 4000 cans a day, they have to know the volume of the cans and know the volume of the preparation container(s), which has a different shape. The preparation container(s) needs to hold at least 4000 times as much as the can. | |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| ***Introductio*n**  We have talked about volumes of three dimensional solids. We know that we can find formulas for these solids, but today we are just going to find how the volume of one solid relates to the others. We are going to use round things (display them as you name them) a sphere, a hemisphere, a cone, and a cylinder. Because these are round, each of them has a radius. For the cone we measure the radius of the circle at the base. What do you notice the radii of each of these solids ( *they are all the same* ).  **Motivating Students**  \_x\_ Verbal Reinforcement \_x\_ Relate to Real World  **Presenting Instructional Content**  \_x\_ Hands-On \_x\_ Work Examples  \_x\_ Discovery Learning  \_x\_ Modeling  ***Instructional strategies:***  **Modeling and Guided Practice *–*** Show students how to pour water from one solid to another. Show them where to get water, and show them where to pour waste water. Provide paper towels. Organize them in groups ( group size based on how many sets of power solids are available). Have each group complete a Fractions using Power Solids worksheet. Each group should appoint a recorder to read questions to the group, write answers on the worksheet and keep the worksheet dry. Other students should work with the solids and water. All students in the group should discuss what they observe and work together to answer questions.  Monitor their work and prompt them with questions as needed.  Well before the end of class, asks students to stop working, dry the power solids, and put them away. Collect the worksheets and conduct the lesson closure.  **Check for Understanding (CFU) –**  ***What am I doing for students that progress at different rates?***  ***What do I do if they get it?*** Ask students to provide other examples of filling or covering a solid or shape with another ( *example: If 5/4 of a sheet of paper covers the front of a textbook, how many pieces of paper are needed to cover 4 textbooks?* )  ***What do I do if they don’t get it?*** Regain the attention of the whole group and demonstrate specific volume comparisons for particular questions on the worksheet, then discuss how to use what was observed to answer the question. | |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning** Questions on the worksheet range from Comprehension through Analysis. The questions here are to help prompt students if they find the worksheet to hard or too easy.  **Knowledge:**  (8th grade) What is the formula for the volume of a (sphere), (hemisphere), (cone), (cylinder).  What does the pre-fix “hemi” mean in “hemisphere?”  **Comprehension:**  What fraction of the sphere’s volume is the volume of the hemisphere?  **Application:**  How is the height of the cone related to the radius of the cone? How do you know? (the height of the cone matches the height of the sphere, so the height is twice the radius)  **Analysis:**  (8th grade) Use the formulas for the volume of a hemisphere and the volume of a cone, along with the relationship between the height of the cone and the radius to explain why the volume of this cone and this hemisphere match.  **Synthesis:**  **Evaluation:**  **Thinking**    \_x\_ **Practical** –Students compare volumes of real objects  \_x\_ **Creative**– Students have to create a way to compare the volume of the cylinder and the sphere  \_x\_ **Analytical** – Students express comparisons of volumes as numbers (fractions)  \_x\_ **Research-based** – Students explore the relationships among the volumes through an experimental process  **\*What am I going to do to give Ss opportunity to?**  **1. Generate variety of ideas:**  **2. Analyze problems from multiple viewpoints:**  **Problem Solving**  **\_x\_\_ Drawing conclusions/Justifying Solutions** Students have to explain why their answers make sense  **\_x\_\_ Predicting Outcomes** Students face multiple questions about “Suppose the \_\_\_\_\_ has a volume of one cubic unit.”  **\_x\_\_ Observing and Experimenting** Students must observe and experiment to compare the volumes of the solids. | |

|  |  |
| --- | --- |
| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Students will work in heterogeneous groups. Groups size should not exceed 5 students, but the number of groups will depend on the number of sets of power solids available. * A member of the group should complete the worksheet and keep it away from the water. Other members should pour water from solid to solid, and all should discuss what they observe and what the answers should be. * Students will get verbal instructions. * Each group will complete a worksheet. | |
| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction. |
| ***Assessments:***  **\_x\_ Teacher Made Test** At a later date, a test question might read “Suppose that a sphere has a volume of 1 cubic unit. A right circular cone has a base with radius equal to the sphere and height equal to the diameter of the sphere. What fraction of the sphere’s volume is the volume of the cone?” or “Which has the larger volume, the sphere or the cone?  **\_x\_ Group Assignment \_x\_\_ Questions/Answers** The worksheet, along with students verbal answers to questions during the activity provide a formative assessment of the students’ understanding of fractions and reciprocal relationships. | |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| * ***Review/Summary:***  Today you should have seen relationships among the volumes of a sphere, cone, cylinder, and hemisphere with a common radius and, for the cylinder and cone, matching heights. If we choose the sphere as our unit of volume, then the cylinder has volume 3/2 cubic units. On the other hand, if we choose the cylinder as the unit of volume, then the sphere has volume 2/3 cubic units. The fraction 2/3 is the reciprocal of the fraction 3/2. We have seen a meaning for the reciprocal using actual objects. We represented these fractions as numbers and as points on the number line. * ***Preview for next lesson: link what they did to day with where they are going next.*** * ***Upcoming assignments: remind them of any upcoming assignments.***   ***Today we…. Turn to your partner and…. Let’s review our I Can statements……***  ***Here is your exit ticket for today…..***  **Follow-up Activities/Extension *These may be designed to create a longer or more intense lesson. For example, if the class is able to cover the material in a lesson much faster than expected, extensions may prove helpful. Extensions may also be useful in various parts of a lesson where the teacher (and class) decides they should spend more time on a skill or topic.***  ***Reflection: You must reflect on every lesson you teach.*** | |

**NOTES:**

This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.