|  |
| --- |
| **TEAM Lesson Plan Template** |
| Teacher: Dr. Jason DeVito |
| Subject/Grade: Geometry, Grade 7 or Grade 8  |
| Lesson Title: Pythagorean Theorem Boxes |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| **SMP1**. Make sense of problems and persevere in solving them.**SMP2**. Reason abstractly and quantitatively.**SMP5**. Use appropriate tools strategically. **SMP6**. Attend to precision. **8.G.B.5** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.**7.G.A.1** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.**7.G.A.2** Draw geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. |
| **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 knowledgeStudent-Friendly (I Can Statement) |
| I can measure the lengths of the diagonals of a box (rectangular prism).I can compute squares and square roots. I can use the Pythagorean Theorem to calculate the lengths of diagonals of a box (rectangular prism).  |
| **MATERIALS AND RESOURCES**  | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook.  |
| **Activities & Materials** Cardboard boxes of various sizes, labeled with names (Box A, Box B, etc). \_x\_Calculators; \_x\_ Rulers/tape measures; \_x\_ Worksheets/Handouts **What if the technology is not working?****Routine for distributing materials** |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners *(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)*****Differentiation****----- Content ----- Process -----Product ----- Tiered Assignments ----- Flexible Grouping****----- Learning Centers \_\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Accommodations****\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring** **\_\_\_ Modified Assignments \_\_\_ Other** **Early Finishers:** |

|  |  |
| --- | --- |
| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Introduce the problem: In construction, often a rectangle made out of beams is braced with a diagonal beam. Construction workers and architects need to be able to know how long the diagonal beams are supposed to be.Images available at: <https://myframe.co/braced-steel-frame/> |
| **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 see rectangular prisms every day. What do we usually call them? ( *boxes* ) We know that a (right) rectangular prism has rectangular faces, and we can find a diagonal of each of these faces. Today we will measure these diagonals on some actual boxes and then compare the lengths to the lengths predicted by the Pythagorean Theorem. Recall the theorem: If *a* and *b* are the lengths of the legs of a right triangle and *c* is the length of the hypotenuse, then $a^{2}+b^{2}=c^{2}$.**Motivating Students** \_x\_ Verbal Reinforcement throughout the activity\_x\_ Relate to Real World using actual boxes **Presenting Instructional Content** \_x\_ Hands-On \_x\_ Work Examples \_x\_ Discussion students will discuss what they are learning within their groups***Instructional strategies:*****Modeling and Guided Practice *–*** Work one example of solving for c in the equation $a^{2}+b^{2}=c^{2}$ . Draw a right triangle with leg lengths a = 3 and b = 7. Then $3^{2}+7^{2}= c^{2}$, so $c= \sqrt{3^{2}+7^{2}}$ = $\sqrt{58}$. If we wanted to record this number as a decimal, say a number of centimeters, we would get approximately 7.6. Arrange students in groups of 3 ( or 4) and give a box to each group. Make sure that each group can find the name of their box. Make sure that each group has a measuring tape or ruler, a pencil, and a worksheet. Have students complete the worksheet as a group. Monitor student work, providing encouragement and prompts as needed. For Question 14, here is a hint: You can do this just by changing the length and nothing else. ( *Just to give it away, if you change length from 2 feet to 3 feet then this works* ).For question 15, if students are interested, point out why the particular lengths were chosen: computationally, there is nothing special about Question 15. However, if you want all 3 sides and all 3 face diagonals to be integers, then this is example uses the smallest numbers possible.For question 16, let students struggle for a while, but not too long. The answer to this question is not known. The point is that it looks almost just like the other questions, which were straightforward. However people are still trying to answer this question. **Check for Understanding (CFU) –** ***What am I doing for students that progress at different rates?*** ***What do I do if they get it?*** ***What do I do if they don’t get it?***  |
| **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** **Knowledge:**Draw dlw on your box. How long is dlw ? What is an integer?**Comprehension:** Write formulas for dlw, dhw, and dlh**Application:**How big is the difference between your measured value and the value predicted by the Pythagorean Theorem? **Analysis:** Write a formula for dlhw in terms of l, h, and w. Why does your measured value not match the value predicted by the Pythagorean Theorem? **Synthesis:****Evaluation:** **Thinking*(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  \_\_ **Practical** –***Students use/apply/implement real life scenarios***\_\_ **Creative**– ***Students Create/design/imagine/suppose*** \_\_ **Analytical** – **Students analyze /compare contrast/evaluate/explain**  \_\_ **Research-based** – ***Students explore/review variety of ideas, models, solutions to a problem*** **\*What am I going to do to give Ss opportunity to?** **1. Generate variety of ideas:** **2. Analyze problems from multiple viewpoints:** **Problem Solving *Note: Teach 2 or more types of problem solving (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***\_x\_\_ **Abstraction** dlhw does not lie on the box. It is an imaginary line through air in the box. **\_**x**\_ Observing and Experimenting** students make measurements to compare to theoretical values from Pythagorean Theorem (which uses numbers from other measurements) **\_\_x\_ Generating Ideas** students are encouraged to find (an) example(s) of Euler Bricks  |

|  |  |
| --- | --- |
| **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 of 3 (or 4) [ Each group has to have a box, so the number of boxes actually dictates the possible numbers of groups ]
* Each group should have a time keeper/recorder, a measurer, and a calculator
* Students will know their roles from 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: aligned with state stds; measurement criteria; measure student performance in more than 2 ways (project, experiment, presentation, essay, short answer, multiple choice test) (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)*****\_\_\_ ThinkLink Probe \_\_\_ Study Island \_\_\_ Teacher Made Test \_\_\_ Unit/Chapter Test \_\_\_ Project \_\_\_ Quiz** **\_\_\_ Group Assignment \_\_\_ Study Guide \_\_\_ Oral Presentation \_\_\_ Graphic Organizer \_\_\_ Exit Ticket** **\_\_\_ Journal \_\_\_ Questions/Answers** **\_\_\_Teacher Observation *(thumbs up/thumbs down, etc.)*\_\_\_ Solution to Real World Problem** **\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *\****Students should achieve \_\_\_\_\_% mastery of this objective: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| * ***Review/Summary:*** Did anyone get an answer to problem 16? No one has found one yet, not just in this class, but in the world, ever. On the other hand, no one knows that there isn’t one. Such a prism is called a “perfect cuboid,” but no one knows if they exist. There are problems "near" to the math they learn which are still unsolved! And it's not that people aren't trying to solve them. For example, in 2017, Walt Wyss wrote a paper title "No perfect cuboid exists", but it has since received a rebuttal from Ruslin Shirapov. These papers can be found via a simple google search.
* ***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.