Lesson Plan Template

Grade: 8

Subject: Math 8 Chapter 6
Day 1: 6.2-The Pythagorean Theorem
Day 2: 6.5-Using the Pythagorean Theorem

Materials: Ch. 6 notes packets, cut-out kits, activity sheets

Technology Needed: Projector (for notes)

Instructional Strategies:

- ☐ Direct instruction
- ☐ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☐ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☐ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☐ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☐ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain:
Students will work with cut-out manipulatives to explore the Pythagorean Theorem. Example problems will be completed individually, then discussed as a class. Book assignment can be completed independently or in small groups/partners.
Students will work in pairs on the activity in the classroom and collab space.

Standard(s)
8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real world and mathematical problems in two and three dimensions.

Objective(s)
Students will explore the relationship of side lengths of right triangles to discover the Pythagorean Theorem. Students will use the Pythagorean Theorem to solve real world and mathematical problems.

Bloom's Taxonomy Cognitive Level: Understanding, Applying, Evaluating

Differentiation

Below Proficiency:

Extra assistance will be given to these students and more check-ins during work time. The cut-out kits will be made available during worktime for students who would like to visualize and manipulate the pieces to solve the problems.

Above Proficiency:

Students will be challenged to discover the formula before discussing it as a whole class. Students will be expected to complete the assignment and help a classmate if asked.

Approaching/Emerging Proficiency:

Students will complete the assignment with minimal assistance from the teacher.

Modalities/Learning Preferences:

The cut-out kits promote visual and hands-on learning. Students can choose to work independently or with a partner on the book assignment.
The activity promotes physical movement as students have to walk around to each problem and collaborate with one another to get the right answer.

Classroom Management- (grouping(s), movement/transitions, etc.)
Partners for the small activity with the kits will be at the pods of students across from one another. If there is an odd number of students, then a group of 3 is allowed.

Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)
Students will know the classroom routine of entering the classroom and finding their assigned seats.

Lesson Plan Template

Students will get to choose their partners for the activity. Group of 3 is allowed if there is an odd number of students.	During work time, students can work with a partner or independently while staying on task. If a phone is seen, it goes on the teacher's desk until the end of class. While students are working in collab space and in the classroom on the activity, they are to stay on task and not be disruptive to other groups or nearby classes. Every student is to complete the activity, not just one of the partners doing all the work. No phones will be allowed during the activity.

Minutes	Procedures
45	**Set-up/Prep:** ***See filled in notes packet for all notes and example problems** Prepare Kits: copies of grid paper, sets of construction paper pieces of Pythagorean theorem proof Create activity sheets, problem sheets to be posted around room, and answer key.
5 10-15	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** Greet students as they come into class. Tell students to take out their notes as they come in. "What have we been learning about so far in this chapter?" Square roots, cube roots, classifying numbers "And last chapter we talked about polygons, right? Specifically, triangles. What were some of the types of triangles we worked with?" Equiangular, Equilateral, Acute, Obtuse, Right "Today and next class, we are going to be working with right triangles. There's something special about the sides of right triangles. Someone named Pythagoras discovered this rule about right triangles and it is one of the most famous rules in mathematics. It is called the Pythagorean Theorem. Has anyone heard about the Pythagorean Theorem?" "This theorem squares numbers and when you're working with it, you'll have to use square roots too which is why we learned about those last week. So, what do you think is going to be helpful today?" Calculators and the table on front page of notes "Who remembers the theorem we talked about last class?" Pythagorean Theorem "And what was the formula?" $a^2 + b^2 = c^2$ "We are using it again today, but in ways that are more real-life. Lots of practice problems today." "But first, remember last week when I taught the lesson, and we did that pre-assessment? We are going to review that content briefly, and I have a post-assessment for you." *review pre-assessment and go over those questions, then assign post-assessment "When you have submitted the post-assessment, put away your Chromebook and take out your notes and you can start looking at page 11, the first problem."
	Explain: (concepts, procedures, vocabulary, etc.) "We are going to start on page 4 of your notes packet. We are going to start at the bottom of the page with the triangle that says to label the parts of the right triangle." "The Pythagorean Theorem uses three variables: a, b, and c. The two legs are a and b, and the hypotenuse is c. So, when we label our triangles, the short leg is a (label on diagram), the other leg is b (label), and the hypotenuse is c (label). The two legs are each shorter than the hypotenuse. And the hypotenuse will always be across from the right angle in the triangle (label right angle)." *Explain top graphic of grid on page 4 of notes "If we look at this graphic, you see that the right triangle has squares on each side of it. The area of the squares is the side length squared. So, a x a is the area of the square on the short leg." *use the measurements of side length 'a' to explain that the area of that square is 4 "Do we understand why we have a-squared, b-squared, and c-squared? That's where we get the squares from." "We are going to do a small activity to explore the relationship between the sides of a right triangle. In a minute, I will pass out some kits. Each kit has 8 of the same right triangle, an a-square, b-square, and c-square. You will also be given some grid paper to help you with the placements of the shapes." "We are going to find out what the relationship is between the sides of a triangle and create a formula. You and your partner, the person across from you at your pod, will work together to arrange the squares and triangles into two equal larger squares. All pieces must be used to make the two larger squares. So, you're just trying to

Lesson Plan Template

50-60	make two squares that are the same size using all these pieces. Do we know what we are doing?" *hand out kits to partners "If there's an odd number at your pod, have a group of 3." *students in the middle row of the classroom will pair up with each other *Walk around while students work with the kits, answer any questions they have, and see progression of ideas. If pairs finish quickly, challenge them to try to create a formula to explain the relationship of the side lengths, allow about 10-15 minutes for this *Once most pairs have created the two larger squares, come back together as a whole class to explain the formula "Alright, what do we think about right triangles and this relationship we are finding between the side lengths? Can someone explain what they noticed during this? Any ideas on what our formula could be for the Pythagorean Theorem?" "We noticed that to make the two equal squares, 4 right triangles were in both, but then the c-squared was in one while the a-squared and b-squared were in the other. So, the 4 triangles cancel out between our 2 squares, what does that tell us about c-squared and a-squared and b-squared?" → $a^2 + b^2 = c^2$ "That is the Pythagorean Theorem. Let's put it in our notes because this is a really important rule for right triangles, and you will want to remember it. On the top of page 5, let's jot down this formula." *fill in the formula at top of page 5 "We will use this formula to find missing side lengths of right triangles. Let's do example a together. Plug in the values to our equation and solve for the missing variable. Use a calculator or your squares table." *remind students how to type squares and square roots into calculators "How do we undo a square? We take the square root of it. Will our answer be negative square root or positive square root? It makes sense that it would be positive because can we have a negative side length of a triangle?" "When you are working today, you will follow the order of plugging in the values to the formula, squaring, and then you square root at the end. Then we can check if our answer makes sense. Is the hypotenuse the longest?" "Now I want you to do example b. I'll give you about a minute and then we will talk about the answer." "We are going to skip examples c and d. I want you to get the hang of using the Pythagorean Theorem with nice and easy numbers. We will see a few decimals later, but for now we won't work with the fractions. But, what should we use to help us with decimals?" Calculators. "Let's take a look at the bottom examples on page 5. What's different about these ones?" Solving for one of the legs instead of the hypotenuse. For the first example here, who can tell me what our equation will be after plugging in our numbers to the formula?" *then work through this problem, get the variable by itself, just like in chapter 1. Do next example in same manner. Use calculators for decimals. "Let's go to page 6. Please do 1 and 2, then we will talk about what to do on the rest of them." *about 3 minutes before going over answers "What do we notice about 4 and 5 that makes the problems a little different? We aren't just given a triangle with one missing side. So, we might have to pay attention to what the picture is telling us and take a few extra steps. For #4, what will the side lengths of our triangles be? Remember when we see the little notch in two sides, that means the sides are equal. Like when we draw an equilateral triangle. #5?" *walk through 4 and 5 as a class "We aren't going to worry about 6-8, they're the same thing as what we have already done." "Are there any questions on how to use the Pythagorean Theorem and solving for missing side lengths of triangles?" "Can you please put all the pieces of your kits back into the bag. Make sure all the pieces make it into the bag. Thank you." "Your assignment is posted on Google Classroom. When you are working, you will want to show your work if you want to be successful. You'll want to keep track of the steps you are doing. Go ahead and get started on that. If you have any questions, let me know."
25-35	

Lesson Plan Template

	"Thank you for taking those online assessments kiddos! Alright, page 11 in your notes. We are working with the Pythagorean Theorem in real life. Let's work on #1 and #2. We are just going to do part a in #1. Do both of these problems and then we will go over the answers." "We have a vocab word to define. Pythagorean Triple: is a set of three positive integers a, b, and c where $a^2 + b^2 = c^2$. Examples: 3,4,5 6,8,10 5,12,13 . "Let's go to page 12. Let's do the square together. What's our equation going to be using the Pythagorean Theorem?" $4^2 + 4^2 = c^2$ "So, we found one side of the square, how do we find the perimeter? Multiply by 4 or add all the sides together. Now I want you to try the parallelogram. I'll give you about 2 minutes then we will talk about it." For 1-3, you'll be using a coordinate plane. You are given a line, so you will have to draw the right triangle in order to use the Pythagorean Theorem. Let's do #1 together." "Now you do 2 and 3 and then we will discuss the answers." "Go ahead and do 4 and 5 as well." *discuss answers "6 and 7 are asking something a little different. We are given all the side lengths, but we don't know if it's a right triangle. Any idea how we will figure out if it is a right triangle?" "If it's a right triangle, the Pythagorean Theorem will work. Remember that a and b are the 2 shortest sides, c is the longest side. So when you plug in the numbers to the formula, c should be the biggest number. Go ahead and try 6 and 7 and then we will talk about it." *discuss 6 and 7 "Let's do 8 together and then we will get you going on the assignment." "Have any of you ever done one of these activities? (show activity sheet) There are problems posted on the walls in the collab space and our classroom. How it works is you go to a problem, solve the problem, and the choices at the bottom will tell you which problem to go to next. The goal is to complete the circle by starting and ending at the same problem. If you answer all the questions correctly and follow the pattern, you will end with the right order. If you answer a question wrong, the cycle will be messed up and you'll be sent to the wrong problem. So, if you are sent to a problem that you've already been to, you have made a mistake and must backtrack to find where you messed up. The problems are all numbered and scattered throughout the collab space and our classroom. Show your work in your notebooks, write the number of the problems on the activity sheet in the order you complete them in." "You will be working in pairs to complete this activity. If you want to avoid any hiccups and backtracking, I recommend that you and your partner do each problem individually and check answers with each other." "Please work quietly in the collab space, I don't want to hear any complaints from other classes that you were being too loud. Once you're completely finished, come check your answers with me." "Any questions on how to do this?"
25-30 45-55	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** *students will complete book assignment that has been posted on Google Classroom: page 240 #'s 1,2, 4-7, 9-14, 16, 18-23 "Find a partner, both of you will need an activity sheet from me, then you can get started. You will want a calculator. Don't start at a problem that someone else is already at." *the problems for this activity are in the book: page 262 #'s 2-6, 8-9, 12-13, 15-16, 19-20, 23, 26
1 2	**Review (wrap up and transition to next activity):** "How do we feel about the Pythagorean Theorem? Think it's useful? We will be using it again next class!" "Have a good day!" As students finish the activity sheet, have them complete DreamBox lessons and any missing work. "Did you like this activity? Are you getting used to the Pythagorean Theorem?" "Have a good weekend!"

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** While students work on example problems and the book assignment, walk around, and check for understanding	**Summative Assessment (linked back to objectives)** **End of lesson:** On Day 2, students take post-assessment for section 6.1 **If applicable- overall unit, chapter, concept, etc.:** Summative Assessment of Chapter 6 will be given the following week.

Lesson Plan Template

by asking how students arrived at their answers. Ask if students have any questions.

While students complete the activity, observe partnerships, and thought processes. Answer any questions students may have.

Consideration for Back-up Plan:
If students finish assignment early, they are to work on DreamBox lessons for the week. If they have DreamBox done, they are to work on missing assignments they have.

If there is an odd number of students in class, allow a group of 3.
If students aren't working well together, they will be separated and will work on the assignment independently.

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

I am very pleased with both days of this lesson. Students really understood the Pythagorean Theorem and were great about responding and participating when a question was asked during notes.
Overall, students were engaged in the intro activity with the cut-out kits. I would change it to having students explain their conclusions instead of coming back together as a class and the teacher reviewing the conclusion. Increase student engagement by making the discussion student-led rather than teacher-led.

On the second day, we took the post-assessment for section 6.1. It took away a little time that could have been used to complete the assignment at the end of class. There were a few students who did not finish the assignment, so those few extra minutes used for the post-assessment could have been helpful. Depending on the schedule for future classes, the post-assessment could be taken at a different time so as to provide ample work time on the activity.
During the activity assignment on Day 2, I regularly checked students' progress to make sure they were on the right track to avoid them having to backtrack too much from an early mistake. Students also asked questions when they needed help. I also saw some groups discussing what the correct answer is because they had arrived at different answers. I was able to observe them resolve and problem solve without me intervening. It is vital to walk around and observe and make myself available for students to ask questions. Observing also allows me to check for understanding in the midst of the activity. When multiple students are struggling with a concept or stuck on the same problem, I will gather the class together to review and walk through that concept or problem.
One thing I should have thought about was once the students finished the activity assignment, if they should keep it or turn it in. They usually don't turn in their assignments because it is in their notebooks, but this was a worksheet. I told them to hold onto it.

When I would ask students what the Pythagorean Theorem was, they whole class would respond and say what it was. They understood the lesson and were engaged. I feel very good about this lesson and the changes I will make in the future.