Matthew Hrbacek

Grade: 8th Grade	**Subject: Mathematics - Geometry**
Materials: Notebook, Pencil, Computer	**Technology Needed: Computer**

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:
There will be an activity on the computer to model the proof of the Pythagorean Theorem. If this fails, we will do a hands-on activity to model the same outcome.

Standard(s)

8.G.6 – Explain a proof of the Pythagorean Theorem and its converse.
8.G.7 – Apply the Pythagorean Theorem to find unknown side lengths in right triangles in real world and mathematical problems in two and three dimensions.
ISTE 1c (Student) – Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
ISTE 6c (Student) – Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models, or simulations.

Objective(s)

By the end of the lesson, students will be able to walk through the steps of a proof of the Pythagorean Theorem and explain each one. Students will also know how to apply the Pythagorean Theorem.

"I am able to explain the different steps in proving the Pythagorean Theorem."
"I am able to apply the Pythagorean Theorem to find unknown side lengths in right triangles."
"I am able to use technology to improve my learning through feedback and effective practice."
"I am able to use technology to help me communicate complex ideas to others."

Bloom's Taxonomy Cognitive Level: Understanding, Applying, Analyzing, Creating

Differentiation

Below Proficiency:
For students who are below proficiency, the hope is that they will be able to understand the conclusion of the proof and begin to look at some applications of the Pythagorean Theorem. They will not be expected to reproduce the proof.

Above Proficiency:
For students who are above proficiency, the expectation will be that they understand each of the steps in the proof. The hope is that they might even be able to replicate the proof with minimal help. These students are also expected to be comfortable applying the Pythagorean Theorem to basic problems.

Approaching/Emerging Proficiency:
For learners approaching proficiency, the goal is to be able to understand the beginning and end of the proof. They may struggle on some of the steps in the middle of the proof, but given an outline, I hope they would be able to fill in the blank within the proof. These students will also be expected to understand how to apply the Pythagorean Theorem with minimal help.

Modalities/Learning Preferences:
Students will have the opportunity to learn through instruction on the whiteboard and taking notes. They will also have the opportunity to learn with technology and math manipulatives online.

Classroom Management- (grouping(s), movement/transitions, etc.)

- Group Discussion
  - Contribute to the discussion
  - Listen quietly when other students participate
- Note-taking
  - Copy important notes
  - Pay attention to the teacher
- Individual Work
  - Work quietly and separately

Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)

- Technology
  - Perform the activity with math manipulatives
  - Work quietly and independently
  - Avoid websites which distract from the content we are learning, stay on task

Minutes	Procedures
3 minutes	**Set-up/Prep:** Students will need to get out a notebook and pencil. They will also be provided a computer to work on.
10 minutes	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** "What do you all know about the Pythagorean Theorem?" – This question will be used to get interest as well as to diagnose where students are at. It will give me an idea how much they already know about applying the theorem. "What is the Pythagorean Theorem?" – This question will require students to recall a formula. This question addresses the Knowledge

	lever of cognitive complexity. We will have a brief discussion based on the responses of students.
20 minutes	**Explain: (concepts, procedures, vocabulary, etc.)** Now, we will continue our discussion by going over a few simple applications of it with triangles and graphs. Then I will write down the important steps in proving the Pythagorean Theorem on the board. I will be using the initial proof which Pythagoras used. **"**Has everyone gotten the steps of the proof written in their notes?" – This is a managing question. "Does anyone know the solution to the first example on the board?" – This question addresses the Application level of cognitive complexity. "Can anyone summarize the first two steps of the proof?" – This question addresses student comprehension, and it can also be used to check on how well students are understanding the proof so far. "Now that we have gone over a couple examples, are we ready to look at a proof of the Pythagorean Theorem?" – This is a question which structures and redirects the discussion. "Does anyone have any ideas for the next step of the proof?" – This encourages to actively participate as well as think creatively about how to continue the proof. It encourages higher order thinking. "Can anyone think of an example where this theorem might be helpful?" - This question addresses the Synthesis level of cognitive complexity. "Are there any steps of the proof that you have questions about?" – This question allows for expression of affect.
20 minutes	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** At this point, I will have students turn on their computers and open the math manipulative that we will be using. The students will work through two puzzles that illustrate proofs of the Pythagorean Theorem. These puzzles are listed on http://nlvm.usu.edu/en/nav/category_g_4_t_3.html. I will walk around during this time to ensure that students are following technology guidelines. I will also assess how students are doing with the assignment.
5 minutes	**Review (wrap up and transition to next activity):** We will end class with any questions that the students have. I will also hand students a worksheet as they are leaving class to assess their understanding of the proof and application of the Pythagorean Theorem. "Can anyone make a comparison between the two proofs that we have seen?" – This question addresses the Analysis level of cognitive complexity. "Now that we have seen multiple different proofs of the Theorem, can anyone argue for which one was better?" – This question addresses the Evaluation level of cognitive complexity.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Students will be assessed based on the way that they are progressing through the manipulative. I will also do a brief checkpoint to see how everyone is doing during the time on the computer. **Consideration for Back-up Plan:** If the technology fails to work, we will go over another unique proof of the Pythagorean Theorem. This proof will still be hands on and it will use origami to demonstrate another proof of the Pythagorean Theorem.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of this lesson, the students will take home the worksheet to finish. Then, I will collect it the next day to see where students are at. **If applicable- overall unit, chapter, concept, etc.:** Students likely will not be tested on the proof of the Pythagorean Theorem, but they will be expected to know how to apply it on a test.

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