

## **WAMC Lab Template**

Math Concept(s): Pythagorean Theorem

Source / Text: Youtube ([https://www.youtube.com/watch?v=9\\_CX2BF-bDs&t=16s](https://www.youtube.com/watch?v=9_CX2BF-bDs&t=16s))

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### **Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

### **Short Description (Be sure to include where in your instruction this lab takes place):**

#### **Lab Plan**

Lab Title: Practical proof of the Pythagorean theorem

Prerequisite skills: perfect squares, multiplication, area of a square

Lab objective: Develop the Pythagorean theorem using areas of squares

#### **Standards: (Note SPECIFIC relationship to Science, Technology, and/or Engineering)**

Mathematics K–12 Learning Standards:

- 8.G.B.7 Apply the Pythagorean theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Standards for Mathematical Practice:

- SMP1 Make sense of problems and persevere in solving them.
- SMP3 Construct viable arguments and critique the reasoning of others.
- SMP6 Attend to precision.
- SMP7 Look for and make use of structure.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.
- W.9-10.1.E Provide a concluding statement or section that follows from and supports the argument presented.
- W.9-10.2.D Use precise language and domain-specific vocabulary to manage the complexity of the topic.
- SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

K-12 Science Standards

•  
Technology

•  
Engineering

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Global Awareness       | <input checked="" type="checkbox"/> X Financial/Economic/Business/Entrepreneurial Literacy | <input type="checkbox"/> Civic Literacy |
| <input type="checkbox"/> Health/Safety Literacy | <input type="checkbox"/> Environmental Literacy  |   |

21st Century Skills (Check those that students will demonstrate in the above activity.)

**LEARNING AND INNOVATION**

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- X Implement Innovations

Critical Thinking and Problem Solving

- X Reason Effectively
- Use Systems Thinking
- X Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- X Communicate Clearly
- X Collaborate with Others

**INFORMATION, MEDIA & TECHNOLOGY SKILLS**

Information Literacy

- Access and Evaluate Information
- Use and manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

**LIFE & CAREER SKILLS**

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- X Interact Effectively with Others
- X Work Effectively in Diverse Teams

**Productivity and Accountability**

- X Manage Projects
- X Produce Results

Leadership and Responsibility

- X Guide and Lead Others
- X Be Responsible to Others

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## **Teacher Preparation: (What materials and set-up are required for this lab?)**

Materials (for each group)

- A large piece of cardstock
- Styrofoam (2" height sheets)
- Uncooked quinoa or other small granules
- Fast drying glue
- Double-sided tape
- Lamination sheets (Clear material that is stiff)
- Rulers
- Tools to cut Styrofoam

Set-Up Required:

- Large tables would be helpful for workspace

## **Lab Organization Strategies:**

Leadership (Connect to 21<sup>st</sup> Century Skills selected):

- Implement Innovations
- Reason Effectively
- Make Judgments and Decisions
- Communicate Clearly
- Collaborate with Others
- Interact Effectively with Others
- Work Effectively in Diverse Teams
- Manage Projects
- Produce Results
- Guide and Lead Others
- Be Responsible to Others

Cooperative Learning:

- Students will be in groups of four (project manager, material manager, measurer, and builder). Students will have to work together and check each other's work in order to create the practical proof to work properly.

Expectations:

- Students will use materials and tools appropriately. Students should ask questions when unsure of directions. Students will attend to precision and work within their groups to create the practical proof. Each student should have a role (project manager, material manager, measurer, and builder).

Timeline:

- This activity should take at least 100 minutes. It may take longer depending on students' precision and motor skills with measuring, gluing, and filling up the largest square with granules.

## **Post Lab Follow-Up/Conclusions:**

Discuss real world application of learning from lab

- The day after construction of the Practical proofs of Pythagorean Theorem, have a contractor or architect visit the class to discuss the importance of the Pythagorean Theorem in construction of buildings.

#### Career Applications

- Contractor
- Architect
- Surveyor
- Farmer

#### Optional or Extension Activities

- Students can explore similar triangles to find other Pythagorean triples that are proportional to the 3, 4, 5 triangle.
- Students can also explore to find other Pythagorean triples that are not proportional to the 3, 4, 5 triangle.

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## Exploration of Areas

Today you will build a structure that will allow us to understand a famous theorem. You may have heard of it (cliffhanger). After you complete the following directions, be prepared to share your ideas on where we are headed and what you notice and wonder. If you are unsure of the directions, work with other groups first to make sense of the next steps. If you are still unsure, please get my attention to make sure you are on the right track.

Student directions:

1. Use the Styrofoam to create a triangle with the following side lengths: 3", 4", 5".
2. Cut out the triangle.
3. Score each vertex of the triangle about halfway through the height. Then take a notch (about the size of your finger tip) out using your cutting tools.
4. Glue the triangle to the middle of your poster paper, notch side down.
5. Using your tools, create 1/2" strips of Styrofoam with the following lengths: 3", 4", 5". Make sure to have three of each length.
6. Glue the strips so that they have the same height as the Styrofoam, while making squares on the corresponding sides of the triangle you glued to your paper.
7. Use double-sided tape to cover all of the top surfaces of your structure.
8. Fill in the 5"X5" square with the quinoa. Make sure to level it off using a straightedge.
9. Remove the backing of the double-sided tape to expose the adhesive.
10. Press a lamination sheet on top of the structure to seal all of the spaces.
11. Rotate your poster paper and analyze the relationships.

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## Practical Proof - Grading Rubric

	Great job! (3 points)	Almost there (2 points)	Getting there (1 points)	Missing (0 points)
<b>Building the structure:</b>				
Creates a triangle with side lengths 3", 4", 5"				
Cuts out Styrofoam strips with lengths 3", 4", 5"				
Creates squares using the sides of the triangle.				
Fills the large square with granules.				
Affixes laminate sheet to the surface of the structure.				
Understands that the areas of the small squares sum to the area of the large square.				
Generalizes the relationship as the Pythagorean Theorem.				
<b>Overall:</b>				
Communicates clearly and uses appropriate mathematical vocabulary.				
Attends to precision.				
Uses appropriate tools strategically.				
<b>Total:</b>				

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Name \_\_\_\_\_ Period \_\_\_\_\_

Use the assessment tool to grade your teammates. Put each of their initials in one of the boxes below. You can put multiple initials in one box.



Key	
Not Observed	Red
Approached	Yellow
Met	Green
Exceeded	Purple

		Effort					
		0	1	2	3	4	5
Collaboration	0	Not Observed	Not Observed	Approached	Approached	Approached	Approached
	1	Not Observed	Approached	Approached	Approached	Approached	Met
	2	Approached	Approached	Approached	Approached	Met	Met
	3	Approached	Approached	Approached	Met	Met	Met
	4	Approached	Approached	Met	Met	Met	Exceeded
	5	Approached	Met	Met	Met	Exceeded	Exceeded

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