

WAMC Lab

Math Concept: Unit Circle

Source / Text: Math Medic

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Attach the following documents:

- Student Handout with Instructions
- Assessment Tool

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

Students will create a unit circle. They will start first by creating the 45-45-90 and 30-60-90 triangles with a hypotenuse of 1 foot, finding the lengths of the other two sides (written in simplified radical form). They will then draw a circle with a radius of 1 foot, with the x-axis and y-axis drawn in. They will then divide each quadrant into 30, 45, and 60 degree reference angles. They will then label the angles and the coordinate of each angle.

Lab Plan

Lab Title: Developing a Unit Circle

Prerequisite skills:

- Knowledge of special right triangles
- Understanding angles on a coordinate plane.
- Reference Angles
- Trigonometric ratios for angles in standard position.
- Writing radicals in simplest form.
- Dividing radicals.

Lab objective:

- Use special right triangles to find coordinates on a unit circle.
- Understand that on a circle, $\cos = x$ coordinate and $\sin = y$ coordinates.
- Evaluate \sin , \cos , \tan functions using the unit circle.

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

Mathematics K–12 Learning Standards:

HS.F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

HS.F.TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric

HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

HS.G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.

HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

HS.G.SRT.11(+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Standards for Mathematical Practice:

MP2 Reason abstractly and quantitatively.

MP4 Model with mathematics.

MP5 Use appropriate tools strategically.

MP6 Attend to precision.

MP7 Look for and make use of structure.

MP8 Look for and express regularity in repeated reasoning.

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

- Speaking and listening
- Comprehension and collaboration
- Work with peers to set rules for collegial discussions and decision making.
- Propel conversations by posing and reposing to questions that relate to current information.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)			
<input type="checkbox"/> Global Awareness	<input type="checkbox"/> 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	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS	Productivity and Accountability
<u>Creativity and Innovation</u>	<u>Information Literacy</u>	<u>Flexibility and Adaptability</u>	<u>Leadership and Responsibility</u>
<input checked="" type="checkbox"/> Think Creatively	<input type="checkbox"/> Access and Evaluate Information	<input type="checkbox"/> Adapt to Change	<input type="checkbox"/> Manage Projects
x Work Creatively with Others	<input type="checkbox"/> Use and manage Information	<input type="checkbox"/> Be Flexible	<input type="checkbox"/> Produce Results
<input type="checkbox"/> Implement Innovations	<u>Media Literacy</u>	<u>Initiative and Self-Direction</u>	<u>Leadership and Responsibility</u>
<u>Critical Thinking and Problem Solving</u>	<input type="checkbox"/> Analyze Media	<input type="checkbox"/> Manage Goals and Time	<input type="checkbox"/> Guide and Lead Others
<input checked="" type="checkbox"/> Reason Effectively	<input type="checkbox"/> Create Media Products	<input type="checkbox"/> Work Independently	<input type="checkbox"/> Be Self-Directed Learners
<input type="checkbox"/> Use Systems Thinking	<u>Information, Communications and Technology (ICT Literacy)</u>	<u>Social and Cross-Cultural</u>	<input type="checkbox"/> Be Responsible to Others
<input type="checkbox"/> Make Judgments and Decisions	<input type="checkbox"/> Apply Technology Effectively	<input type="checkbox"/> Interact Effectively with Others	
<input type="checkbox"/> Solve Problems		<input type="checkbox"/> Work Effectively in Diverse Teams	
<u>Communication and Collaboration</u>			
x Communicate Clearly			
x Collaborate with Others			

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

Materials

- Butcher Paper
- Protractor
- Pencils
- String
- Ruler
- Scissors

Set-Up Required:

- None

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

Think Creatively 1.A.3 Elaborate, refine, analyze, and evaluate their own ideas in order to improve and maximize creative efforts Cooperative Learning:

Expectations:

Work Creatively with Others 1.B.3 Demonstrate originality and inventiveness in work and understand the real-world limits to adopting new ideas

- **Communicate Clearly** 3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts - Students must communicate and work together in order to develop a unit circle.
- **Access and Evaluate Information** 4.A.1 Access information efficiently (time) and effectively (sources) - Understand that on a circle, $\cos = x$ coordinate and $\sin = y$ coordinates and to evaluate \sin , \cos , \tan functions using the unit circle.

Timeline:

One-70 minute block period

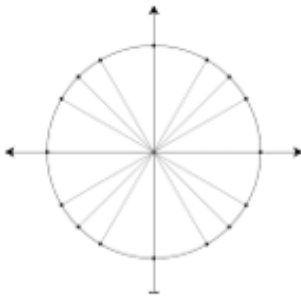
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Developing a Unit Circle

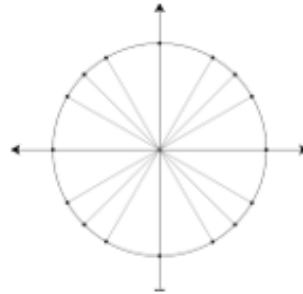
Check Your Understanding

Draw each angle. Then use the unit circle to find each of the following.

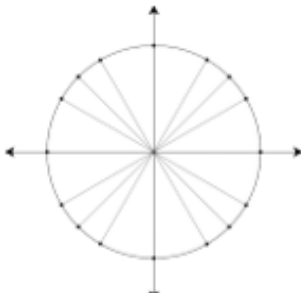
1. $\sin 120^\circ$



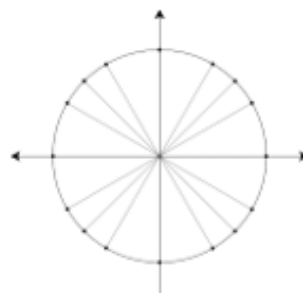
2. $\cos 225^\circ$



2. $\tan 45^\circ$



4. $\sin -30^\circ$



Student Demonstrates Understanding:

1

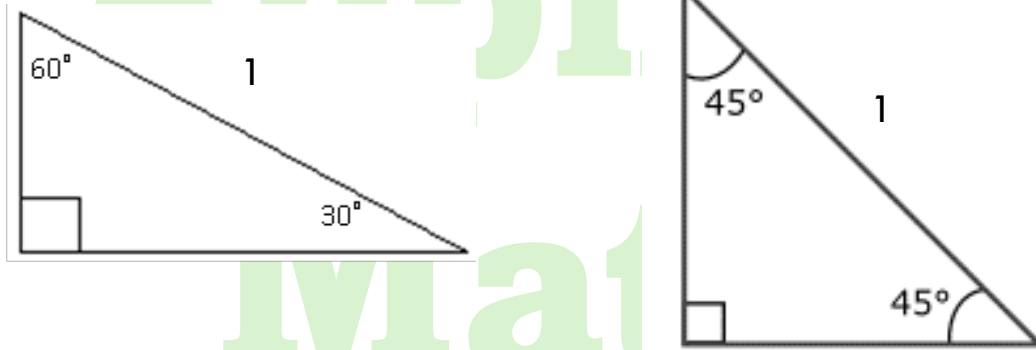
2

3

4

DEVELOPING A UNIT CIRCLE

1. Using copy paper create a 45-45-90 triangle and a 30-60-90 triangle, both with a hypotenuse of 1 foot. Cut out triangles.
2. Find the lengths of the legs for each of the triangles. Show your work.



3. Label all the sides and angles on **both** sides of the triangles.
4. Using given materials draw a circle with a radius of 1 foot on the large easel paper.
5. Draw in an x-axis and y-axis with the origin in the center of the circle.
6. Divide each quadrant of the circle into 30° , 45° and 60° reference angles.
7. Fill in the whole circle labeling the angle at each line.
8. Use the corresponding triangle to find the x-coordinate and y-coordinate on the angle points marked on the circle lining up the hypotenuse with angle line. (Don't forget which quadrants have positive and negative coordinates.)

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9. Use your cut-out triangles and your unit circle to complete the table:

	Using triangle find $\cos \theta$:	Coordinate on the unit circle at θ :
$\cos 30^\circ$	$\cos 30^\circ = \frac{a}{h} = \frac{\left(\frac{\sqrt{3}}{2}\right)}{1} = \frac{\sqrt{3}}{2}$	$\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$
$\cos 60^\circ$		
$\cos 45^\circ$		

What do you notice?

10. Use your cut-out triangles and your unit circle to complete the table:

$\sin \theta$:	Using triangle find $\sin \theta$:	Coordinate on the unit circle at θ :
$\sin 30^\circ$		$\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$
$\sin 60^\circ$		
$\sin 45^\circ$		

What do you notice?

11. How do the sine and cosine of an angle relate the coordinates on the circle?

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