LESSON PLANNING GUIDE

Teacher: Kaleena Carter	**Topic of Lesson: Define General Angles and use Radian Measure**
Grade Level: 9th – 11th	**Content Area: Algebra II with Trigonometry**
Class Time: 50 min	**Previous Lesson: Trigonometry with Right Angles**

Lesson Rationale:

This lesson incorporates technology, collaboration and communication. I work at an international school, so most students have a first language that is not English. Therefore, at times it can be challenging for the students to effectively communicate their understanding to each other and to me using the academic language presented in the math class. Taking into account my audience, I wish to deepen their understanding of radian measure by using a hands on visual simulation to place an angle in the correct position using correct direction (clockwise/counterclockwise) and correct vocabulary (terminal ray/ standard position). They will be required to collaborate in groups given assigned roles, and to communicate their process using the vocabulary presented to them. The design of this lesson was based off of the understanding by design approach by Wiggins, G. and McTighe, J. (2005), in which the standards drove the essential understanding/questions and goals of the lesson.

The goal that I started the design of the lesson was to observe student to student led discussions and revelations during the "task" portion of the lesson, observing students experimenting, failing and finding success using the makey prototype and then eventually be able to express their understanding of an abstract concept, using the prototype as a reinforcement to the lesson. Not wanting the prototype to be the lesson itself, but rather a tool to enhance their learning, Using my technological content knowledge from TPACK (Koehler & Mishra, 2009), I addressed the technology that I present in the lesson and determined that the application of the technology is suited for the learning goals, however I do think that students will learn of its limitations and will be asked about this as a follow up self assessment.

Lastly, by using components from Instructional Design (Yelon., 2001), I decided that the best method to help my participants meet the learning objective is if I direct taught examples and quickly allowed students to explore the representation of the examples using the prototype with their peers. Furthermore with the addition of the Makey prototype and the chromebooks, the students will be able to simulate radian and degree measure, becoming 'creative communicators' according to the ISTE standards for students.

Lesson objectives:

1. Students will be able to use draw and model general angles measured in radians in standard position.

2. Students will be able to identify parts of an angle using vocabulary such as terminal side, and initial side.

3. Students will collaborate with each other using the Makey Makey Kit to demonstrate their understandings of the lesson.

Essential Questions:

- What is a Radian ?
- What does it measure?
- What is the relationship between degree measure of an angle and radians?

21st Century Learning Objectives:

1. Communication

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact

2. Collaboration

- Demonstrate ability to work effectively and respectfully with diverse teams
- Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Common Core Mathematics Standards:

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

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.

G.C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Lesson Materials

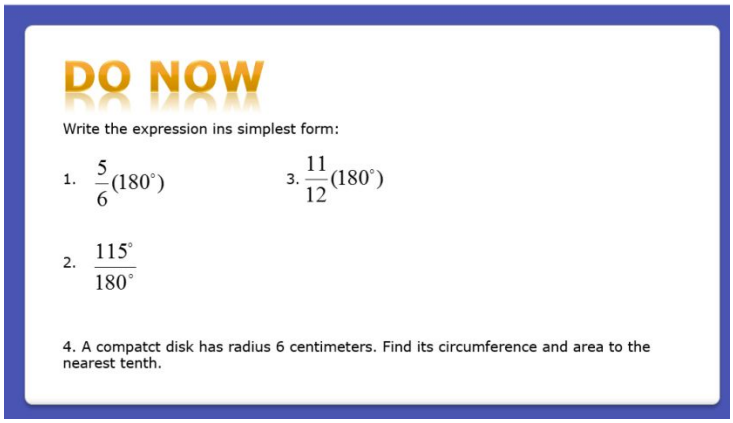
1. Google chromebook for each table with activity PPT loaded on the screen
2. Makey Makey Kit for each table group
3. Makey Makey Prototype Board one for each table group
4. White boards & markers one for each table group
5. Teacher tablet + Projector

6. CW Note page for each student
7. 1 piece of string for each table group

Lesson Design

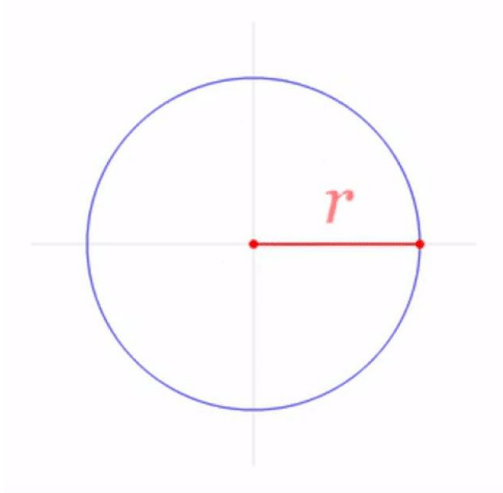
DO NOW (5 minutes) Students will be in their table groups with seats labeled 1, 2, 3, 4

During the DO NOW activity they will be encouraged to work out their problems together, collaboratively as a group. Teacher will project the slide below on the screen. They will use the white boards to culminate their solutions. Teacher will randomly select a student representative by seat number from each table to explain each answer. (One answer explanation per table)



Guided Question:

What is a radian Measure?



Discussion 1 (2 minutes)

Using the turn timer the teacher will allow each student 30 seconds for each seat to discuss what they think the animated gif is showing about radians. Teacher will encourage them to use math language.

Direct Instruction: (35 Minutes)

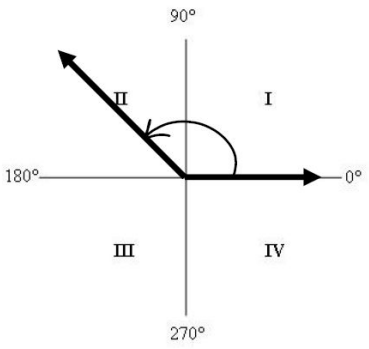
Vocabulary Review:

Teacher will directly teach students about the vocabulary that they are to use in this lesson.

Angles are made up of two rays:

- Initial side – The fixed ray
- Terminal side The ray that is rotating.

Standard position- An angle whose vertex is at the origin

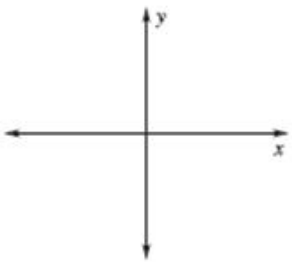


Example 1 Draw Angles in Standard Position

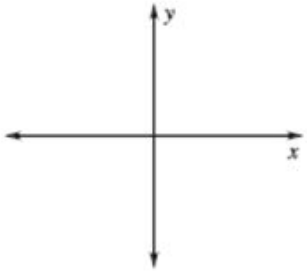
Teacher will use the tablet PC to ask students to draw an angle with the following measurements in standard position. They will follow along on their note page.

Draw an angle with the given measure in standard position.

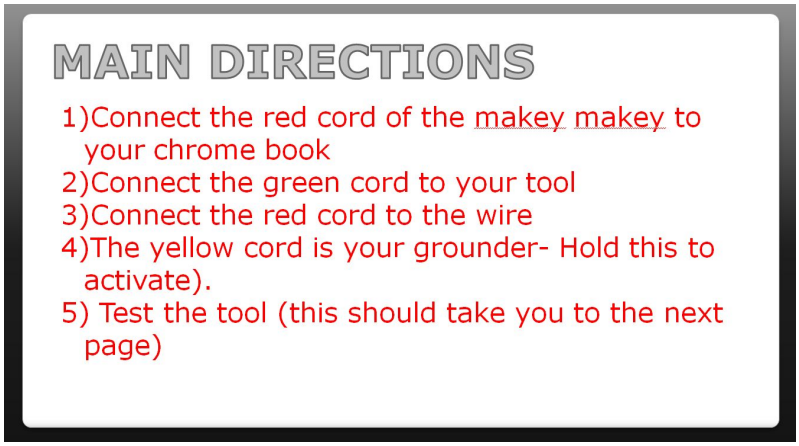
a. 405°

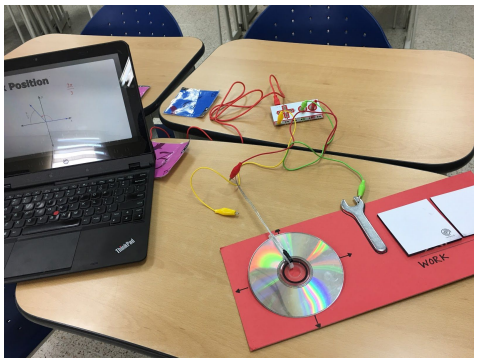


b. −65°

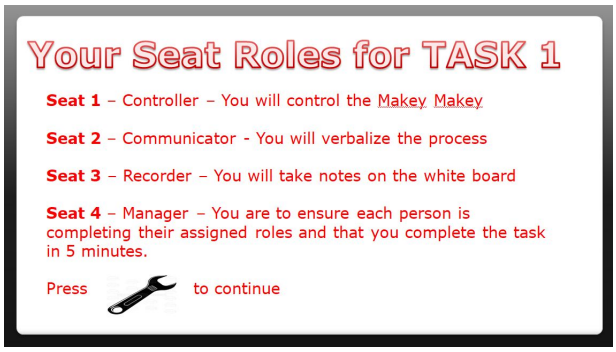


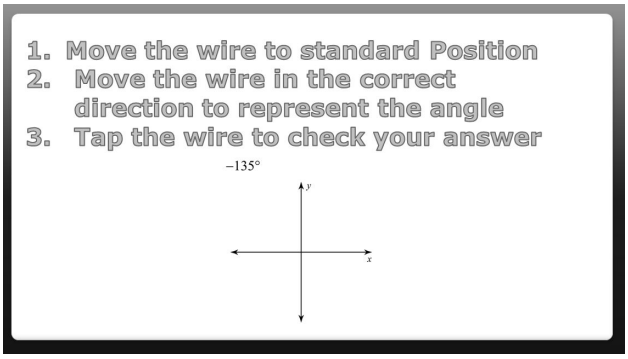
Once completed, they will be asked as a group to complete **Task #1**

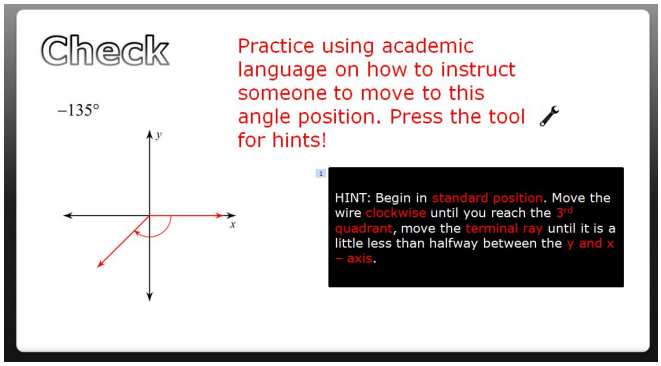




They will get assigned new roles for each task







Goal of task 1 *: students will be able to understand the positioning of an angle on the x - y plane, and what the direction of the angle given the sign implies. They will use mathematical vocabulary to express their actions and work.*

Example 2 Find Coterminal Angles

Teacher will use the tablet PC to ask students to find one positive and one negative angle that are coterminal.

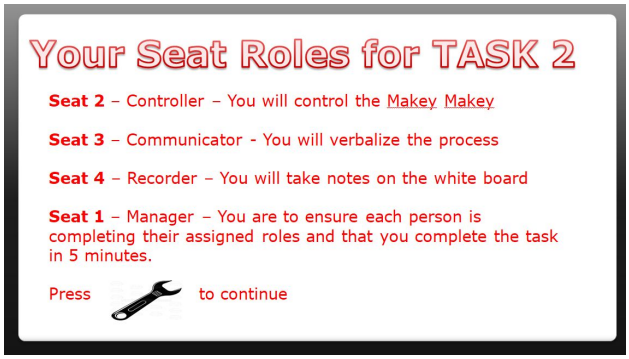
Example 2

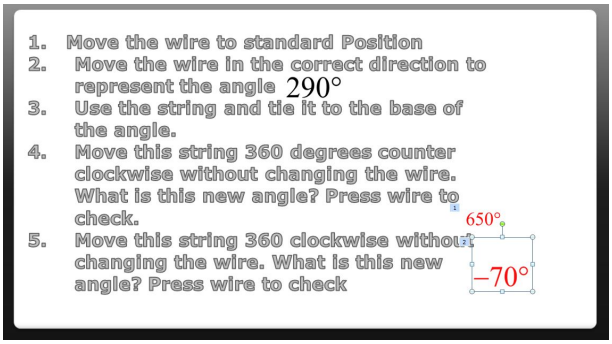
Find co-terminal angles

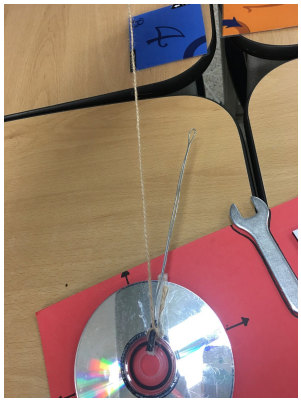
Find one positive angle and one negative angle that are coterminal with 210°.
There are many such angles, depending on what multiple of 360° is added or subtracted.

$210° + 360° =$ _____ $210° - 360° =$ _____

Once completed, they will be asked as a group to complete **Task #2**






With tied string

Goal of task 2: *Students will be able to understand that adding or subtracting a full rotation will produce a coterminal angle. They will note that the wire did not and should not change position*

Example 3 Converting between degrees and Radians

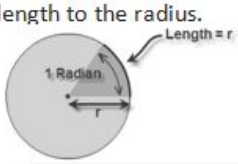
Teacher will use the tablet PC to identify what is a radian. Students will discuss if their hypothesis was write in the beginning of the class. Teacher will use turn timer to allow all students to have opportunities to share. **(2 minutes)**

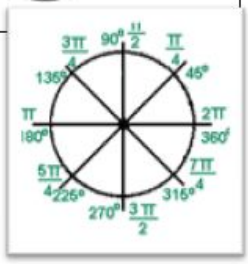
CONVERTING BETWEEN DEGREES AND RADIANS

- ✓ **Degrees to radians**
  Multiply degree measure by: $\frac{\pi \text{ radians}}{180°}$
- ✓ **Radians to Degrees**
  Multiply radian measure by: $\frac{180°}{\pi \text{ radians}}$

Vocabulary

Radians: a unit of _____, equal to an angle at the center of a circle whose _____ is equal in length to the radius.





Example 3

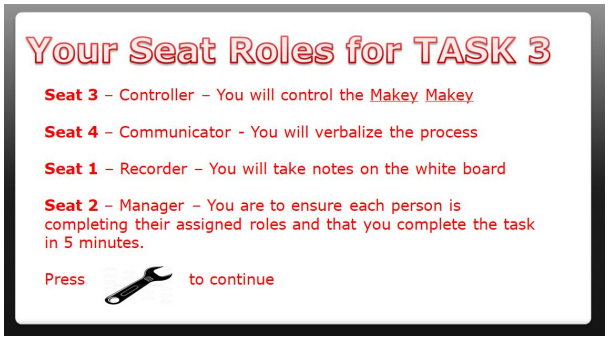
Convert between degrees and radians

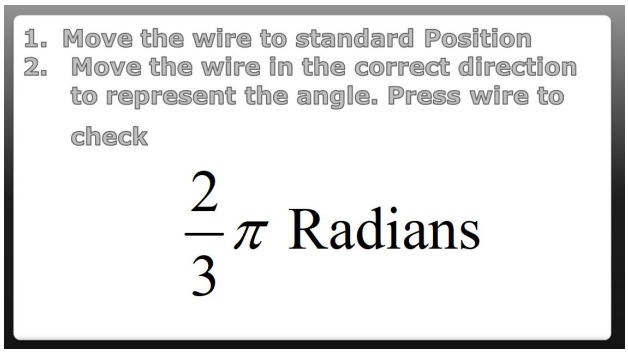
Convert the following:

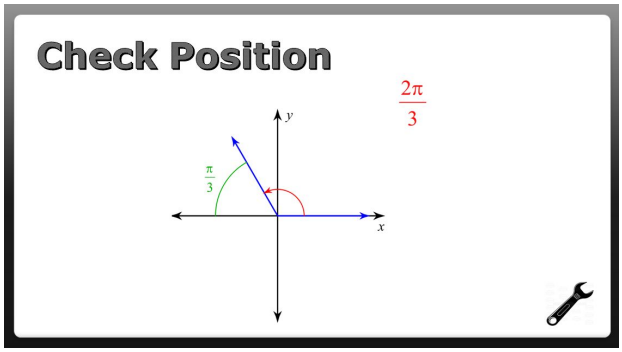
(a) 315° to radians

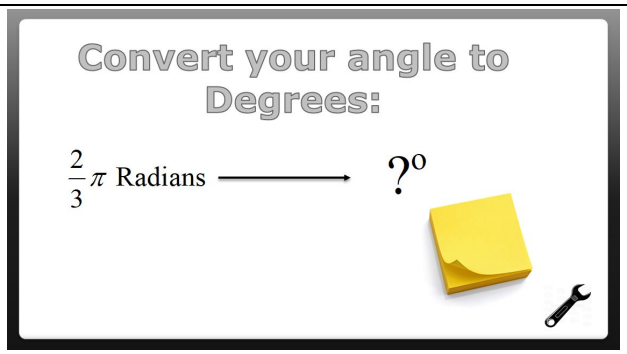
(b) $\frac{\pi}{6}$ radians to degrees.

Once completed, they will be asked as a group to complete **Task #3**

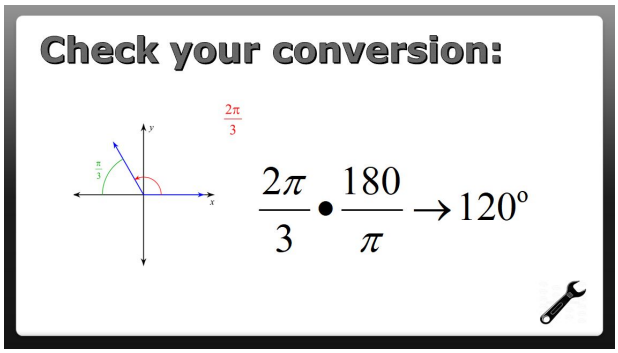


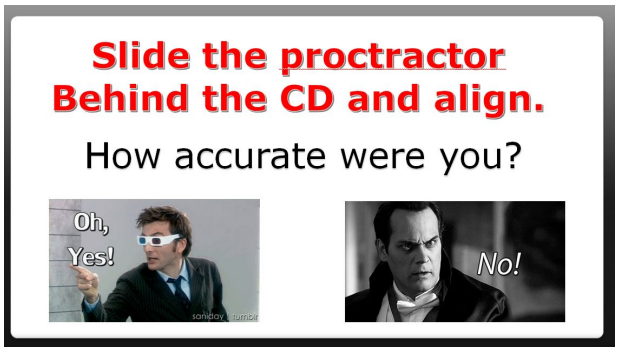






Students will show work on sticky notes. To see a video of this example please click here.





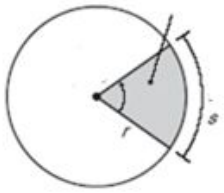
Goal of Task 3*: to make connections with degree measure, radian measure and movement of the terminal ray of an angle on the x - y plane.*

Last Example - Applications and assessment

Teacher will use the tablet PC to identify reasons as to why we must use radian measure. In situations such as arc length and area of a sector, we have to convert the angle to radians in order for the formulas to work.

ARC LENGTH AND AREA OF A SECTOR

The _____: ***s*** and _____ ***A*** of a sector with radius ***r*** and _____ angle θ(measured in **radians**) are as follows:



Arc length: $s = r\theta$ **Area:** $A = \frac{1}{2} r^2 \theta$

Problem solving Task:

Students will be asked the following question to apply their learnings from the lesson:

Situation presented to students:

An adjustable-angle pop-up lawn sprinkler has been installed in an awkward corner of the neighbor's yard. This sprinkler, assuming full water pressure, can spray everything within four meters. Given that the angle has been set to 70°, how much lawn will this sprinkler head water? (Round to two decimal places.)

Roles for Problem solving Task:

Seat 1 - Reader - Reads aloud the text and ensures everyone understands

Seat 2 - Produce Diagram/Annotator - draws the diagram that represents the situation

Seat 3- Communicator- Applies academic language to the diagram and starts to adjust

Seat 4 Computation Manager - ensures that computations are accurate and checks with the calculator

Assessment

Since the students have a lot of student driven moments, the teacher will have time during each task to will assess their learning by observing, listening and visiting each table while they are completing each task. They will be assessed on not only if they get the correct answer, but how well they are communicating their thoughts and collaborating with each other.

Self Assessment

Google classroom Question:

"We used a prototype that helped us visualize radian measure and the relationship to degrees. If you could enhance or change this prototype what would you change? Explain.

[This question is being asked to determine if the students found a more feasible solution to the limitations of the prototype. I would like to see how creative they can be! This will also encourage

future lessons in which students could make prototypes of their own to solve or simulate a problem/understanding.]

Citations

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