WAMC Lab Template
Math Concept(s):
Source / Text: Inspired by CORD Geometry 3rd ed. Page 495 Activity 2
Developed by: Martina Leonard & Thomas Schlenker
E-Mail: leonarml@puyallup.k12.wa.us thomas_schlenker@yahoo.com
Date: Summer In-service 2013

Attach the following documents:
Lab Instructions: See Attached

Student Handout(s): See Attached

Rubric and/or Assessment Tool: See Attached

Short Description (Be sure to include where in your instruction this lab takes place):
After reviewing the formulas for area and circumference of circles and calculating area and circumference, students will measure the diameter and circumference of circles. This will allow students to recognize the proportional relationship between the circumference and the diameter of a circle. Additionally, students will build their own version of surveyor's wheel to use as a tool to measure large distances on the campus of the school.

Lab Plan
Lab Title: Rolling The Can

Prerequisite skills:
Students will be able to calculate the area and circumference of a circle.
Students will be able to measure distances with rulers and tape measures.
Students will be able to graph points on the coordinate plane, calculate slope, and graph lines.
Students will have a knowledge of the necessary vocabulary: radius, diameter, circumference, arc length, survey wheel, revolution, and degree.

Lab Content Objectives:
- 1) Students will be able to measure the diameter and circumference of a circle as evidenced by the data collected and graphed to find the ratio of pi.
- 2) Students will be able to graph a set of points to show the relationship between diameter and circumference as evidenced by the graph of a straight line with the slope of pi.
- 3) Students will be able to measure great distances using a circular object as evidenced by the precision with which their instrument measures and the calculations made.

Lab Language Objectives:
- 1) Student will communicate their understanding through the use of a reflection journal.
- 2) Students will need to read directions and communicate with others in their group to design and implement the project.
- 3) Students will need to research and interpret information to come up with a design for their survey wheel.
- 4) Students share out results from their measurements.

Standards:

CCSS-M:

- Domain 1: Circles
  - Cluster 1: Find arc lengths and areas of sectors of circles.
    - Standard 1: Define the radian measure of the angle as the constant of proportionality.
- Domain 2: Modeling with Geometry
  - Cluster 2: Apply geometric concepts in modeling situations.
    - Standard 2: Use geometric shapes, their measures and their properties to describe objects.

Standards for Mathematical Practice:

- 1) Reason abstractly and quantitatively
- 2) Make sense of problems and persevere in solving them
- 3) Model with mathematics

State Standards addressed (2008 Washington State Mathematics Standards):

- 1) Derive and apply formulas for arc length and area of a sector of a circle. (G.6.A)
- 2) Select and apply strategies to solve problems (G.7.B)

Reading:

- Grade 9-10: 3.3.1

Writing:

- Grade 9-10: 3.2.1

Leadership/21st Century Skills:

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

- ☐ Global Awareness
- ☐ Financial/Economic/Business/Entrepreneurial Literacy
- ☐ Civic Literacy
- ☐ Health/Safety Literacy
- ☐ 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
- ☒ Implement Innovations

Critical Thinking and Problem Solving
- ☒ Reason Effectively
- ☐ Use Systems Thinking
- ☒ Make Judgments and Decisions
- ☒ Solve Problems

Communication and Collaboration
- ☒ Communicate Clearly
- ☒ 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
- ☒ Interact Effectively with Others
- ☒ Work Effectively in Diverse Teams

Productivity and Accountability
- ☒ Manage Projects
- ☒ Produce Results

Leadership and Responsibility
- ☒ Guide and Lead Others
- ☒ Be Responsible to Others

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

Materials

- 20-30 circular objects in various sizes
- Yardsticks
- Nuts and bolts
- 10-15 wheels of different sizes
- Masking tape

Set-Up Required:

- Collect and prepare materials for students.

Lab Organization Strategies:

Grouping/Leadership/Presentation Opportunities: Groups will share out their reflections of the learning experience and their results of their measurements. Students will reflect upon what they learned and what they want to learn more about as well as what they would do differently if they were going to repeat this lab.

Cooperative Learning: Students will work in groups of two. Grouping will depend upon the work habits of the individual class.

Expectations: I expect students to build a reliable and accurate survey wheel. Students must work cooperatively to define and carry out given group roles (Wheel Person, Counter).

Timeline: Three class periods of instruction will be needed to complete this lab. During the first class period, students will discover the ratio of circumference to diameter to be pi. During the second class period, students will design and construct a simple survey wheel, and be formatively assessed while measuring a given length. During the third class period, students will measure distances around campus and begin their reflections, concluding with a brief share out of results.

Post Lab Follow-Up/conclusions:

Discuss real world application of learning from lab

- This process can be used to measure large distances across a variety of terrain or non-linear paths in a short amount of time.

Career Applications

- Road Construction, Surveying, Construction, Insurance Inspector

Optional or Extension Activities

- The students can utilize their survey wheels to measure large distances while conducting later labs on large scales. Doing so facilitates a variety of labs exploring many different content areas.

Rolling the Can Lab Instructions

Our class has been asked by the maintenance department to help them measure the length of the back parking lot, the practice football field and the distance from home plate on the baseball field to the fence in the middle in center field. However, we can't use a measuring tape because the distances are too long. Therefore, we are going to create a measuring tool out of a wheel and yardsticks and you will measure these distances using the tool you build.

1) Using the materials given, you and your group members are going to develop, design and build a circular measuring tool. This will require team work, creative brainstorming and perseverance. Use the space below to brainstorm and record your ideas and sketches.

2) One requirement of building this tool will be to incorporate the use of the circumference of your given wheel. Therefore, you and your group must calculate the circumference of your wheel and show your calculations below. Once you have calculated the circumference of your wheel, you must have your calculations checked off by your teacher.

Teacher signature:_____

3) Now that you have correctly calculated your circumference, you are ready to begin building. When your circular measuring tool has been constructed, you must demonstrate its integrity to your teacher. You must accurately calculate a given distance determined by your teacher and have your calculations checked off by your teacher. Show your work and calculations below.

Teacher signature: _____

4) You have demonstrated the accuracy and integrity of your circular measuring tool. Now you are ready to measure the three distances needed by the maintenance department. Show your work and calculations below.
   a) Back parking lot:

b) Practice Football Field:

c) Home Plate to Center Field:

5) Reflection: What did you learn from this lab? What can be done to improve this lab? Where could we use these skills in the world of work? Compare your results to #4 with other groups. How does the size of the wheel affect the accuracy of measurements? Any other comments, thoughts or ah-ha's.

Student Circle Data Sheet

Name:

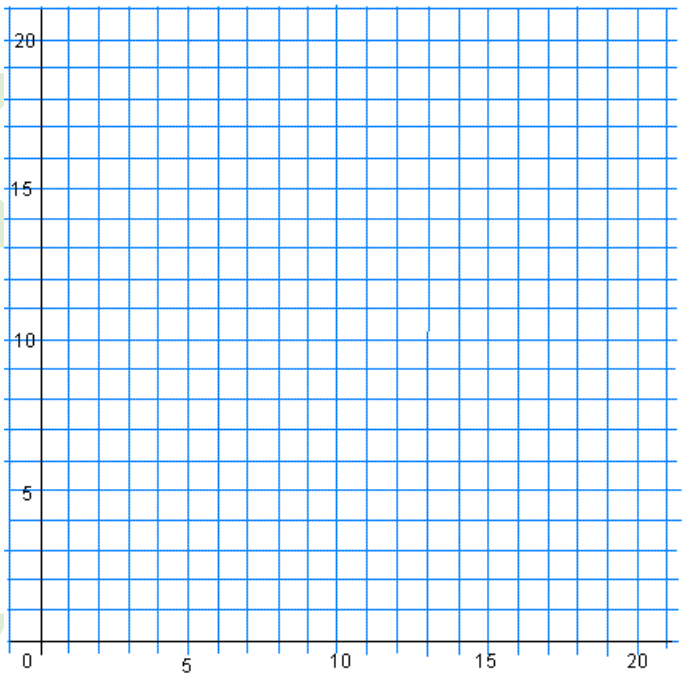
Object Number	Diameter(in)	Circumference (in)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

In groups of two, you will select 10 circular objects to measure. You will choose 2 or 3 at a time and go back to the front table to get 2 or 3 more.

Step 1: Measure and record the diameter of the circle.

Step 2: Use a piece of string to wrap around the circumference of the circle. Hold the length of the string to a tape measure to measure and record the circumference of the circle.

Step 3: Plot your data in your chart on the coordinate plane below.



Step 5: Calculate the slope of the line on the graph you made above. Use any two points. Show your calculations below.

Step 6: Repeat step 5 two more times. Each time use two new points to calculate the slope. Show your calculations below.

Step 7: Answer the following questions below: 1) What were the results for the slope you found in steps 5 and 6? 2) Where have you seen this number before? Explain. 3) Where do we get the formula $C = \pi \cdot d$?