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Area Circumference

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Grade level(s)/Subject taught: Math A/B and Living Environment

Objectives: (Remember…*How will the modeling tool help the student better learn the objective?)*
Objective:
Students will be able to identify and apply formulas for the circumference and area of a circle in the design of a vegetable garden for Science class.
To accomplish the objective the students will explore the formulas for the circumference and area of a circle through GSP software and the TI-84.
The GSP software and the TI-84 Plus Silver Edition calculator will help students visualize the concepts through models and graphs built by the teacher or the students. By manipulating the elements of the models and graphs students will construct their knowledge.

Mathematical Concepts*:*

Standard 3:
Key Idea 1 - Mathematical reasoning. Students use mathematical reasoning to analyze math situations, make conjectures, gather evidence, and construct an argument.

Key Idea 4 - Modeling/Multiple Representation. Students use mathematical modeling/ multiple representations to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

Key Idea 5 - Measurement. Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world in order to describe and compare objects and data.

Key Idea 7 - Patterns/ Functions:
Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Science Concepts:

Standard 1:
Key Idea 1 - The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.

Key Idea 3 - The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.

We plan to use both the Geometer's Sketchpad (GSP) software program and the TI-84 calculator in this lesson.

The classroom contains approximately 30 students in the 9th grade. They will be in a laboratory setting for this exploration and each student will have access to a TI-84 calculator and a PC with the GSP software installed (Version 4). Students will be working in groups of 2 or 3.

1. How will you assess the prior knowledge of the student?

Prior knowledge of the student can be assessed by use of do now (bell work) and do now review. The do now assignment will consist of some short exercises where students need to show their personal skills to square numbers and multiply by π. The class will discuss the formulas for circumference and area of a circle. (10 minutes)

2. How will you begin the lesson?

The lesson will begin with the introduction and discussion of the Essential Question. The beginning of the lesson is the ***Engagement.*** The view screen of the TI-84 will be used to show the application called A*reaForm* to review the concept of area for a circle. The objective is for the students to connect the "mathematical" topic of area with something that will create interest and encourage curiosity. (15 min)

3. What are the teacher and students doing every 5-10 minutes? (Teacher actions and student actions)

After the engagement, students will be encouraged to form groups of 2 or 3 students to perform the following explorations:

Exploration/Explanation

Exploration 1: Programming the formulas for circumference and area of a circle

The students will be able to modify a given program. The given program calculates circumference and they need to modify it to make the program calculate area of a circle. (25-30 minutes)

Exploration 2: Exploring the circumference, looking for π.

Students will construct a circle in GSP, calculate its circumference, and, by dragging its radius, find the ratio C/d to find the value of π. (25-30 minutes)

Exploration 3: Exploring the area of a circle.

Students will derive the formula for the area of a circle by cutting out and reassembling a given number of sectors (3) of the circle using GSP. Students are expected to write the formula in terms of π and the radius, r. (25-30 minutes)

Exploration 4: How does the radius of a circle relate to its circumference and to its area?

Students explore a given model of a circle in GSP that graphs circumference and area as functions. The model let students compare linear vs. quadratic functions. (25-30 minutes)

To help keep everyone on task, students will need to write notes, interact, share ideas, questions, and explanations as they arise though the use of the models.

The teacher will encourage students to explain concepts in their own words and to ask for justification and to give the formal names to the different elements of the process.

The student will be able to explain possible solutions, to listen critically, and to question others' explanations.

4. Describe your thinking on how the concepts will be integrated?

Application

Students will be assigned an activity where they need to apply their acquired knowledge to solve a real-world problem. In Science class we want to create a vegetable garden. We have 100 feet of fence to enclose the garden. Students must determine if a square or a circle provide more area. Students will use

mathematical reasoning to solve the problem. The science class is providing a physical, natural problem and the math class is providing tools (concepts and language) to solve the problem. Students will model the solution using GSP.

5. How will you assess the learning for the lesson?

Assessment. Rubric and peer evaluation form are attached.

6. How will the chosen software/tool(s) be integrated into our teaching as per rubrics in this packet? (i.e. you may want to discuss a problem or describe how you might use the chosen modeling package in your plan. How does the model/tool help the concept(s) to be taught)?

The GSP software is user-friendly for the 9^{th} grade student and allows students to model many geometrical concepts. When students attempt to maximize area, they can visualize and test their results quickly using the software. The integration of the GSP software into the lesson plan and in the general teaching has many practical consequences:

1. The presentation made with the TI engages students and captures their attention.
2. GSP technology allows explorations, where students can work by themselves; students can change parameters in previous models to create generalizations and to develop theories.
3. GSP let students apply their knowledge to new situation and self assess their knowledge.
4. The use of technology in the classroom promotes change in the traditional roles of teacher and student. The teacher becomes more a guide, assessor and designer of activities and the student becomes the builder of their own understandings!

1. DO NOW

Students need to evaluate the next exercises:

1. 5^2
2. 6.7^2
3. V36
4. 2π
5. 3π + 1.3
6. $3^2 + 2\pi$

2 ENGAGEMENT

The TI-84 view screen will be used to review definitions and concepts related to determining the area and circumference of a circle.

3. EXPLORATION/EXPLANATION

Exploration 1: Programming the formulas for circumference and area of a circle
The students will be able to modify a given program. The given program calculates circumference and they need to modify it to make the program calculate area of a circle.

```
PROGRAM:CIRCUM
:Prompt R
:π2R→C
:Disp "CIRCUMFER
ENCE IS",C
:
:
```

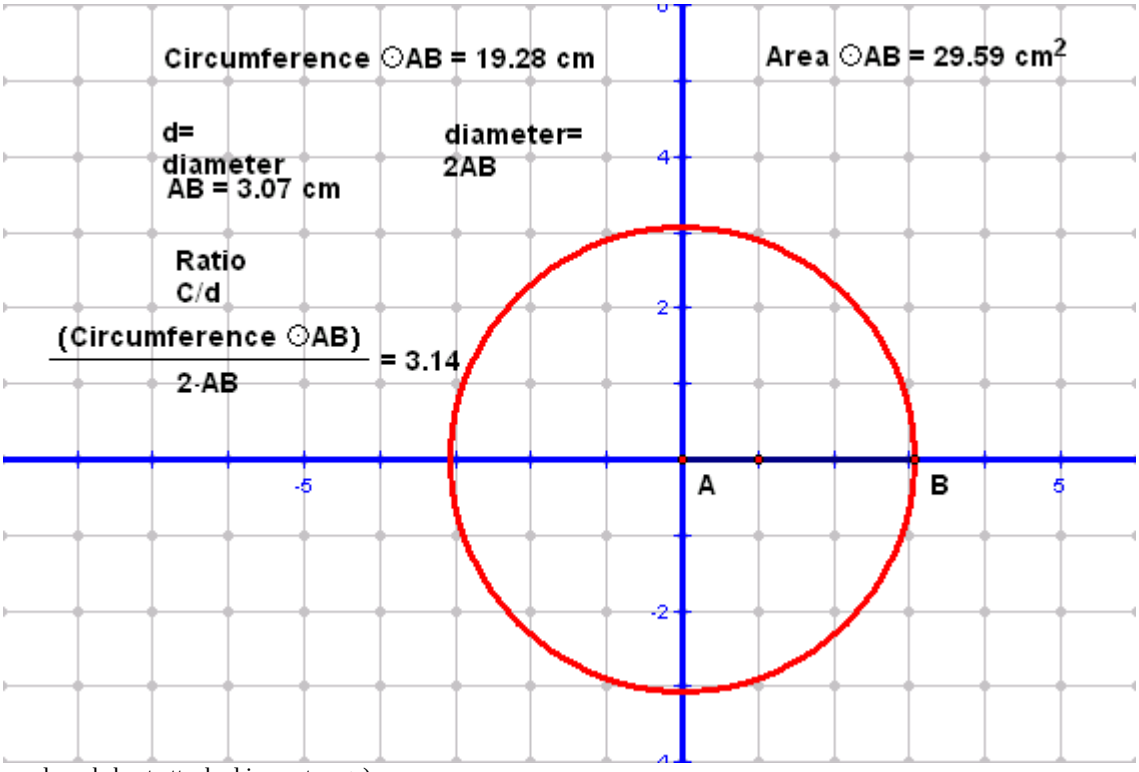
```
prgmCIRCUM
R=?6
CIRCUMFERENCE IS
     37.69911184
           Done
```

```
PROGRAM:CIRCAREA
:Prompt R
:πR²→A
:Disp "AREA IS",
A
```

```
prgmCIRCAREA
R=?6
AREA IS
     113.0973355
           Done
```

Exploration 2: Exploring the circumference, looking for π.

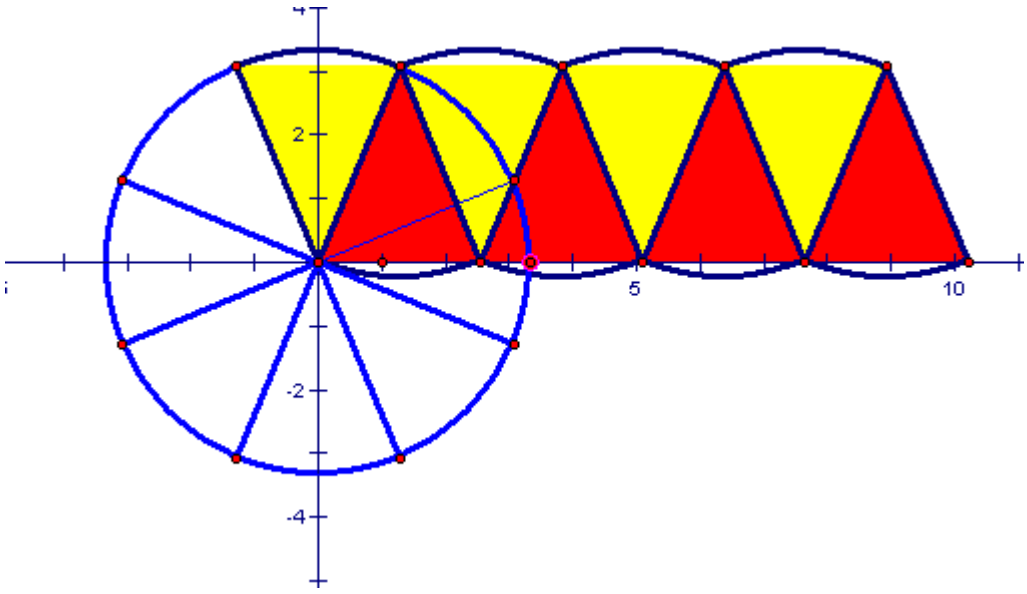
Students will construct a circle in GSP, calculate its circumference, and, by dragging its radius, find the ratio C/d to find the value of π.



(Explanation and worksheet attached in next page)

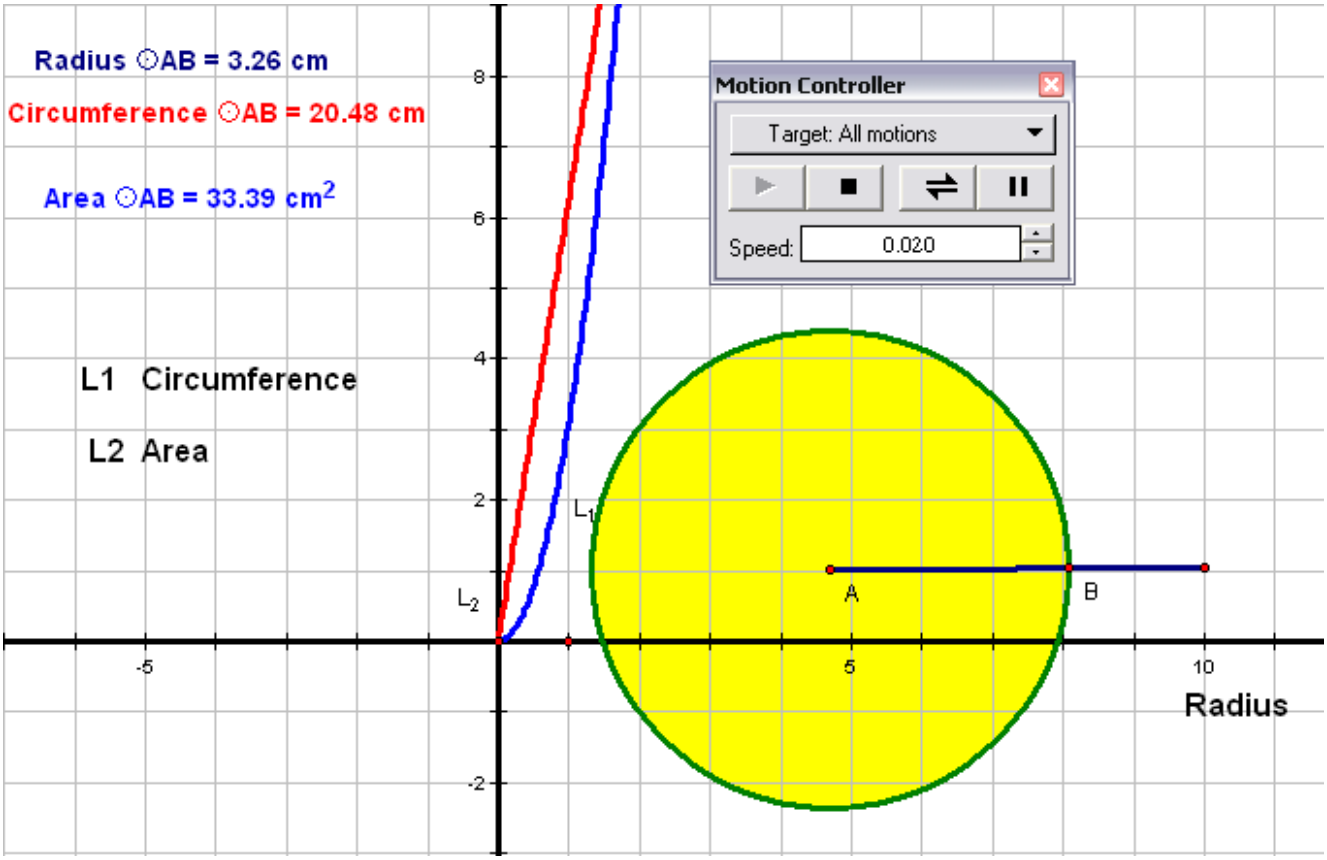
Exploration 3: Exploring the area of a circle.

Students will derive the formula for the area of a circle by cutting out and reassembling a given number of sectors (8) of the circle using GSP. Students are expected to write the formula in terms of π and the radius, r.



(Explanation and worksheet attatched in next page)

Exploration 4: How does the radius of a circle relate to its circumference and to its area?
Students explore a given model of a circle in GSP that graphs circumference and area as functions. The model let students compare linear vs. quadratic functions.



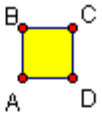
How does the radius of a circle relate to its circumference? To its area?
These are examples of geometric relationships that can also be thought of as functions and studied algebraically.
The student will start constructing a circle whose radius adjusts continuously along a straight path.
The student will need to measure the circle's radius, circumference, and area.
Dragging the circle's radius (or animating point B) students will explore how the circumference and area measurements change, and what's different about the way they change. They will explore these questions by plotting, and constructing the Locus of both functions.

4. APLICATION

In Science class we want to create a vegetable garden. We have 100 feet of fence to enclose the garden. Students must determine if a square or a circle provide more area. Students will use mathematical reasoning to solve the problem. The science class is providing a physical, natural problem and the math class is providing tools (concepts and language) to solve the problem. Students will model the solution using GSP.

Perimeter ABCD = 100.00 pixels

Area ABCD = 625.00 pix^2



1 pixel = 1ft

Circumference ⊙EF = 95.28 pixels

Area ⊙EF = 722.40 pix^2

Radius ⊙EF = 15.16 pixels

Holistic Scoring Rubric

Reflection:

PERFORMANCE GOALS AND CRITERIA	LEVEL ONE LIMITED	LEVEL TWO COMPETENT	LEVEL THREE SUPERIOR
Mathematical Reasoning: Selecting and using appropriate types of reasoning and methods of proof through inductive and deductive reasoning	- Uses limited mathematical reasoning - Includes no arguments	- Uses sound mathematical reasoning - Includes some supporting arguments	- Uses sophisticated mathematical reasoning - Provides strong supporting arguments - Includes examples and counterexamples
Problem Solving: Solving of problems through the use of exploration, appropriate strategies, and a systematic approach.	- Shows little understanding of the problems - Uses poor or inappropriate strategies that lead to incorrect solutions	- Shows basic understanding of the problems' mathematical ideas and processes - Uses and synthesizes multiple strategies that lead to correct solutions.	- Shows thorough understanding of the problems' mathematical ideas and processes - Uses and synthesizes multiple strategies that lead to correct solutions
Communication: Communication ideas, thoughts, and approaches through the use of everyday language, mathematical language and symbols, graphs, tables, charts and diagrams.	- Uses some appropriate mathematical language - Uses few if any, diagrams.	- Contains a solid response but is expressed less elegantly and less completely - Uses accurate diagrams	- Contains a complete response with clear, precise, and approapriate language. - Uses effective diagrams such as graphs, tables, or charts.
Mathematical Connections: Recognizing connections between different mathematical ideas or between mathematics and other disciplines.	- Does not demonstrate or demonstrates inappropriate connections to other mathematical topics or other disciplines.	- Demonstrates some knowledge of connections to other mathematical topics or other disciplines.	- Demonstrates a comprehensive knowledge of connections to other mathematical topics or other disciplines.
Use of Tools: Using technology	- Rarely uses technology and manipulatives appropriately	- Uses some technology and manipulatives to demonstrate solutions to problems.	- Makes appropriate use of technology and manipulatives to demonstrate mathematical concepts.

PEER EVALUATION FORM

Name:_____
Date:_____
Home Base:_____

The members of my group today were:

1. Rate: 0 1 2 3 4

2. Rate: 0 1 2 3 4

3. Rate: 0 1 2 3 4

4. Rate: 0 1 2 3 4

Rate each member above for cooperation and participation from 0 – 4 and circle the number next to his/her name above. (4 is the highest rate; 0 is the lowest.)

Did all members of your group contribute evenly? If not, please make a comment below:

_____
_____
_____
_____
_____

List one thing new that you learned today:

_____
_____
_____
_____
_____
_____