EXPLORING A WORLD OF CIRCLES
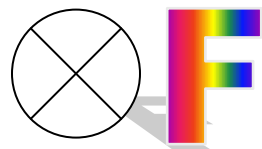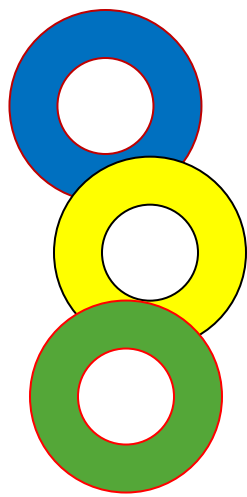
By

Merine Williams

Brooklyn SDA School
NY
Teacher Bulletin # 13

TABLE OF CONTENTS

INTRODUCTION

The circle is a very common but interesting shape, with a vast array of properties. Circles are used in many ways and in numerous places to create a host of mathematical designs. They are found in art, social studies, science, math, on buildings, and even on our bodies. We learn about the "family circle," the equator as an imaginary circle, and Saturn's circle. Isaiah 40: 22 states that God "sits above the circle of the earth," clearly indicating that the earth is circular. No matter where it's found, the circle is the same—a closed figure with no visible beginning or ending.

"**Exploring a World of Circles**" is a comprehensive unit, catering to the needs of students and teachers from Kindergarten through Grade 4. This unit constitutes a wealth of activities and ideas projected to assist teachers of these grades in developing practical knowledge and awareness in understanding the circle's properties and functions in Mathematics. It is compatible with multi-grade classes because the activities are adjustable to cater to the different abilities of the students from K to Grade 4. The activities are also suitable for differentiated instructions through the use of Art, (drawing, coloring, and the assembling of shapes.) and technology.

The fundamental aspect of this unit is the spiritual connection, where teachers and students can be made aware of the uniqueness of creation—the handiwork of God, the Greatest Mathematician. The skills are based on the NAD/ Common Core Standards. A number of enriching related activities are included to provide hands-on engagement for students.

In summation, this unit is planned for five class sessions, but if teachers wish to extend them over a longer period, adequate activities are provided which will accommodate this arrangement.

UNIT OUTLINE

Title: EXPLORING A WORLD OF CIRCLES
Aim: To introduce students and teachers to creative and practical ways for understanding the circle, and develop a better awareness of circular objects in God's creation and in Mathematics.

1. Introduction
Grade Levels: K- 4
Objective and Rationale

2. Methodology and Lesson Plan

Lesson 1
What is a Circle?
Characteristics of a Circle
Lesson Plan
Christ as Center of the Family Circle
Preview Vocabulary: diameter, radius, chord, and center.
A Search for Circles—where are they?
Instructions for Circles Search
Students' Worksheets
Answer Keys

Lesson 2
Round and Round We Go!
Lesson Plan
How to Find the Circumference of a Circle
How Diameter is related to the Circumference
Instructions and Materials
Students' Worksheets
Answer Keys

Lesson 3
How Can we Draw Circles?
Lesson Plan
Use three methods to draw circles of different sizes.
Measure and compare diameter and radius of each circle.
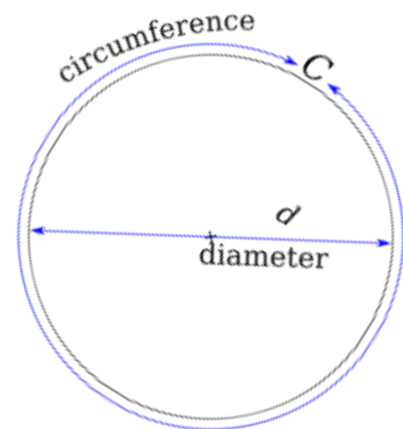Cut circles and use them to create designs.

Lesson 4
Finding the Area of a Circle
Lesson Plan
What is area?
Use cut out circles from previous lesson as template to trace circles.

Find area using grid paper.
Count squares on grid and record them.
Compare area of big circle with area of small circle.
Worksheets
 Answer key

Lesson 5
To What Degree?
Lesson Plan
Vocabulary: Semi-circle, protractor
Draw two perpendicular diameters, and use a protractor to measure each quarter.
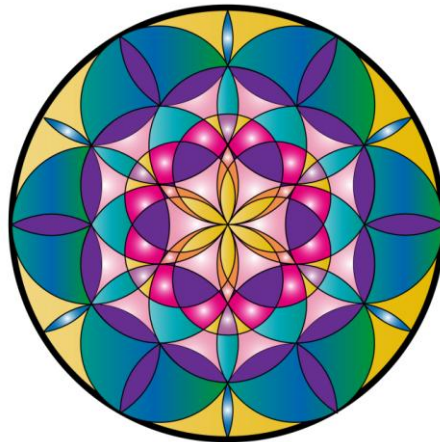Add up measurements of all four quarters and record answer.
Repeat the above activity with circles of different sizes.
Find the number of degrees in a circle by using a protractor to measure a circle.
Relate the 360 degrees in a circle to the movement of the hands on a circular clock.
Worksheets, protractors, rulers.
Answer key

ELEMENTARY MATHEMATICS
STANDARDS
FOR GEOMETRY

KINDERGARTEN

Common Core State Standards Critical Areas • Describing shapes and space
K.GEO.1 Identify, describe, analyze, and compare two and three dimensional shapes (Regardless of size or orientation) by size, color, and shape; describe relative positions of objects (e.g. above, beside, behind, nearer, farther) **K.GEO.2** Create two-and three-dimensional shapes by building or drawing; compose simple shapes to form larger shapes

GRADE 1

Common Core State Standards Critical Areas • Reasoning about attributes of, and composing and decomposing geometric shapes
1.GEO.1 Describe, build, and draw shapes with defining attributes
1.GEO.2 Compose two- and three- dimensional shapes to form composite or new shapes

GRADE 2

Common Core State Standards Critical Areas
• Describing and analyzing shapes. **Shapes--2.GEO.1** Recognize and draw two- and three- dimensional shapes having specified attributes **Area-- 2.GEO.2** Partition a rectangle into rows and columns of same-size squares and count to find the total number of squares.

GRADE 3

Common Core State Standards Critical Areas • Describing and analyzing two-dimensional shapes.
Geometric Measurement **3.M.4** Understand concepts of area and its measurement by counting unit squares (cm², m², in², ft²); apply multiplication and addition to area. **Geometry** **Shapes 3.GEO**.1 Sort and classify shapes to compare and contrast attributes

GRADE 4

Common Core State Standards Critical Areas • Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry
Angles--- 4.M.5 Recognize angles as geometric shapes that are formed wherever two rays share a common end point; understand concepts of angle measurement and measure all angles in whole-number degrees. **Angles--- 4.M.5** Recognize angles as geometric shapes that are formed wherever two rays share a common end point; understand concepts of angle measurement and measure all angles in whole-number degrees.

Adventist Education
A JOURNEY TO EXCELLENCE

LESSON ONE

WHAT IS A CIRCLE?

Aim: How can we identify a circle?
Duration: 30-60 minutes
Grade Levels: K-4
Objectives: Students will be able to:

- Identify and describe a circle.
- Recognize Christ as the center of the family circle.
- Give examples of circles in the Bible.
- Define point, center, diameter, chord, radius, line segment.
- Recognize that every diameter is a chord, but not every chord is a diameter.
- Apply concepts taught in this lesson to given activities and circular objects in the real world.
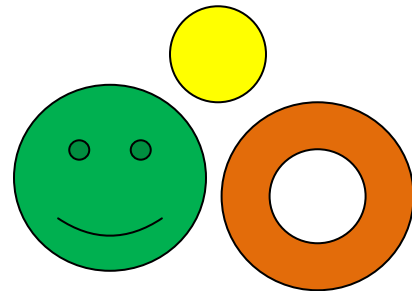
Materials:
geoboard
rubber bands
camera
sidewalk chalk
LCD projector
papers with a circle

Motivation:

I belong to a unique shape family. You roll me over and over, and over and over I keep going and going. The Bible says God sits on the--------of the earth. My shape has no end. I look like a ring, the sun, the moon, and a wheel on a car. What am I?

Procedure:

1. Have students explain what a circle is.
The teacher will demonstrate how to use a geo-board to show a circle. Then have students explain to their peer partner how they made the circle on the geo-board.

2. Have students identify things that are circular in their school, and write them in their math journals.

3. The teacher will preview the circle vocabulary:
diameter
radius / radii
chord
center
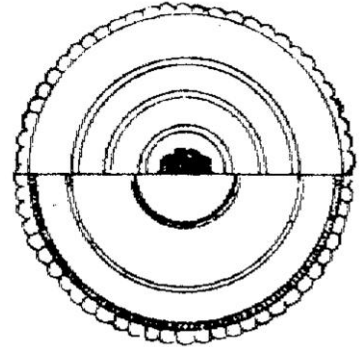
4. Teacher will use different color rubber bands to show the different parts of the circle on the geo-board, while students imitate each step. Students will draw in the different parts of the circle on their worksheet, after they put them on the geo-board.

5. Teacher will show a Power Point with parts of the circle to reinforce concepts, for the purpose of differentiation.

6. Take students to the gym, and have them form a circle on the floor. Teacher will use "sidewalk chalk" to draw circles around the students' bodies. Use different color strings to stretch across students' bodies to show diameter and radius. Stretch string from object in the center of the circle to one end to show the radius. Teacher will take pictures of the bodies-circle for classroom display, yearbook, and for Day # 2 review.

7. Make a large dot to represent the center of the circle. Say to student: Imagine that Jesus is standing in the middle of the circle. Would you all be able to touch Him? Have you heard of a family circle? What does this mean? (The people in your immediate family and friends who are very close to you.) Teacher will explain: "We must make Christ the Center of our families so He will always be in our hearts. If Christ is not in your family circle, won't you take a minute to invite Him in right now?"

Assessment:

Students will do a short quiz at the end of the Power Point. (See PPT)

Remediation:

For students who did not fully grasp the concepts have them pair with a "Math Buddy" who have mastered the concepts. Have Math Buddy explain the concepts to the circle.

SUPPLIMENTARY LESSON

Topic: What is a Circle?
Grade: Kindergarten
Duration: 30 minutes
Vocabulary: circle, round, curve

Objectives: Students will be able to:
1. Identify the circle.
2. Describe the characteristics of a circle.
3. Recognize circular objects in the environment.

Motivation:
Tell children they are going to listen to a song about a special shape. As teacher first sing the song, *Circles Everywhere,* hold up a large cut out circle. Point to the words of the song, and have students echo and sing. (Tune: "Twinkle, Twinkle Little Star.")

Procedure:
Teacher reads the story: *Circle Dogs* to the class and ask:
Why do you think the Circle Dog is digging in the ground?
What kind of sounds do you think dogs make?
Mama and Papa call dogs Pooches and Hounds. Do you know the names of any other kind of dogs?
Why do you think Circle dogs sleep a lot?
Discuss the characteristics of a circle, by asking students to describe it.
On page 4 of *Circle Dogs* have students trace the sun, clock, baby, and bird with their fingers.
Have students name other circular objects in the classroom and in their homes.

Culminating Activities
Students will sort circles according to color. Teacher will have pre-cut circles available.
(See resources for Lesson 1)

Create a simple mask with paper plates. (See picture.)
Color the circles on the picture, (See Lesson 1 Resources)

VOCABULARY BUILDER

PART 1

NAME: _____

GRADES: 3 and 4

DATE: _____ _____

Write the words on the lines according to their sizes on the circle.

Largest part

   5. _____

   4. _____

   3. _____

   2. _____

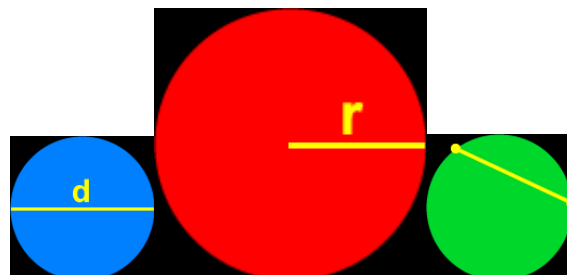   1. _____

Smallest part

# VOCABULARY BUILDER

PART 2

UNDERSTAND THE VOCABULARY

Read each definition. Which word does it describe?

1. The _____ is a line segment with one end point at the center of the circle and the other end point on the circle.

2. A line segment that passes through the center of a circle and has its endpoints on the circle is a _____.

3. A line segment with its end points on the circle, but does not go through the center is the _____.

4. The _____ is the perimeter or the line that forms the circles' edge.

5. The _____ is the point in the middle of the circle.

ANSWER KEY

VOCABULARY BUILDER

PART 1

NAME: _____

GRADES: 3 and 4

DATE:_____ _____

Write the words on the lines according to their sizes on the circle.

Largest part

5. circumference

4. diameter

3. chord

2. radius

1. center (point)

Smallest part

ANSWER KEY

VOCABULARY BUILDER

PART 2

UNDERSTAND THE VOCABULARY

Read each definition. Which word does it describe?

1. The <u>radius</u> is a line segment with one end point at the center of the circle and the other end point on the circle.

2. A line segment that passes through the center of a circle and has its endpoints on the circle is a <u>diameter</u>.

3. A line segment with its end points on the circle, but does not go through the center is the <u>chord</u>.

4. The <u>circumference</u> is the perimeter or the line that forms the circles' edge.

5. The <u>center</u> is the point in the middle of the circle.

POEM
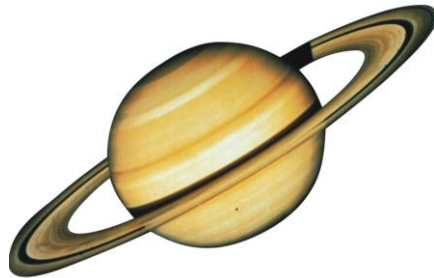
If You Were a Circle
By Merine Williams

If you were a circle, where would you be found?
You would be all over town.
On a wheel
Or on a seal!

If you were a circle, you would be very round.
You could put on a red nose and look like a clown.

If you were a circle, you could be around Saturn.
God used his paint brush, to paint this great pattern.

CIRCLE SONGS

Have you ever seen a circle, a circle, a circle?
Have you ever seen a circle?
It goes round and round.

Have you ever seen a circle, a circle, a circle?
Have you ever seen a circle?
It looks like a wheel.

Have you ever seen a circle, a circle, a circle?
Have you ever seen a circle?
It looks like the moon.
God made it like a circle, a circle, a circle
God made it like a circle, and also the sun.
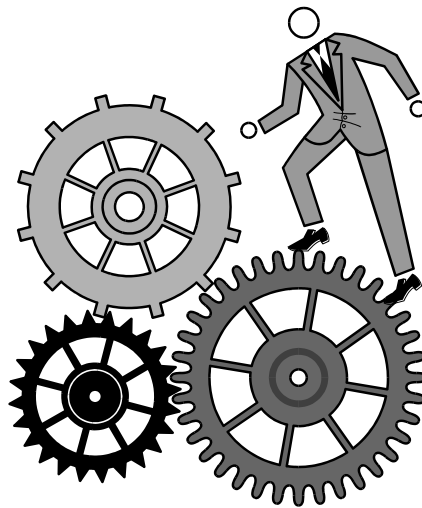
SONG

Look Through the Circle
By Merine Williams

Students:
Look through the circle and who do I see?
It's my teacher, yes my teacher
Looking straight at me.

Teacher:
Hello! Hello! Hello! And who are you?

Students:
It's your students, your students,
Looking straight at you.

Students say:
Your face is round, but it does not fit in the circle.
Then your face is not a circle. My face is not a circle. (Students use their hands to make a circle in the air.)

A SEARCH FOR CIRCLES

WHERE ARE THEY?

NAME: _____

GRADES: 2-4

Directions: Make a list of all the circular objects you can find and tell where they are found. Use the chart below to arrange your work. The first two are done for you.

Where are they?	Uses	Pictures
In the parking lot.	It tells us that it's a handicap parking space.	
In restaurants and other public places.	It shows that there should be no smoking.	

KINDERGARTEN WORKSHEETS

NAME: _____

GRADE: Kindergarten

Color the circles on the animal.
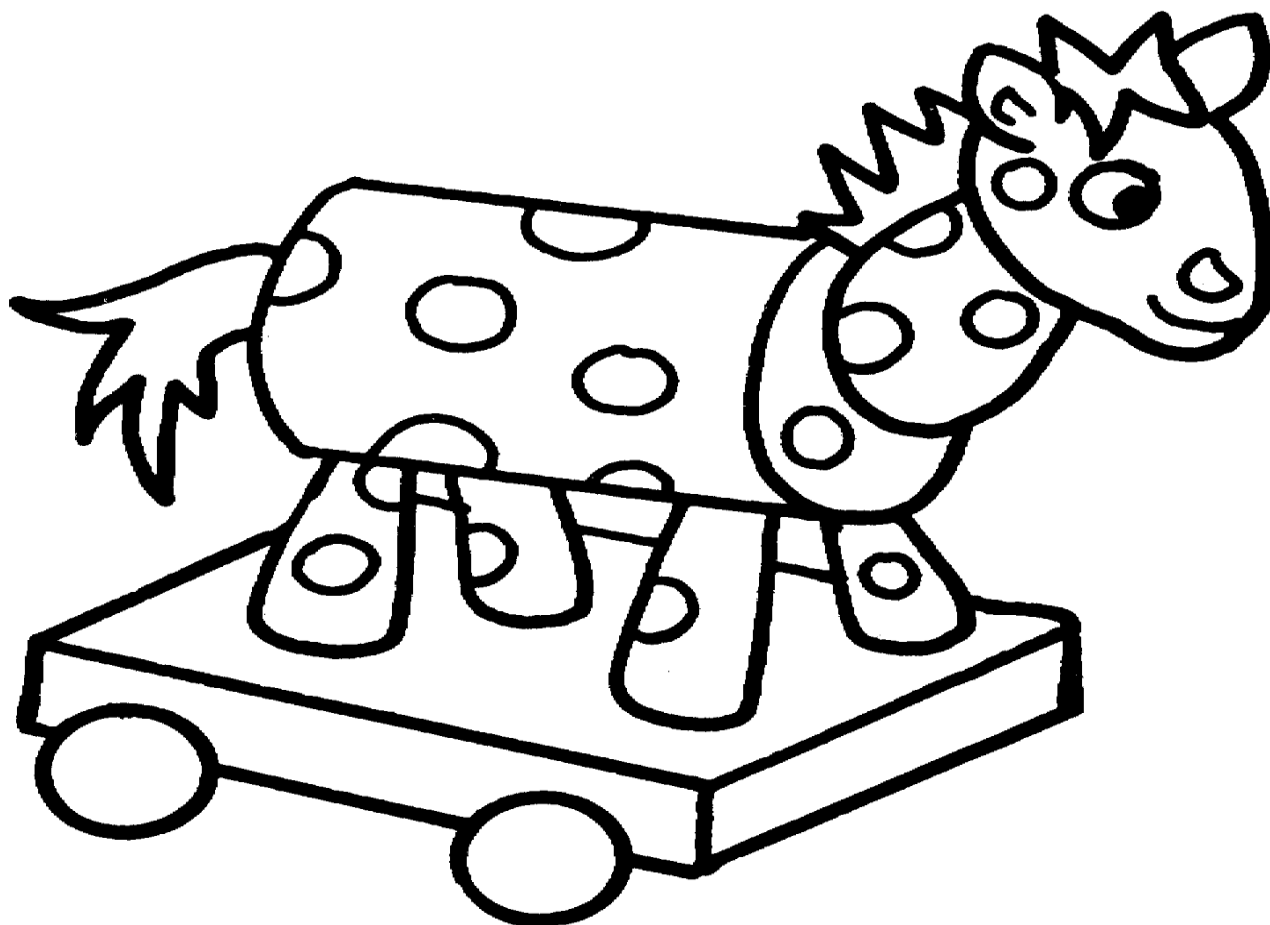
WORKSHEET
FOR SUPPLIMENTARY LESSON

NAME:_____
GRADE: Kindergarten

Sort and draw the circles in the boxes, according to their color.
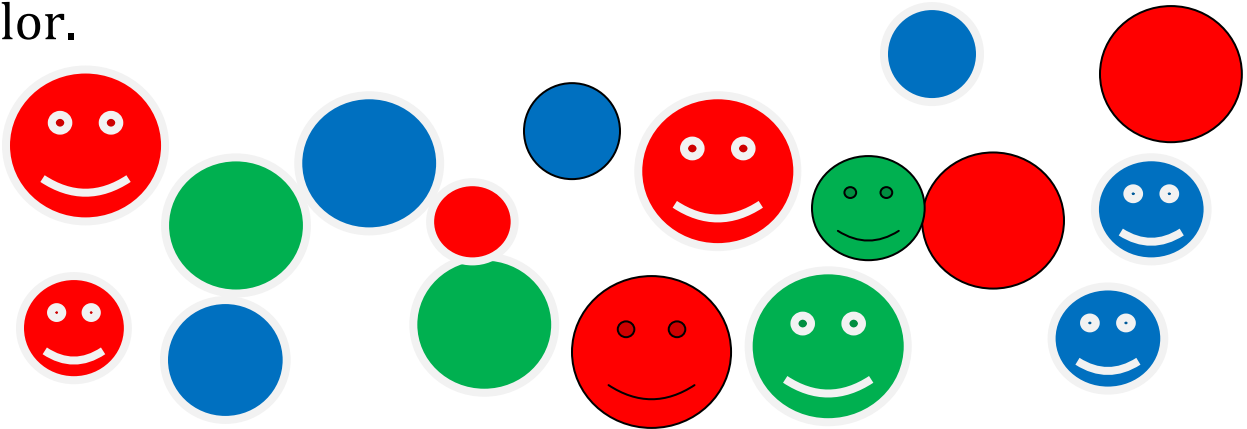
RED	BLUE	GREEN

HOW MANY **RED**? _____
HOW MANY **BLUE**? _____
HOW MANY **GREEN**? _____

NAME_____

GRADE: Kindergarten

DATE: _____

Look at the faces in each box. Write O beside those that are circles, and X beside those that are not circles.

_____	_____
_____	_____
_____	_____
_____	_____
_____	

ANSWER KEY

NAME_____

GRADE: Kindergarten

DATE:_____

Look at the faces in each box. Write O beside those that are circles, and X beside those that are not circles.

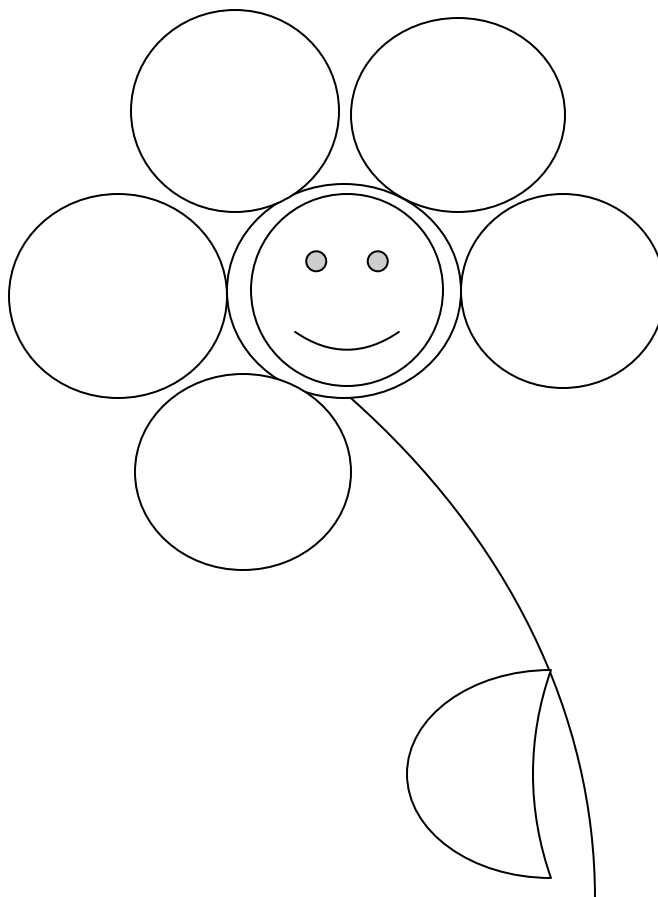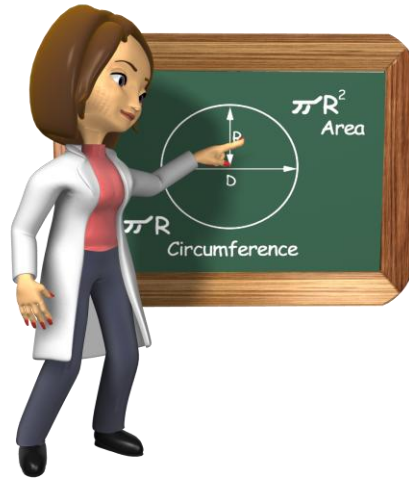|	
____O___	___X____
___O____	____X____
___X____	____O____
___X____	____O___
____O___	__O____

NAME: _____

GRADES: Kindergarten & Grade 1

I am a flower. Finish drawing my petals, then color me.

LESSON TWO
ROUND and ROUND WE GO!

Topic: Round and Round We Go!

Circumference refers to the total **distance around** the **outside** of a circle.
It can also be called the **perimeter** of a circle.
Symbol is an upper case **C.**

Aim: What is the Circumference of a Circle?

Duration: 40-50 minutes

Grades: K-4
Aim: How do you identify the circumference of a circle?

Objectives: Students will be able to explore ways in identifying the circumference of a circle.

Vocabulary: circumference, edge, around

Motivation: Ring games are exciting and funny. Which ring game have you played? In a ring game we sometimes go round and round. What else goes round and round? Yes, a circle goes round and round. Students and teacher read Ezekiel 10: 9-13 and discuss the scene of the wheels Ezekiel saw. Have them draw on the board a wheel within a wheel.

Procedure:
1. Have students sit in a circle, in the classroom or in the gym and play a circle game. (See directions for game in this Lesson Resource section.)

2. As students return to their seats have them sing the song they learned in Lesson one "Have You Ever Seen a Circle."

3. Distribute different sizes circular plastic cover (with the diameter drawn), and a piece of string, to each student. Following the teachers directions, each student will find the circumference of the circle by first taping the string on the outer edge, and wrap it around until the string reaches the point where the tape is.

4. Have students see how many of the circles' diameters they can get from the length of the string that goes around the circle.

5. Have each student exchange the circle for another size and do the same activity using the string.

6. Draw students' attention again to the wheel within a wheel that Ezekiel saw.

7. Ask these questions:

What do you observe from measuring both circles?

Were the circumferences of both circles that Ezekiel saw the same? Explain your answer.

How is the activity you did with the circles and string similar to our ring game?

Culminating Activities:

1. Have students do **"Turn and Share"** sharing with their classmates what the circumference of the circle is.

2. Complete matching worksheets from Lesson 2 Resources.

3. Students will write in their Math Journal an explanation of the steps they took in finding the circumference of the circle and what they learn from these activities.
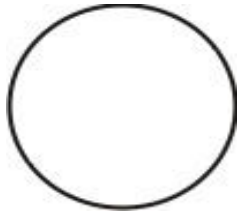
LESSON 2 RESOURCES

WORKSHEET # 1

NAME:_____

GRADE: 4

Read the direction for each problem. Show your work in the space below each problem.

1a. |———| *d* = 5 ft Calculate the circumference of the circle.	1b. |———| r = 5 cm Calculate the circumference of the circle.
2a. |———| *d* = 4m Calculate the circumference of the circle.	2b. *r* = 1 mm Calculate the circumference of the circle.
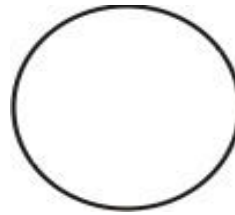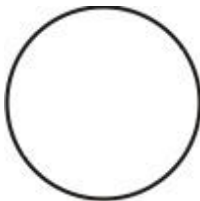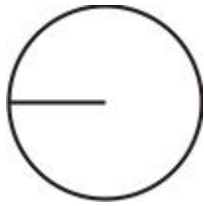
3a.	3b.
   r = 3 ft Calculate the circumference of the circle.	 |———| *d* = 8 yd Calculate the circumference of the circle.
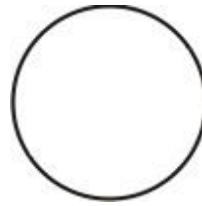
ANSWER KEY

Worksheet #1
Acceptable estimates

(1a.) 15.5 to 16.5 ft

(1b.) 30.5 to 31.5cm

(2a.) 12.5 to 13.5 m

(2b.) 6.5 to 7.5 mm

(3a.) 18.5 to 19.5 ft

(3b) 24.5 to 25.5 yd

WORKSHEET # 2

NAME_____

GRADE: 4

Use a centimeter ruler to measure the diameter of the circles below. Fill in the information in the chart below, ESTIMATING the circumference.

1.

2.

3.

4.
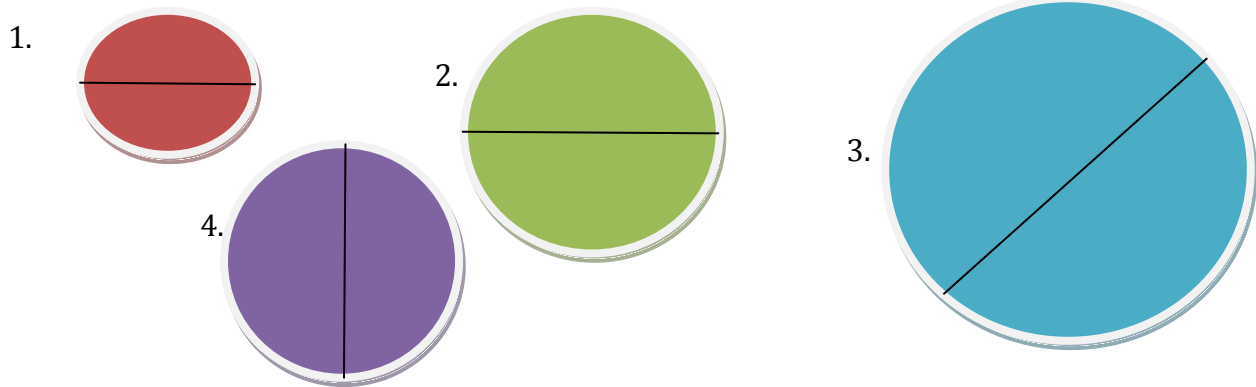
PARTS	1	2	3	4
DIAMETER				
CIRCUMFERENCE				

Adventist Education
A JOURNEY TO EXCELLENCE

NAME: _____
GRADE: Kindergarten

SMILING FACES
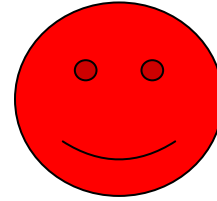
Draw three smiling faces in the box. And color them.
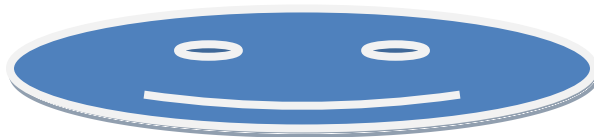
ACTIVITY

The Circumference of a Circle

NAME:_____
GRADES: Grades 1 to Grade 4

Show the circumference using pennies.

1. Place a plastic cover on a white piece of paper.
2. Place pennies all around it.
3. Count the pennies to see how many there are. Write the number_____
4. Try this with bigger circles as well.
5. Remove the pennies and look at the circumference.

LESSON 3
FUN WITH CIRCLES

Duration: 20-50 Minutes
Grade Levels: K-4

Aim: How can we draw circles?

Objectives: Students will explore ways of drawing circle, cut them out, and use them to create different designs.

Vocabulary: compass, fold, pattern, design.

Materials: paint, oranges (cut in halves), paintbrushes, scissors, small containers, paper.

Motivation: God made many beautiful objects in the form of a circle. Can you name any of these objects? Have you ever wondered why God made the planets to look like circles and not like squares or triangles? We may not know why, but one day if we are faithful we will get a chance to ask Him.

Procedure:
1. Teacher will preview vocabulary using a graphic organizer. (See Lesson 3 Resources)
The teacher will tell students that she has a special object that God created. (Teacher hides an orange behind her.)

 Ask: Can you guess what it is?
2. Teacher will show students an orange cut in cross-sections, and ask students to tell the shape they see. Help them to describe the lines in the orange as radii, and the outer edge as circumference.
3. Explain to students that they are going to learn how to draw and cut out circles to do a few fun activities.
Method #1: Draw around a cup. (See instructions in Lesson 3 Resources)

Method #2: Draw a circle with a protractor. (See instructions in Lesson 3 Resources)

Method # 3: Draw a circle by folding a piece of paper. (See directions in Lesson 3 Resources)

Method # 4: Trace around dotted circle**. (This activity is suitable for Kindergarten)** (See directions in Lesson 3 Resources)

Method # 5: Another option for drawing a circle, is to use the modern plastic compass, Students need much practice in using this instrument.

Culminating Activities:
A. Divide the class into two large groups. Each group will choose one of the above methods to cut out circles of different sizes.
B. Group One will need six tiny circles, a large half circle and two medium size circles. Use them to create a collage of a Volkswagen car.(See Activities for Lesson 3)
C. Group Two will make a Teddy Face Circles. (See Activities for Lesson 3)

LESSON 3 RESOURCES

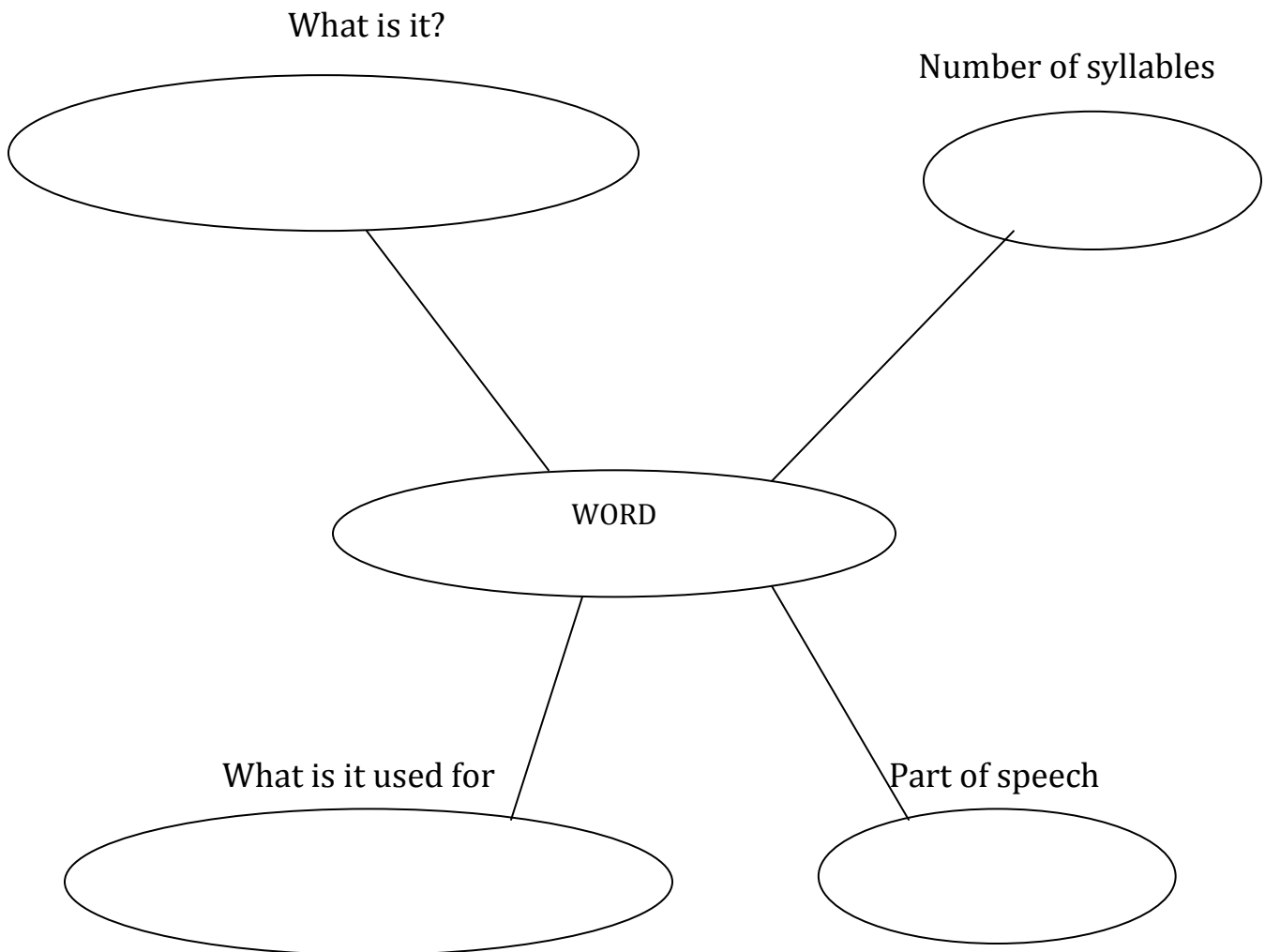## ACTIVITIES
UNDERSTAND VOCABULARY

NAME:_____
GRADES: 1-4
Use the following graphic organizer to map one of the words below:
compass
fold
pattern
design

What is it?

Number of syllables

WORD

What is it used for

Part of speech

ANSWER KEY
UNDERSTAND VOCABULARY

NAME:_____
GRADES: 1-4

Use the following graphic organizer to map one of the words below:
compass
fold
pattern
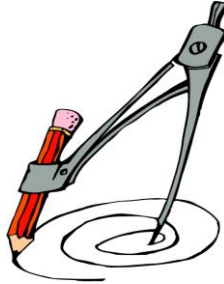design

Number of syllables

two

What is it used for?

It is used to draw circles.

compass

What is it?

A tool that has 2 arms. One joint used for carrying a pencil, and the other has a point to fix it on the paper.

Part of speech

Noun
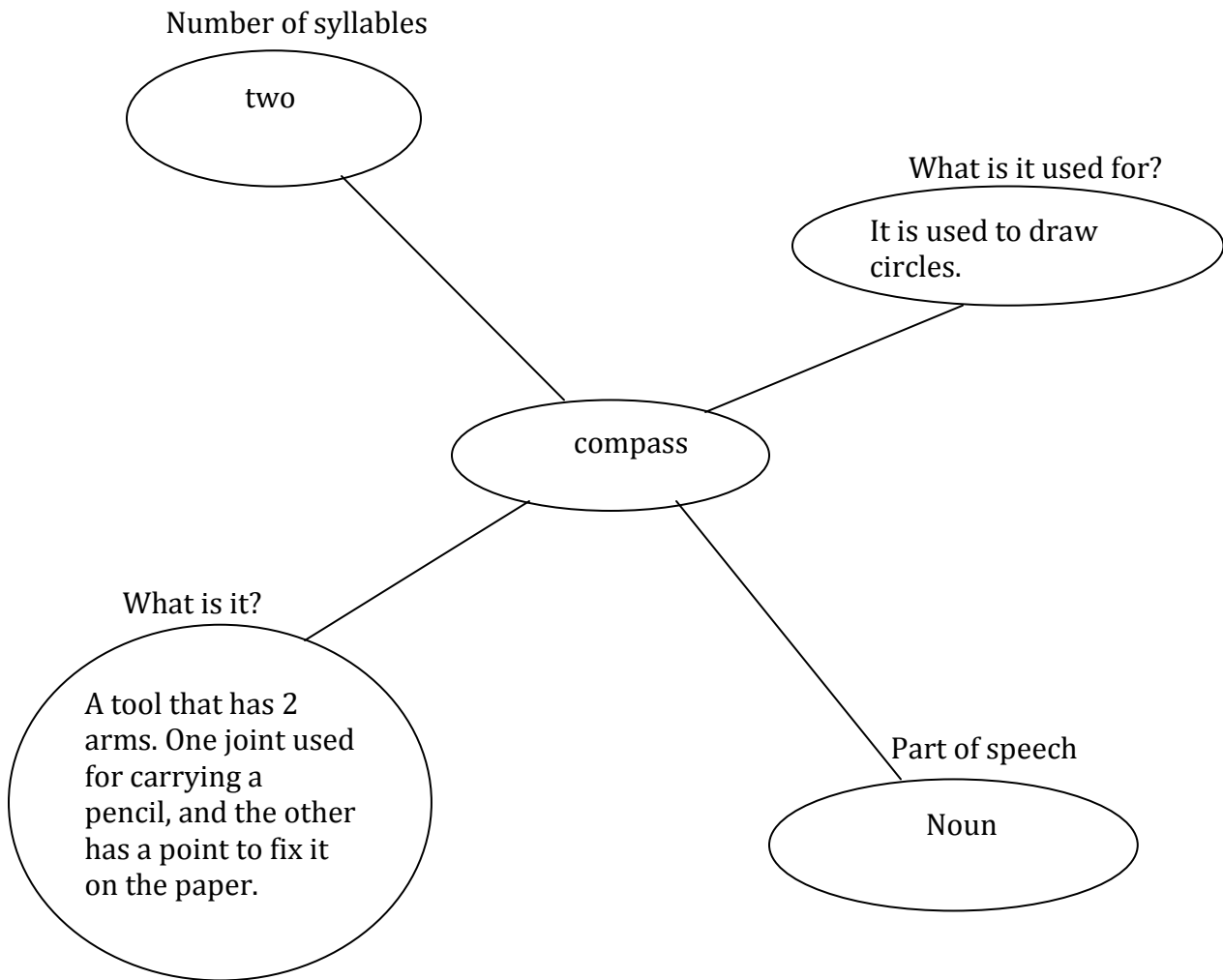
WAYS TO DRAW A CIRCLE

Method # 1

Materials: Cup, Paper pencil, scissors

Directions:
    1. Place the cup on your paper.
    2. Hold it firmly on the paper, and use a pencil to draw around its circumference.
    3. Remove cup and view the circle you made. If the lines are jagged, repeat the activity.
    4. To find the center of this circle, you must fold the circle in halves, and then in quarters.
    5. Open the circle. The center will be where the two folds cross each other.

Use a cup to draw a circle.

Method # 2

Materials: protractor, pencil, scissors, paper
            (This activity is more suitable for Grades 3 and 4)

Directions:
1. Place the protractor on the paper.
2. Identify the center by placing a small dot in the tiny hole on the protractor.
3. Note the ends of the protractor at 0 degree and 180 degree, and place a dot on both ends.
4. Use your pencil and draw around the protractor, then remove the protractor.
5. Draw a line from the 0 degree dot to the 180 degree dot that you made previously.
Your drawing should be a perfect half circle.
6. Place the protractor on the opposite side of the semi-circle so that the 0 degree and 180 degree line fits perfectly on the corresponding line on the projector.
7. Use a pencil to draw around the protractor as before.
8. Remove the protractor and look at the circle you made.
 This activity will help the students to understand later that there are 360 degrees in a circle.

_____

Method # 3
Materials: construction paper, small paper plate, scissors, pencil
Directions:

1. This activity is a bit challenging, and may be more suitable for 3rd and 4th graders.
2. Fold the construction paper in half.
3. Fold the small plate in half to find the diameter of the circle.
4. Align the folded side of the paper with the diameter of the plate.
5. Hold the plate firmly on the paper, and trace around the semi-circle formed by portion of the plate that overlaps the paper.
6. Remove plate, cut around marked area, and unfold the paper to reveal the circle.
7. This activity will help to reinforce the concept of the diameter of the circle, and also to assist in the future to teach line of symmetry.
See pictures below.

STEP 1

STEP 2

STEP 3

Method # 4

Materials: Pencil, white heavy weight paper with large dotted circles.
Directions:
      Model for students how to slowly trace the circles on the dotted lines.
      Guide students' hands as they trace.

NB: Kindergarten students' circles will not be accurate but they will grasp the concept of "roundness." They will develop their finer muscles while they are enjoying the activity.

CULMINATING ACTIVITY # 1
LESSON 3

Materials: Six sheets paper of different colors, string, scissors, and transparent tape
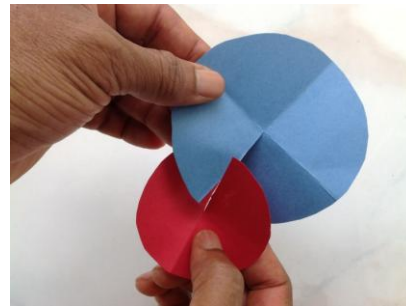
Directions:
1. Choose a method for drawing circles.
2. Draw six circles of different color and sizes. (For Kindergarten to Grade 2 the teacher will provide precut circles.)
3. Use your scissors to cut out each circle. Make sure each circle is cut neatly around the circumference.
4. You may gently fold each circle in quarters to find the center.
5. Cut one radius in each circle along one of its folded radius.
6. Insert each circle into each other from largest to smallest. (You may add other tiny circles if you wish to create the idea of ears or eyes, etc.)
7. Make a tiny hole at the top of the large circle and insert a string. Hang it from the ceiling to decorate the classroom. See picture below.

   HAVE FUN!!!!
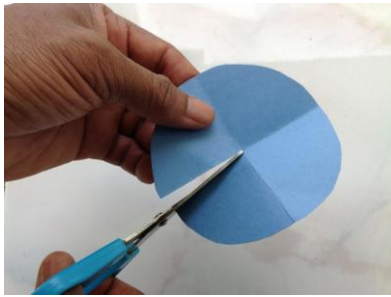
STEP 1

STEP 2

FINAL PRODUCT

ACTIVITY # 2
Circles Volkswagen

Materials: colored paper, white construction paper, ruler, paper punch

Directions: (Pre-cut circles are recommended for K-Grade 1)
1. Draw a large circle and fold it in two halves to show the diameter.
2. Open the circle and cut it along the diameter.
3. Punch a number of circles around the semi-circle as shown below.
4. Draw and cut two small circles to represent the wheels
5. Punch two tiny circles to be placed inside the wheels.
6. Use a ruler to draw four diameters in each small circle, then paste the tiny red circles in the middle of each wheel.
7. Paste the large semicircle on a sheet of white paper.
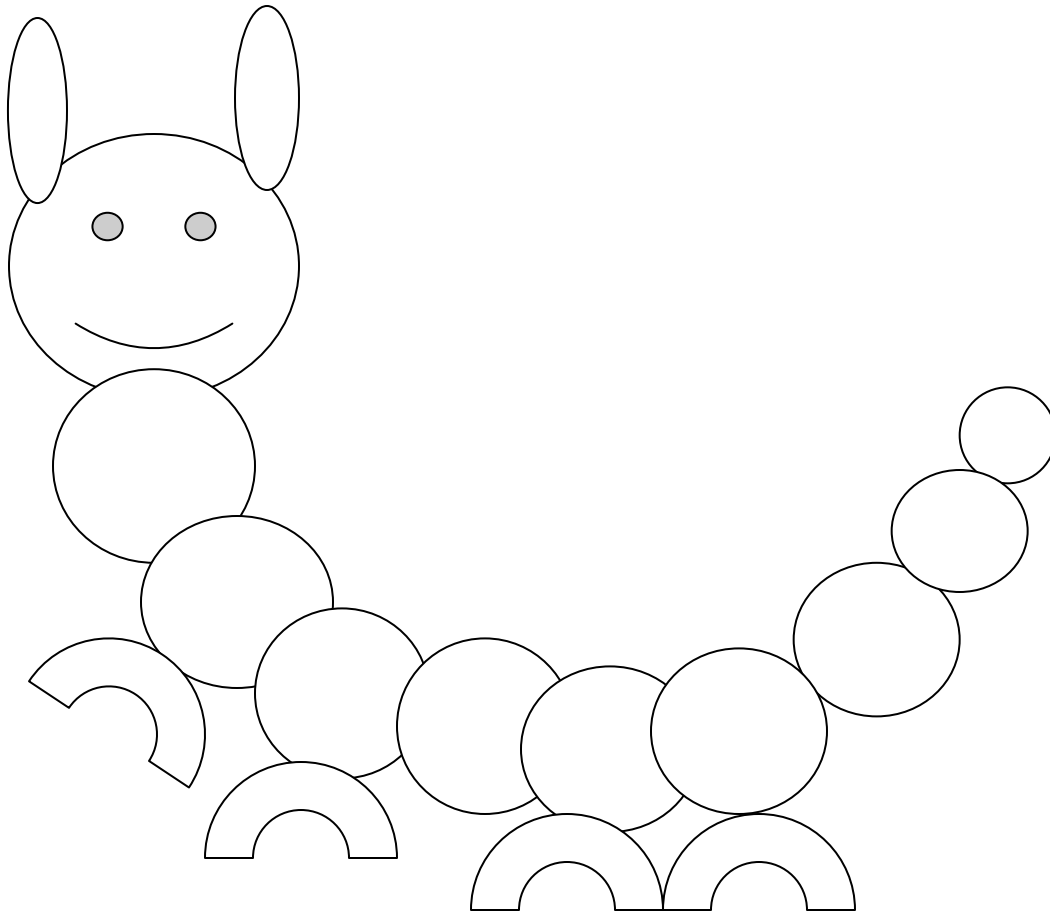8. Paste both wheels on as shown in the picture.
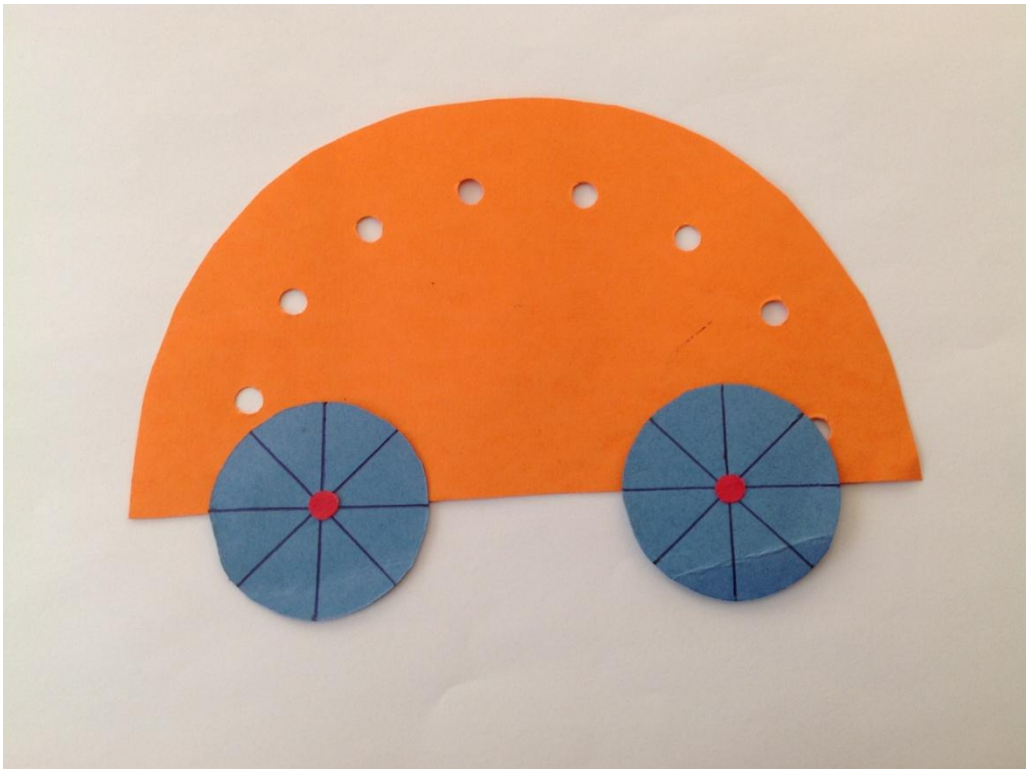
NAME:_____

GRADE: Kindergarten_Grade 2

Color each circle on the catepillar in a different color. Cut out the catepillar and paste them on your classroom's door.
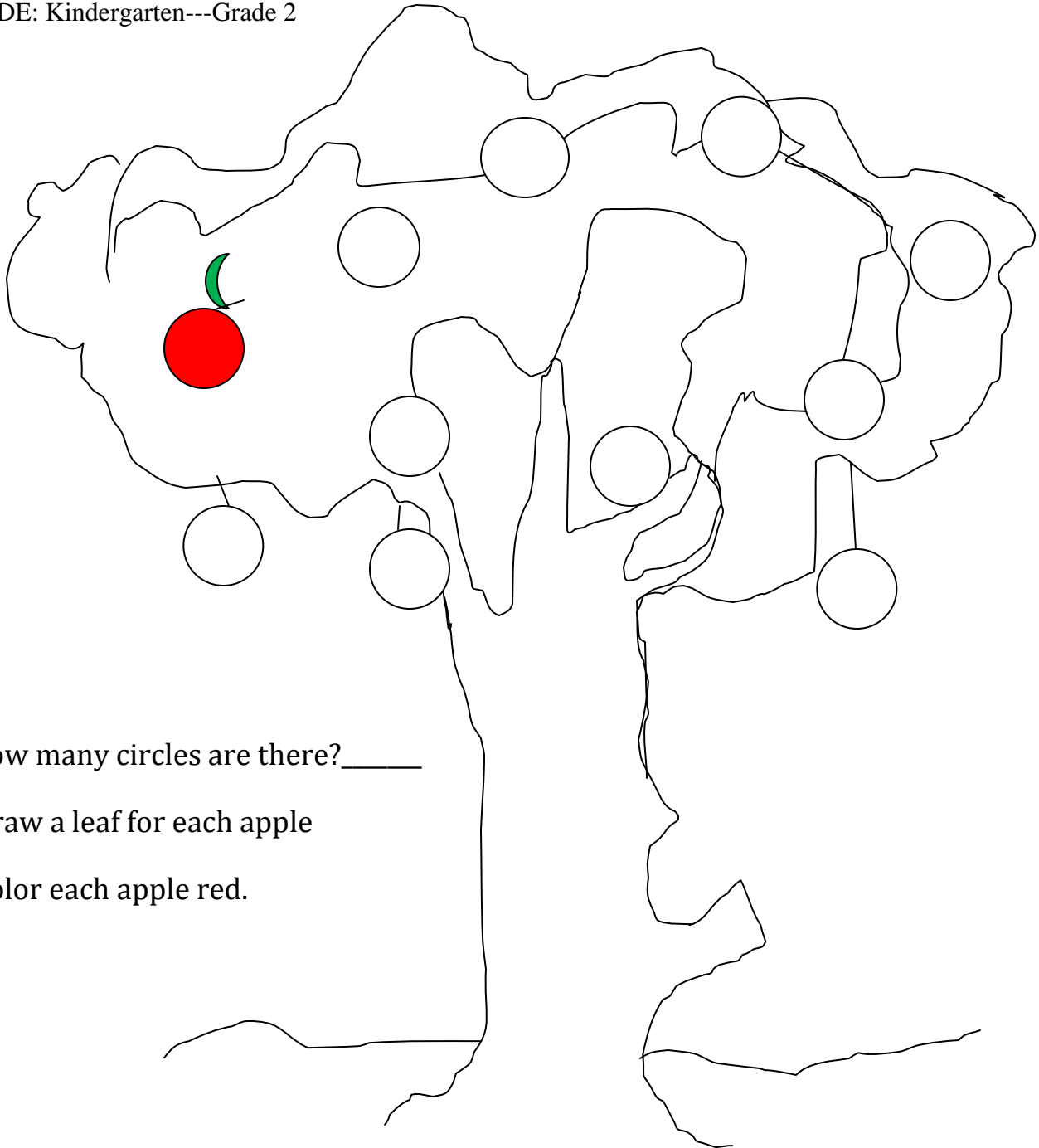
NAME_____

GRADE: Kindergarten---Grade 2

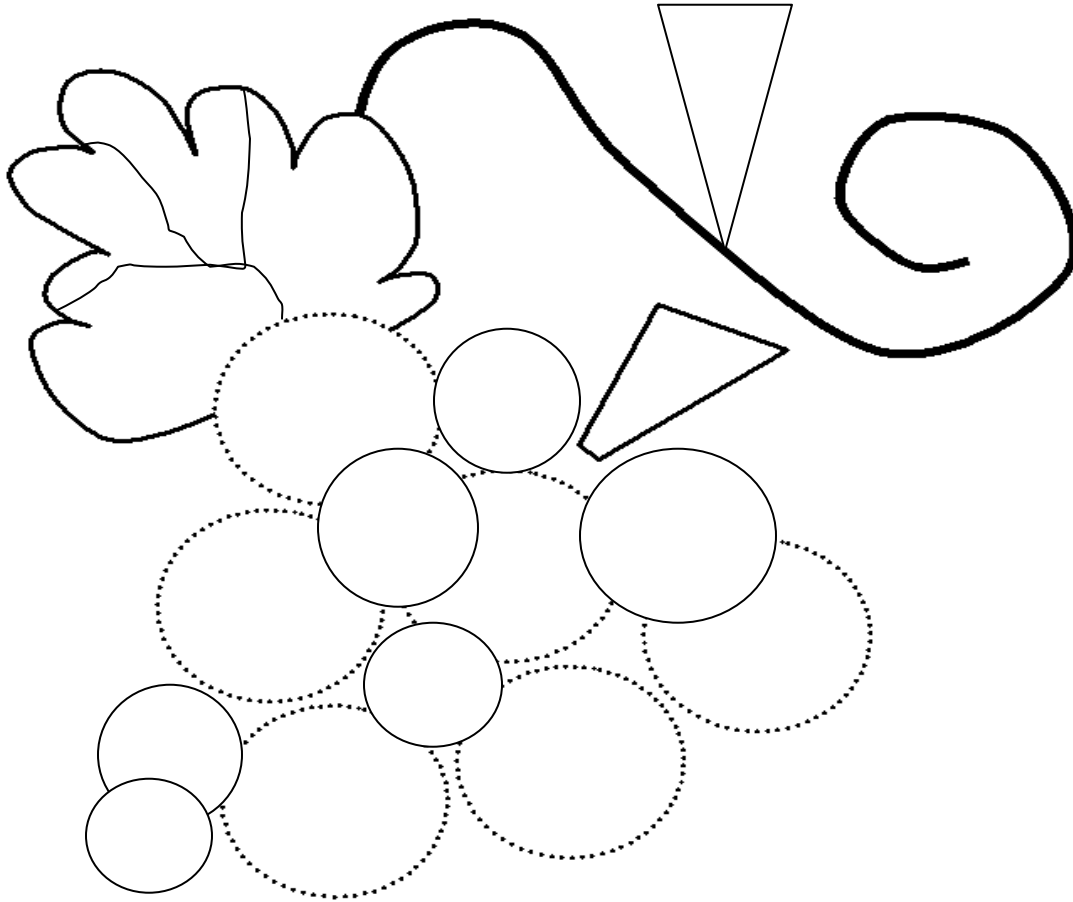1. How many circles are there?_____
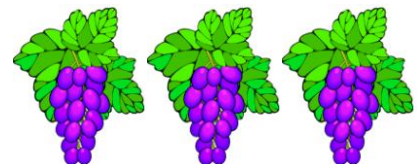
2. Draw a leaf for each apple

3. Color each apple red.

NAME: _____

GRADES: K-2

Shapes and Colors: Trace the circles ⭕ and color them purple.
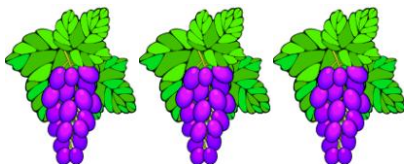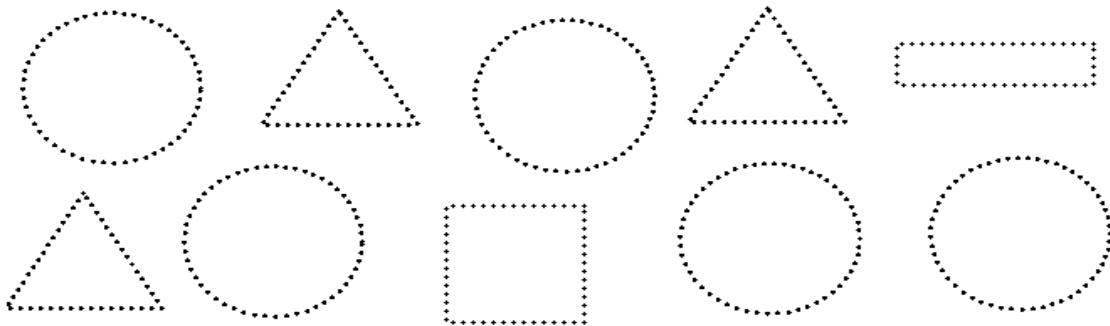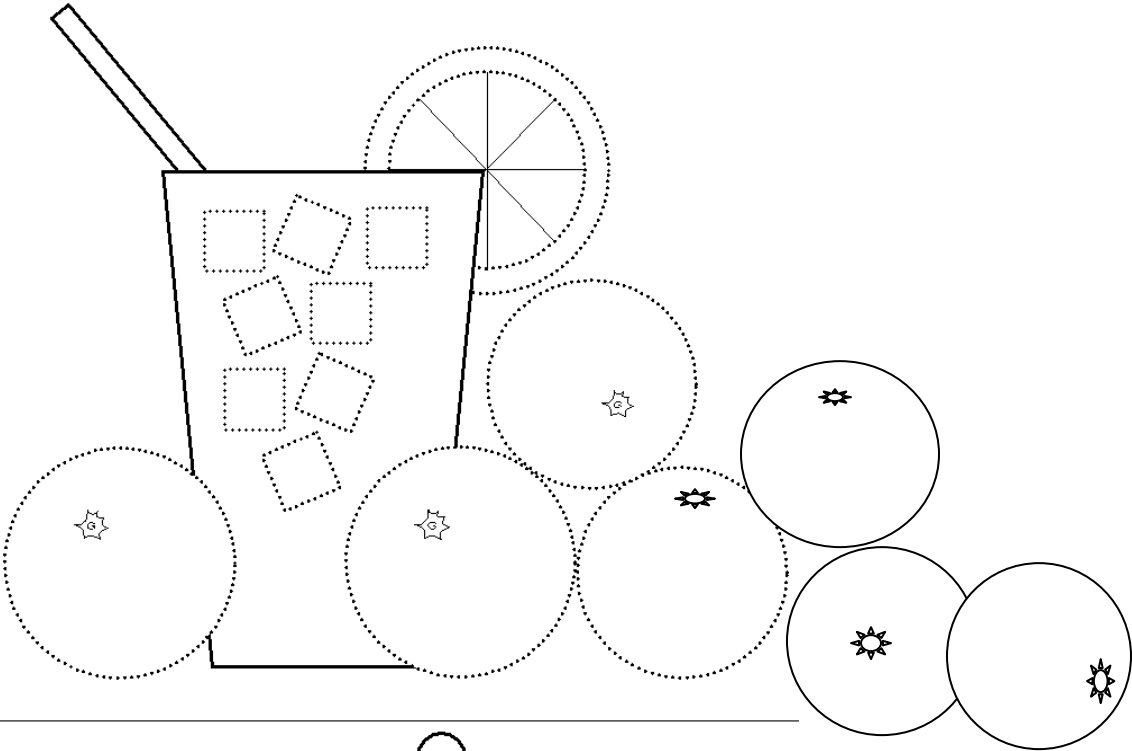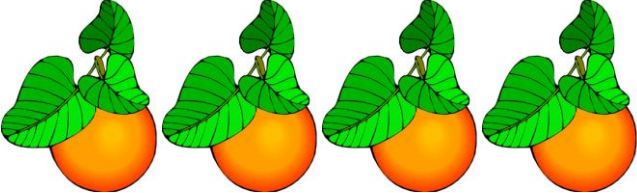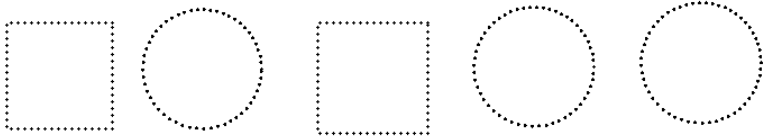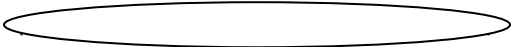
NAME: _____

GRADES: K-1

Shapes and Colors: Trace the circles ◯ and color them orange.

ADDITIONAL ACTIVITY

Grades 3 and 4
May be used to reinforce concepts taught.

Materials:
 Black or brown construction paper, ruler, container with bubbles mixture.

Directions:
 Explain the bubble blowing activity. The students are to take turns blowing bubbles onto a piece of dark construction paper until the bubble pops and leaves a circular soap bubble print (This can also be modeled for the students.) The students will blow three bubbles and use a ruler to measure the diameter, and radius and list the measurements in centimeters in their books.

 After the students have experimented with blowing bubbles and measuring them have a class discussion on their findings. Ask: What did you find most difficult? What was easy? Did you notice any patterns?

Bubble Blowing Competition:

3.Tell the students that now that they have an understanding of the concepts of diameter, and radius they are going to have a Bubble Blowing Contest. Tell the students that they will have 5-10 minutes to blow a bubble with the biggest circumference. After they have done this each pair will bring their biggest bubble to the front of the class. The teacher will display the circles and have students judge which ones are the biggest. As a class we will decide who has the 1st, 2nd, and 3rd largest circumference. Each pair of winners will come to the front of the room and pick a prize.

Conclusion & Assessment:

Ask them why is it important to know how to measure things. Ask the students what was their favorite part of the activity and why. The teacher will also go around and view experiment sheets and make sure that the students do what they were required to do.

Hand out treats:

The teacher congratulates students and hands out a round cookie to each one. Before the students can eat them they have to all agree on the measurements of the diameter and the radius of the cookie.

LESSON 4

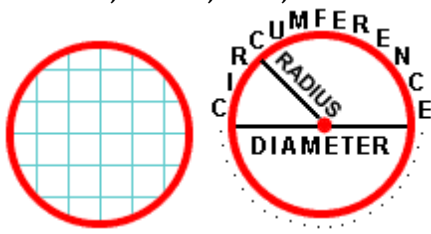**Aim**: How do we find the area of a circle?
Duration: 30-40 minutes
Levels: K- 4

 **Materials:** paper, crayon, pencil, overhead projector.

 Objectives: Students will use grid paper to identify the area of a circle.
Vocabulary: surface, whole, area, estimate.

Motivation:
Show students a video clip of the Heavenly bodies. Ask them to describe the shape and colors they see. Emphasize that the planets are all spherical in shape, but when we look at them they look like circles. In order to help students understand the term "surface", ask them: Would you like to walk on any of those planets one day? What do you think you would find on their surfaces? Help students to stretch their imagination as they take an imaginary walk over the whole area of one of the planets.
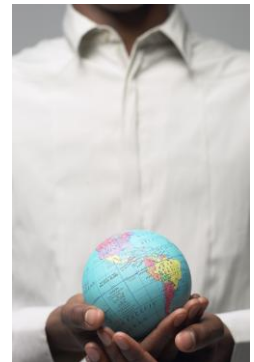
Procedure:
Have students sing: "*He's Got the Whole World in His Hands*" Let them substitute   the word "wide world" with "round world."
Read Habakkuk 2:14 and lead a brief discussion on what it means for the earth to be filled with God's glory.
Ask: What are some other things that fill the earth? (water, people, land, animals, etc.)
Explain that like all the other planets, when we look at the earth in a picture, it looks flat like a circle. If we remove all the land from the picture of planet earth, what will we have left? (only water.)
Distribute to students, paper with a large circle drawn on it and crayons.
Say: The circle that you have represents the earth. We have removed the land and only the sea will remain. You are going to use your blue crayon and color the inside of the circle to represent the sea. (Let the students take two to three minutes and color)
Explain to students that they have just colored the whole surface of the circle. Have students repeat: "I have just colored the whole surface of the circle.
Ask: Can you think of another word for surface? (
Area)
 What borders the surface of the circle you just colored? (The circumference)

Explain that instead of coloring the surface, we could also use a grid the estimate the area of the circle.

With the use of an overhead projector, show how to estimate the area of a circle. First, project the transparency grid on the board, and then place the circle transparency on top.

Have students count all the whole squares that they see. Explain that counting the circles is just one way to estimate the area. It is all about trying to see how many squares will fit inside the circle. When you tell how many squares fit into the circle, you must write your answer like this:

For example, **Area of the circle = 8 squares. Area is always written in Squares (sq).**

For a better estimate of the area of the circle, the teacher could ask the more advanced students to count the pieces of squares remaining, after they count the whole ones. They may use two pieces to make one whole square, and then add the new squares they make and add them to the whole ones.

Teacher may challenge more advanced students by introducing them to Pi π = 3.14.

Explain the formula: Area of circle = π R squared and model its use for advanced students.

NB: If this lesson is taught in the third semester, students would have already completed multiplication of decimals. This could be a springboard to what they will do in the 5th grade.

Culminating Activity   Part 1

Provide students with 1cm square grid paper and a cup.

Direct students to use a cup and draw two circles, one with the top of the cup and one with the bottom, so that they make two circles of different sizes.
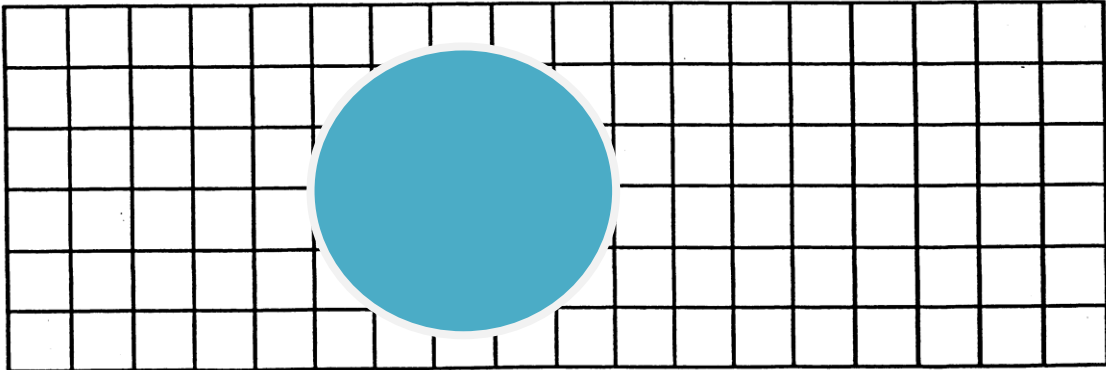
Estimate the area of each circle by counting up the squares. Write the answer as square units.

Teacher may challenge more advanced students with WORKSHEET # 3.

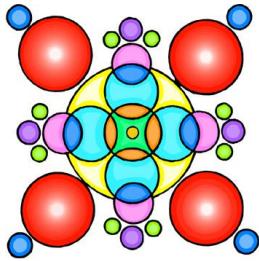NB: The teacher should provide 1-inch square grid for K-Grade 2, with large circles drawn on the grid.

Part 2   JUST FOR FUN!

Have students color all full squares red and all pieces green.
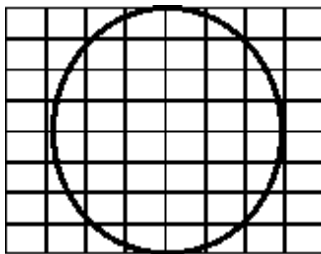
LESSON 4 RESOURCES

WORKSHEETS # 1

NAME:_____

GRADE: 4

Write in the answers to the following questions.

Estimate the area of the circle by counting the squares inside the circle.
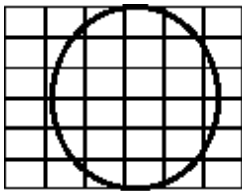   (Circles not drawn to scale)

Area = about _____squares

If each square is 1 centimeter wide, what is the diameter of the circle? _____cm

Worksheet # 1: Continue

3.

Area = about _____squares.

If each square is 1 centimeter wide, what is the diameter of the circle? _____cm

How much bigger is the first circle than the small circle?

About_____squares

SHOW YOU WORK

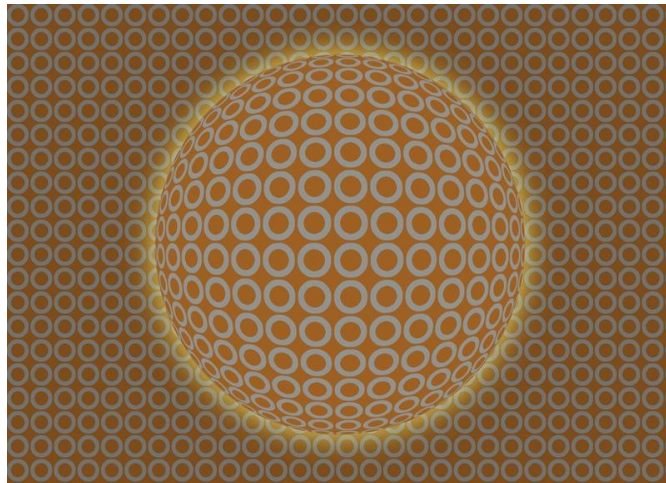# ANSWER KEY
WORSHEET # 1
AREA OF A CIRCLE

1. About 36 squares

2. Diameter = 8 cm
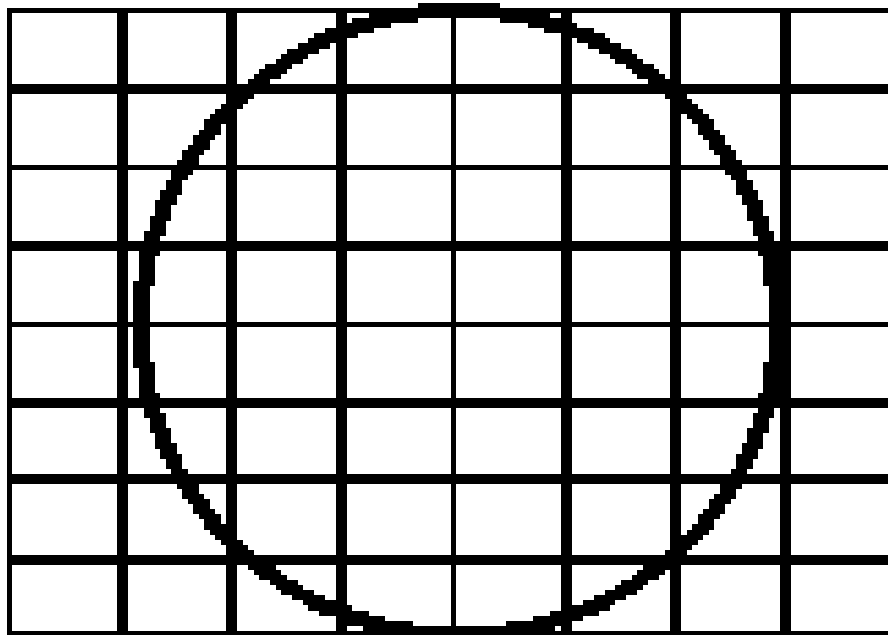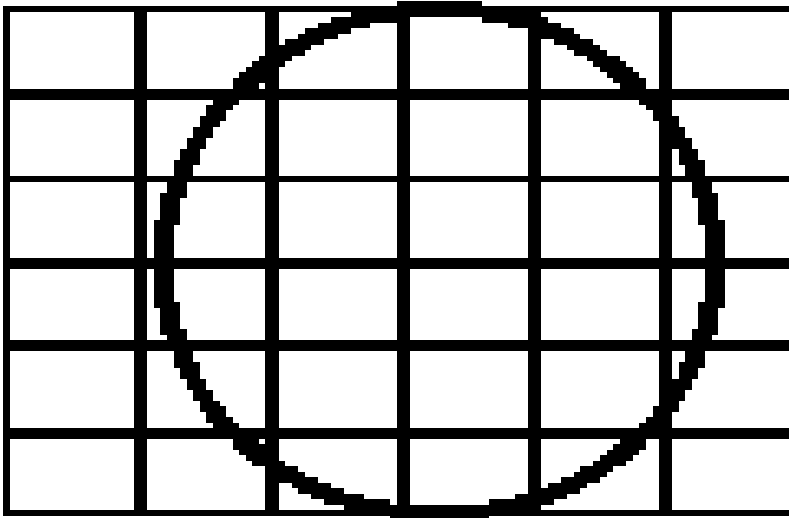
3. 20 squares

4. Diameter = 4.5

5. 36-20=16 squares

WORSHEET # 2

NAME_____

GRADE: K-2
Count the number of BIG squares in each circle and write the number on the line.
Color one circle RED, and one GREEN.

_____

_____

WORKSHEET # 4
Area of Circle Worksheet

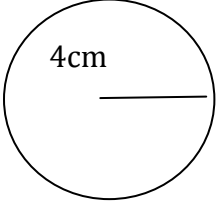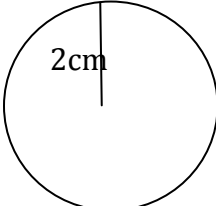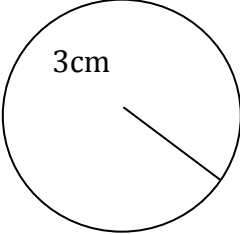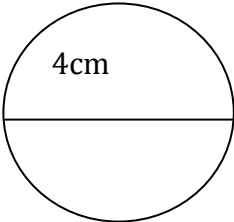Challenging π = 3.14

NAME: _____

GRADE: 4

Find the area of the following circles for the given diameter and radii.

SHOW WORK IN BOXES

1. 4cm	
2. 2cm	
3 3cm	
4. 4cm	
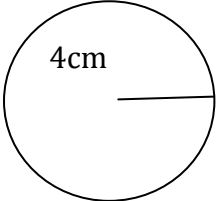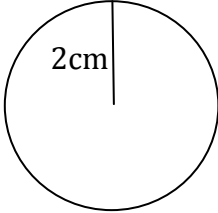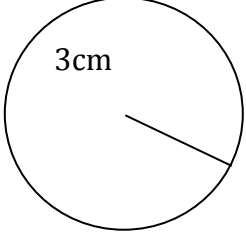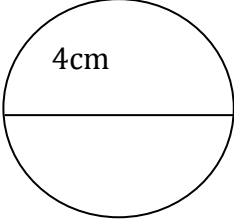
WORKSHEET # 4
ANSWER KEY

NAME: _____

GRADE: 4

Find the area of the following circles for the given diameter and radii.

SHOW WORK IN BOXES

1. 4cm	Radius =4cm 4x 4=16 Area =3.14 x 16=50.24 sq cm
2. 2cm	Radius =2cm 2x2=4 Area = 3.14 x4=12.56 sq cm
3 3cm	Radius=3cm 3x3=9 Area = 3.14x9=28.26sq cm
4. 4cm	Radius= 2cm 2x2=4 Area =3.14x4=12.56 sq cm

Adventist Education
A JOURNEY TO EXCELLENCE

LESSON 5

TO WHAT DEGREE?

Aim: How do we measure degrees in a circle?
Duration: 40-60 minutes

Levels: K- 4

Materials: paper with two circles, pencil, protractor, overhead projector, transparencies, ruler.

Objectives: Students will use a protractor to measure the number of degrees in a circle.

Vocabulary: protractor, degrees, measurement, perpendicular, projector, transparency, vertex.

Motivation: In Genesis 1:16 we learn that God created the sun and the moon and the stars. I wonder what tool He used to measure their diameters, their radii, and their circumferences. Did He really need a measuring tool? I don't think so because He is God and he knows all things.
Sing the song: *He's Still Working on Me* (See Lesson 5 Resources for song lyrics. Tune can be downloaded from YouTube.)

Procedure:
Say: So far you have learned about the circle, its parts, and how to find the circumference and area. Today you are going to learn how to measure a circle.
Ask: Does anyone know what tool is used to measure a circle?
Have a brief discussion on tools and units of measurement used to measure lines, temperature, angles, and time.
Say: Earlier this year you learned to measure angles. What you know about measuring angles will help you understand how to measure the circle.
Show the students the following picture on the overhead projector.

Adventist Education
A JOURNEY TO EXCELLENCE
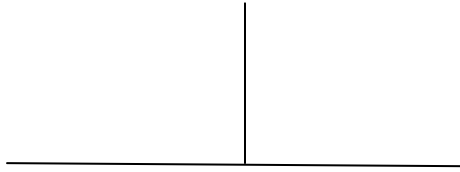
Ask: Which two angles are there? (2 right angles)
How many degrees are shown in both right angles? (180 degrees)

The teacher places the transparency (with a circle already drawn) over the two right angles shown above.

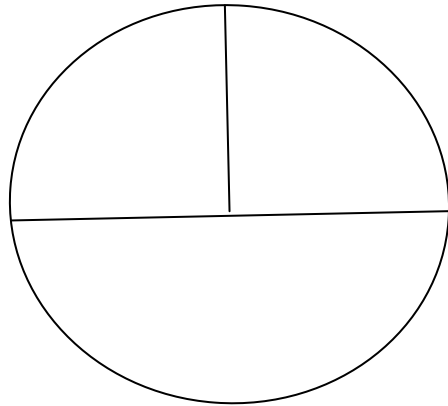Give each student paper with the two transparencies used above (smaller pieces of transparencies), and have students place their circle over the perpendicular lines as was modeled by the teacher.
Ask: What do you notice when the circle is placed over the two 90 degrees angles? Students should conclude that two 90 degree angles make ½ a circle, which is equal to 180 degrees.

Ask: If there are 180 degrees in ½ a circle, how many degrees are in the whole circle? Students are required to show their work, adding 180 plus 180.
Have students extend the vertical line then place the circle with the center at the intersection over it. This will give the students a better understanding of how they arrive at 360 degree in a circle.
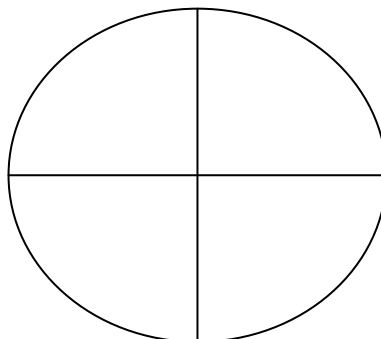
Another practical way to help students understand the degrees in a circle is by using a circle with two hands to show the turns. The teacher will model the turns as the students imitate. Ask students to tell how many degrees are in ½ turn, ¼ turn, ¾ turn, and full turn. (See Lesson 5 Resources for additional materials.)

PART 2
Using a Protractor

Distribute a protractor to each student and discuss what the numbers mean. Demonstrate how it is used to measure the degrees in a circle.

Explain to students that it does not matter how small or how little a circle is, all circles still have the same 360 degrees.

Culminating Activity:

Students will practice to measure degrees in ½, ¼, ¾, and full circle, using the protractor.
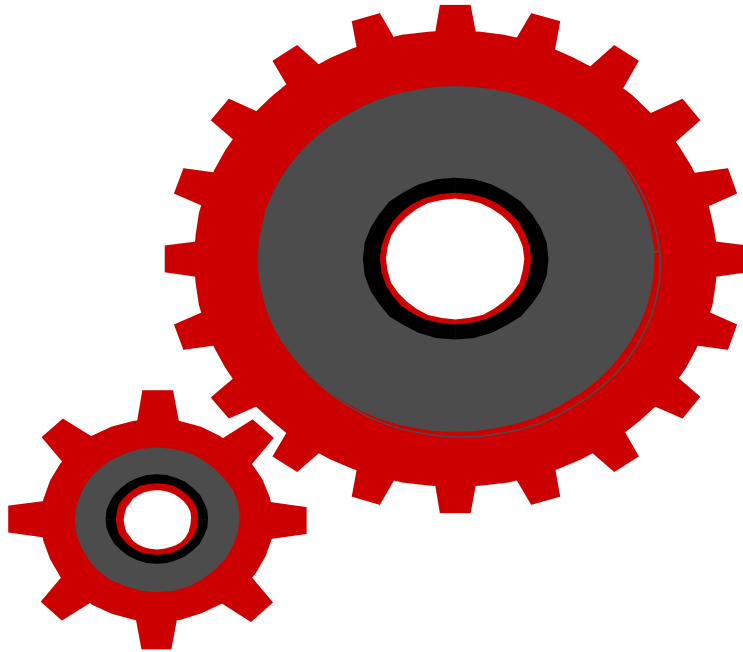
LESSON 5 RESOURCES

SONG

HE'S STILL WORKING ON ME
He's still working on me
To make me what I need to be
It took Him just a week to make the moon and the stars
The sun and the earth and Jupiter and Mars
How loving and patient He must be
'Cause He's still workin' on me.

Written by: Joel Hemphill
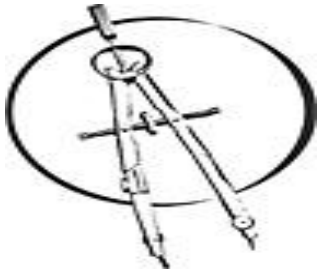
MEASURING THE CIRCLE

Angles are measured in *degrees*. The full circle forms a **360 degree** angle. Therefore a half circle or a straight angle is 180 degrees, and a fourth of a circle or a right angle is 90 degrees. Look at the pictures. We use the tiny circle above the last number, to show the degree.

Note how it has the shape of half a circle; therefore it only measures angles up to 180. It has two sets of numbers: one set goes

from 0 to 180 one way, one set from 0 to 180 the other way. Which one you read depends on where you place the one side of the angle you are measuring.
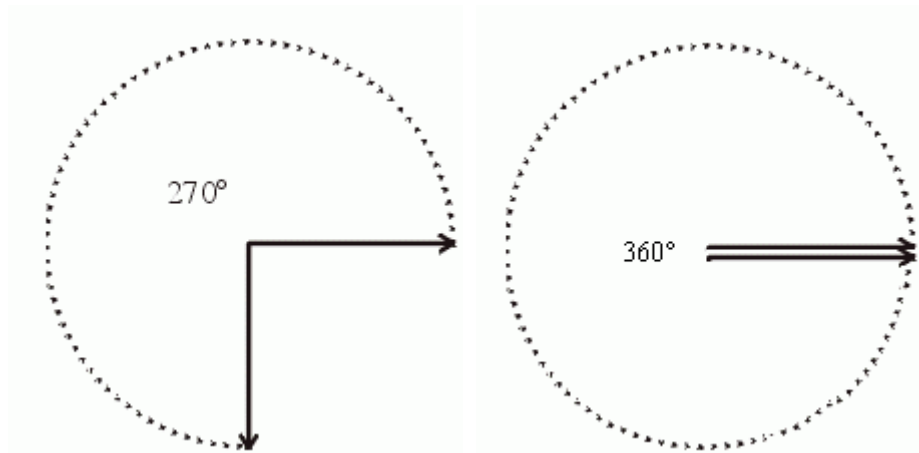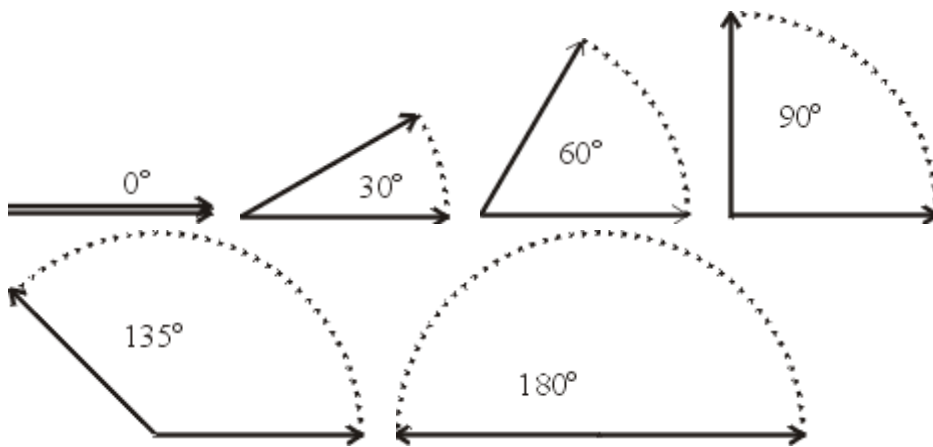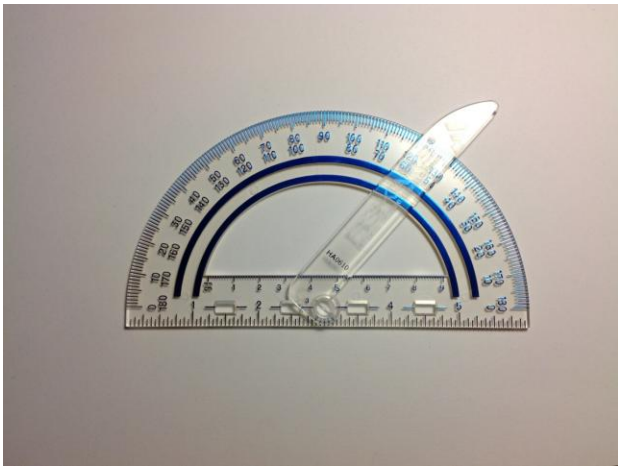
To measure an angle, place the little circle or open hole of the protractor on the VERTEX of the angle. Place the zero line of the protractor on the ONE SIDE of the angle. Then read the measure where the other side hits the protractor scale. This angle is obviously an OBTUSE angle, so we read the scale at 127 degrees.

These pictures illustrate how to measure angles from triangles or other figures. The zero line of the protractor needs to be lined up with one side of the angle, and you read the set of numbers from your zero line on.

NB: Even though Kindergarteners to Second Graders will not be measuring degrees, doing the ¼, ½, ¾ and full turns could be fun for them to do.

WORSHEET #1

MEASURING ANGLES IN A CIRCLE
NAME_____
GRADE: 4
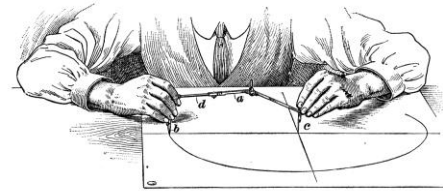
Count the number of diameters in the spider web.
   1.   How many are there? _____

WEB OF GARDEN SPIDER (FIG. 2).
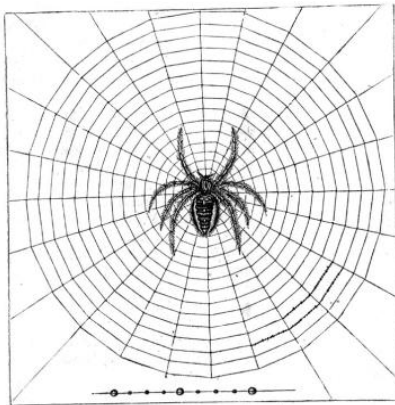
   2. How many radii can you count?_____
   3. Notice that the lines that form the acute angles are equal distance apart. If each acute angle measures 15 degrees, what is the total degrees in the circle?

   SHOW YOUR WORK

4.Use your protractor to measure the angle shown in the circle above. How much does it measure? _____
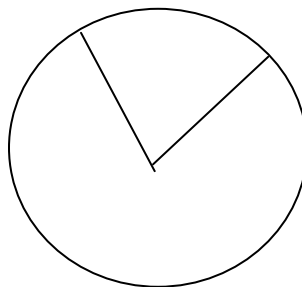
WORSHEET # 1
ANSWER KEY

1.There are 12 diameters in the spider web.

2.There are 24 radii shown in the spider web.

3.If each acute angle measures 15^0 the sum of the whole spider web is 360^0
    $24 \times 15 = 360^0$

4.The measure of the angle in the circle is 75^0

WORSHEET # 2

NAME:_____
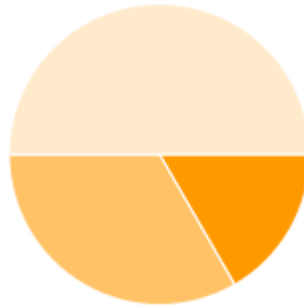
GRADE: 4

Use your protractor to measure each angle shown by the colors in the pie chart and record your answers in the boxes below.

Large area	_____ ^{0}	Score: 5 points
Medium area	_____ ^{0}	Score: 5 points
Small area	_____ ^{0}	Score: 5 points
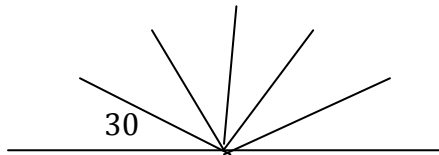
4.The figure has been divided into six equal angles. How many degrees are in all six angles? **SHOW YOUR WORK**.

WORKSHEET # 2 continues

5.Use your hand or your protractor to draw a semicircle so that ithe figure looks like a half an orange. What conclusion can you draw that helps you understand the number of degrees in a circle?

_____
_____

6. If section x measures 45^0, how many degrees are in 3/8 of the circle?
_____

FINAL PROJECT

TOPIC: MORE THAN A HAPPY FACE

AIM: Students will do this project to reinforce their understanding of the parts of the circle.

Materials: circular objects: old CD/DVD, medium size plastic covers, or paper plate, digital camera or an iPad, construction paper, oak tag, tape, glue, and scissors.

Instructions: Find five circular objects from the list above or other suitable ones (each one about 4 inches in diameter).
Draw six boxes on the oak tag board as indicated below.
Follow the directions for each box listed below.

BOX A
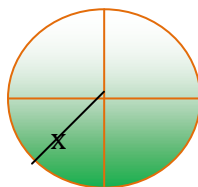In this box, draw the circle by tracing around one of the objects you found

BOX B
In this box tape one of your circular objects, (an old CD/DVD would be great). Show the center by placing a red dot in the center.

BOX C
Draw the diameter and the radius on one of your circular objects in 2 two different colors, and then paste the circle in this box.

BOX D
Paste another circular object in this box. Place a piece of colored yarn around it to show the circumference.

BOX E
Cut small pieces of colored paper to color the area of a circular object and paste it in this circle.

BOX F
Take pictures of at least six circular objects in the environment and paste them in this box. Tell which part of the circle is shown on each picture. For example, a no smoking sign would show the

Due _____
Your work will be graded for neatness and for following the directions in the boxes. The rubric below shows exactly how your work will be graded.

RUBRIC FOR PROJECT

MORE THAN A SMILING FACE

CATEGORY	3 points	2 points	1 points	0 points
Presentation of information	Presented all information in a clear and organized way.	Presented most of the information in a clear and organized way.	Presented information which was poorly organized and difficult to follow.	Presented information that was poorly organized and difficult to understand.
Layout/format	Selected a highly effective and creative format for the project.	Selected effective format for the project.	Selected a format that was only minimally effective.	Selected a format that was not effective for this project.
Labels and caption	Very neat labels and captions.	Somewhat neat labels and captions.	Labels and captions in their places, but not very neat.	Poorly done with no captions or labels.
Photographs	At least 6 photos relating to the topic.	At least 6 photos, but not all relating to the topic.	At least six photos, but not relating to the topic.	No photos were placed on the board.

HOPE YOU HAD FUN

EXPLORING CIRCLES

ANNOTATED SOURCES

The following sources were very useful in compiling this unit.

Websites

1. www.brainpop.com (Brainpop Jr): This site has a number of exciting and colorful videos, worksheets and quizzes on the circle. Brainpop Jr. is for grades K-4, even though it caters specifically to students from Kindergarten to Grade 3.
2. www.homeschoolmath.net contains a number of games and worksheets. Students and teachers can view a very informative video on parts of the circle: radius, diameter and circumference.
3. www.superteacherworksheets.com This site has a wealth of worksheets based on the circle. There are a few free worksheets, but with an annual subscription, a vast number can be at your disposal.
4. www.adaptedmind.com: A better way to learn math. This site consists of a number of videos on the circle that are great for classroom instructions.
5. . ixl.com is a very exciting site for both teachers and students. It is very interactive. For example, check out www.ixl.com/math/grade-4/circle graphs. Explore the colorful circle graphs. Do the work and submit your responses. Great for differentiated instructions.
6. www.kidzone.ws An excellent worksheets site especially for Kindergarten.
7. www.teacherfiles.com has a number of free clip arts and lessons ideas.
8. www.abcteach.com has a wealth of worksheets, flashcards, geo board, and directions how to measure angles.
9. www.syudyzone.org This is a site that is suitable for Grades K-4. It contains lessons, practice pages, games, teacher resources, and related literature.
10. www.nrich.maths.org "Triangles in Circles" As children use rubber bands to make circles on the geoboard, they are seeing the center of the circle, a number of chords, and the circumference of the circle. (Most suitable for grades 2-3).
11. www.coolmath.com "The Geometry of Circles" A free site that is great for students, parents, and teachers.
12. www.mathgoodies.com On this website, student can learn about the circle at their own pace. It is great for reinforcement of concepts taught about the circle.
13. www.mathworksheets4kids.com contains a number of worksheets on how to find area and circumference of the circle.
14. www.busybeavers.com is an excellent site for Kindergarten students. On this site, students can learn about circles and different colors. It's very colorful and musical. The little kids will love it.
15. www.songsforteaching.com This site contains lyrics of a number of math songs, including "Mr R"s Song for Early Listeners." This shows a video with the circles in various forms. This may also be viewed on www.YouTube.com
16. www.sesamestreet.org Bert and Ernie sings: "It's a Circle." A great video for Kindergarten or even Grade One.

Apps Resources

1. "A Math Dictionary" is great for teachers, parents and students. There are over 250 charts and posters for many subject areas in math. Some are free, but a very reasonable subscription is available for additional materials.
2. "Learn Zillion for Students" Students can use this App to reinforce math concepts taught in class.

3. "iOrnament" This is a "Just for Fun" where students and teachers can explore a number of circular designs for fun. Students from K to Fourth Grade will enjoy this. Students who complete their math assignment early in class could be given a chance to explore this App as an incentive.
4. "Math Slash" is filled with games. There are three sections: Parents, Practice, and Games.
5. "Kidspix" Students can use this App to draw their own circles. It is used like an interactive white board.

Books

2. Henkes, Kevin. *Circle Dogs.* This book is great to introduce the circle to kindergartners. It has great   pictures and activities just for them.

3. The Holy Bible, King James Version.