

Geometer's Skethchpad 6th Grade Guide to Learning Geometry



This Guide Belongs to:

Date: _____

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-

***a story can be added or one could choose to use the activities alone and add their own fun and games to make it interesting!*

Getting Started with Sketchpad

What is Sketchpad?

Sketchpad is a computer program specially designed for drawing and manipulating geometric figures. Using Sketchpad is a fun way to learn about and experiment with geometry.

Activities in this booklet

There are 14 activities in this booklet covering a wide-range of geometric concepts. You will work with a partner to complete each activity. You and your partner will share unique jobs throughout these activities. For each activity you will be either a **Mouse Operator** or an **Activity Recorder**. At the end of each activity you will change jobs with your partner.

A lot of geometry terms are **not** described in this booklet. When you see words with which you are not familiar, you should look in your textbook to find out more about the subject. Words that you see in **bold** may be new words for you.

Using Sketchpad

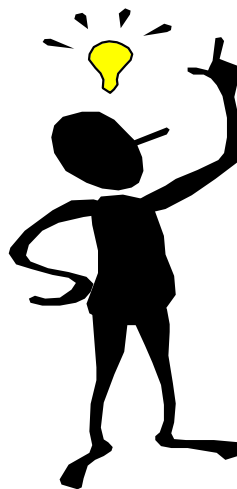
In this section, you will learn some of the basics of using Sketchpad. You will find other information about using Sketchpad in other sections of this booklet. All the information about Sketchpad you need to do the activities can be found in this booklet.

Creating a new sketch

Create a new sketch by clicking on the File menu and selecting New Sketch. A blank sketchpad will appear.

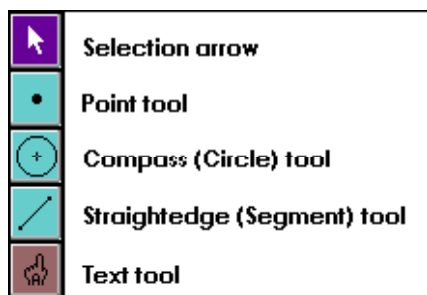
Saving a sketch

During these activities, you may want to save your work to a disk. To save a sketch, click on the File menu and select Save. You will be asked to type in a name for your file. (The name must be 8 characters or less.)



IMPORTANT: Before beginning, turn on Auto Show Labels for points and circles. To do this, click on the Display menu and select preferences. Click on the boxes beside Points and Circles if they are not already selected. Also, while in the Preferences dialog box, change the Distance Unit preference to centimeters (cm) and set the precisions to tenths.

The toolbar



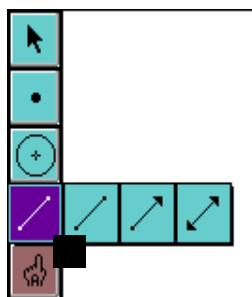
• **Selection arrow**—use this tool to click on objects to move them or resize them. Also use this tool to select (or highlight) objects.

Important: To select one or more objects at the same time, hold down the Shift key and click on all of the objects you want selected.

• **Point tool**—use to place points on your sketch.

• **Compass tool**—use to draw circles.

• **Straightedge tool**—use to draw segments, rays, and lines (you will learn more about these in Activity 1). Click and hold down the Straightedge tool to see the options for segments, rays, or lines.



• **Text tool**—use to change object labels. Click on an object to display or hide its label. Double click on a label to change it.

Clicking and dragging

Something you will be doing a lot in Sketchpad is “clicking and dragging” objects. **Click** means to position the pointer over an object and press the mouse button (and not let go) to select it. **Drag** means to then move the mouse to move the object on the sketchpad.

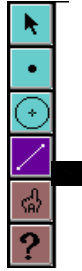
Investigating Points & Lines

How to draw a point

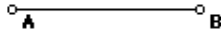
1. Select the Point tool by clicking on it in the toolbar.
2. Position the cursor where you want to place the point. Click. The point appears on your sketchpad.

How to draw a line segment

1. Select the Segment tool by clicking on it in the toolbar.



2. Click and drag the mouse across the page to draw a line segment.

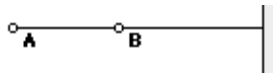


How to draw a ray

1. Click and hold the Segment tool on the toolbar. Select the Ray tool.



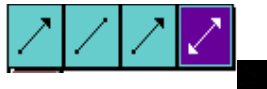
2. Click and drag the mouse across the page to draw a ray.



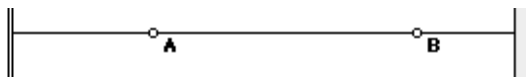
Notice how the ray starts at point A, passes through point B and extends off the sketchpad on one side.

How to draw a line

1. Click and hold the Segment tool on the toolbar. Select the Line tool.



2. Click and drag the mouse across the page to draw a line.



Notice that the line extends off the page on both sides.



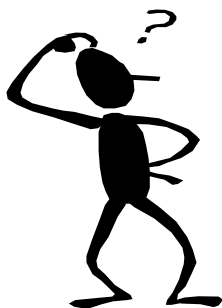
*REVIEW
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ACTIVITY 1

Determine who will be the mouse operator and who will be the recorder for this activity. Remember, you will rotate jobs.

1. Create a new sketch. To do this, click on the File menu and select New Sketch.
2. Place three points on the sketchpad. (Look back to page 3 if you need a reminder.) How many points do you think you could draw on a sketch if you tried? Explain your answer.

3. If someone were to plan a trip, they may want to plot a flight course. To do this, you need to begin by drawing the two airports that will serve as your endpoints. Open a new sketch and place two points wherever you want.



Now let's name the points. Click on the arrow tool, then double click on the letter A (next to point A). Now type in the name of the airport you will be arriving at in the place of A. Then change point B to the airport that you will leave from in the same way.

Now that you have your points, chose the line segment tool and connect these lines together. This line **segment** represents the path that your plane will fly on when going from your home airport to your final destination.

Now that you have drawn the segment, how many **endpoints** does it have?

How would you describe a line **segment** to someone that may not know what it is?

Check out your book for more information on points and endpoints.

How many **points** are on this segment that you drew? Explain.

4. Using the same sketch, place a point anywhere on the segment. Your sketch should look similar to this one:*

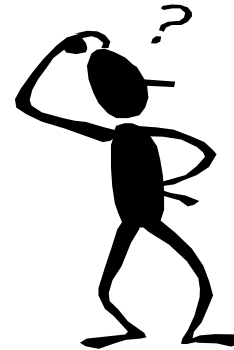


*The labels on your sketch should be different.

Now, how many segments do you see? What are the labels (names) of the segments? Explain your answer.

*Go to the File Menu and Open the file named “**Activ1.gps**”

This Map represents the path that a metro train would take from one stop to the next. In this case the train is traveling from Washington National to the Metro Center stop. If the train tracks represent segments, what do you think the stations represent?



5. Now, draw a **ray** anywhere on your sketchpad. (Look back to page 3 if you need a reminder.)

How many endpoints are on this ray? Explain your answer.

How many points are on this ray? Explain your answer.

To learn more about rays, look in your textbook!

Do you see a segment on the ray? Explain.



You know, we see examples of rays in real life everyday! Think of a flashlight. The bulb, where the light comes from is like an endpoint. Suppose we shine our flashlights into the night sky. What would the shining light be like?

To learn more about **lines** check out your textbook again.

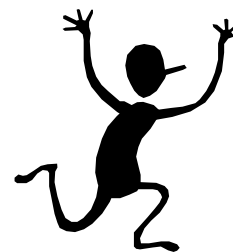
6. Draw a **line** anywhere on your sketchpad.

How many endpoints are on this line?

How many points are on this line? Explain your answer.

Do you see a segment on the line? Explain.

Save this sketch as “sketch1.gsp”

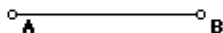


You are doing an excellent job so far. Keep up the good work!

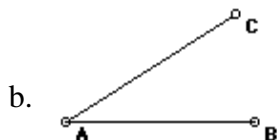
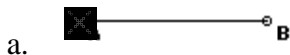
Investigating Angles

How to draw an angle

1. Select the Segment Tool by clicking on it in the toolbar.
2. Click and drag the mouse across the page to draw a line segment.

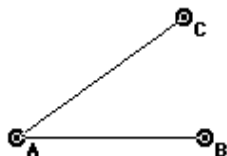


3. While the segment tool is still selected, move the mouse cursor over point A, then click the mouse button and drag to make a new line segment above the first line segment (like Figure b. below).



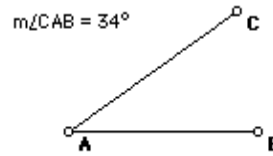
How to measure an angle

1. Click the selection arrow in the toolbar. Click on one of the endpoints (for example C or B below), then hold the Shift key down and click on the **vertex** and then the other endpoint. (You must select the vertex second.)



2. Click on the Measure menu and select Angle.

You should now see the measure of the angle in the upper left-hand corner of your sketch. Notice the way the angle is labeled. The letters should be in the same order as you selected them.



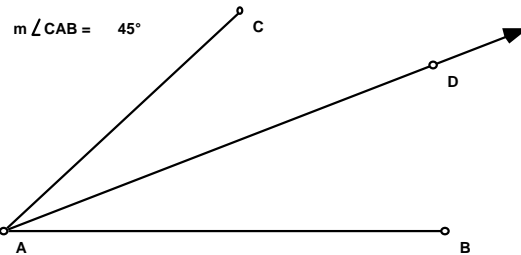
Activity 2

Meets SOL 6.16

Swap jobs with your partner. Create a new sketch.

1. Construct a 45 degree angle. Be sure to measure the angle.
2. Click on the three points (the angle side, the vertex, and the other angle side) just like you are measuring the angle.
3. Click on the **Construct** menu and select **Angle Bisector**.
4. Place and label a point on the ray.

Your sketch should look similar to this:



5. Measure each of the new smaller angles.

What is the measure of each angle?

Sum the two small angles. What do they add up to?

6. Drag the endpoint of segment CA to the left.

Sum the two smaller angles again. What do they add up to?

Ray AD **bisects** CAB. What do you think is a good definition of an angle bisector?

Investigating Special Lines and Angles

How to construct a perpendicular line

1. Construct a segment.
2. Place a point on the line.
 - a. Click the Point tool on the toolbar.
 - b. Move the mouse over the line segment and click where you would like to place the point.

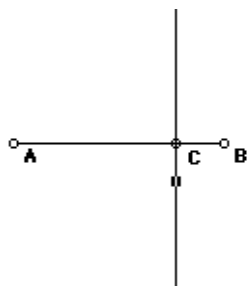


3. Click the selection arrow in the toolbar. Select the new point and the line segment by holding down the shift key and clicking both the point and the line segment.



4. Click on the Construct Menu and select Perpendicular Line.

You should now see a new line running through the point on the line segment. This new line is a perpendicular line.



Meets SOL 6.16

Activity 3

Swap jobs with your partner.

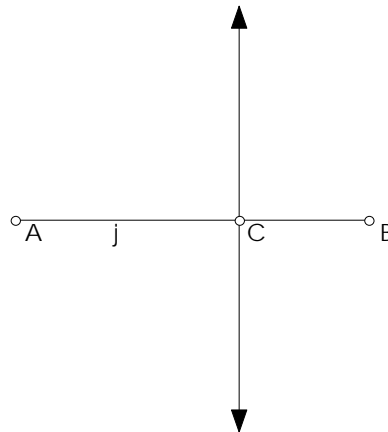
1. Construct a line segment.

Label the line segment **j**. To do this, click on the Text tool and click once on the line segment. Then double click on the label. Enter the letter **j** and press return.

2. Place a point on segment **j**. (Point C in the sketch below. Remember, your labels may be different.)

Construct a line perpendicular to segment **j** that runs through the point.

3. Your sketch should look similar to this one:



4. How many angles do you see?

5. What kind of angles do you see?

6. Measure one of the angles using the Measure menu. Write the measure below. (You will have to place more points on the line to be able to measure the angles.)

7. Measure another angle. What is its measurement?

8. What would be a good definition for **Perpendicular Lines**?

Activity 4

Meets SOL 6.13

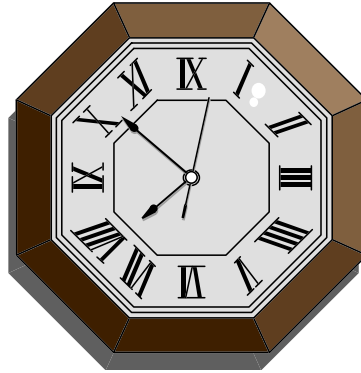
Swap jobs with your partner.

1. Open the sketch named "**Activ4.gsp**."
2. In this activity you are going to be reading clocks! From the time on the clock (represented by the angles of the hands) you can predict whether angles are acute, right, or obtuse.
3. Look at the clock in Figure 1. What time does the clock read? How big do you think the angle is? (Give approximate value as well as the name of the angle: acute, obtuse, right, or straight.)

4. Now look at the clock in Figure 2. What time does this clock read? What do you predict the angle to be now that time has passed?

5. Look at Figure 3. What time is it now? What do you predict the angle to be at this given time?

6. In order for the clock hands to form a straight angle, what time does it have to be?
-



Telling time can take on a whole new meaning when using angles!

Meets SOL 6.14

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To learn more about each of these polygons, look in your textbook.

Activity 5

Change jobs with your partner.

Open a new sketch and draw all of the polygons using the line segment tool. When finished, save the sketch as “**Sketch2.gsp**”



- Triangle
- Quadrilateral
- Pentagon
- Hexagon
- Septagon
- Octagon

*Washington D.C. is a city full of polygons. Open “**Activ7.gsp**” and look at the pictures of the Washington D.C. area. Can you identify examples of the above polygons? Please record the names of the polygons and number of sides below.*

NAME:

of sides:

A) _____

B) _____

- C) _____
- D) _____
- E) _____
- F) _____

Congratulations!! You have now completed Activity 5! You are on your way to becoming an expert in Geometry!



Activity 6

Meets SOL 6.11

Don't forget to swap jobs with your partner.

The reflecting pool, located in Washington, D.C., is found between the Lincoln Memorial and the Washington Monument. Open "Activ6.gsp". This sketch will be used to solve the following questions.

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1. Measure the length of each side of the rectangle (representing the reflecting pool) and record your answers below. (Look back to page 3 if you need a reminder.)

w = _____
 x = _____
 y = _____
 z = _____



2. What is the **perimeter** of this figure?

3. Drag point B to resize the figure. Write your new lengths for the sides.

w = _____
 x = _____
 y = _____
 z = _____

To find out more about **perimeter**, look in your book.

4. What is the new **perimeter**?

5. Check your answers by using the measure menu to measure the perimeter. Select all four points of the figure (hold down the Shift key and click on all four). Click on the Construct menu and select Polygon Interior. Click on the Measure menu and select Perimeter.

Does Sketchpad give you the same answers you came up with? If not, list the answers Sketchpad gave you.

6. What do you think would be a good definition of **perimeter**? Record your answer below.

7. Think of a situation in your home, school, or community, where you would use **perimeter** to solve a problem. Record your thoughts below:

Save the sketch as “**sketch3.gsp**”



Activity 7

Meets SOL 6.11

Swap jobs with your partner.

- In “**Activ7.gsp**” you see a map of Virginia and Maryland. Located between the two is Washington DC. What do you notice about the shape of DC? Is it similar to any polygons you know?

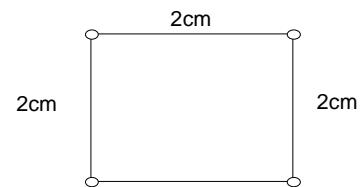
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- What is the approximate **area** of the Washington D.C., given that each side of the polygon is 6 miles?

To find out more about **area** look in your textbook.

If you didn't know the length of **one** of the sides of the square, could you still solve the problem? (*hint)

*HINT: Information given--

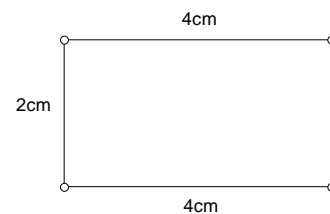


Open up “**Activ7_2.gsp**” and you will once again see the reflecting pool.

What is the **area** of the rectangle?

If you didn't know the length of one of the sides of the rectangle could you still solve the problem? (*Hint)

*Hint: information given:

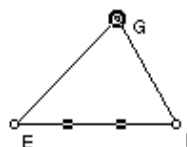


Congratulations! You are doing great!!!



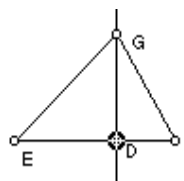
How to measure the height of a triangle

1. Select the base of the angle and the vertex opposite the base.



2. Construct a perpendicular line by clicking on the construct menu and choosing perpendicular line.

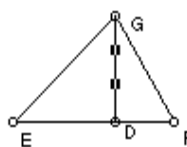
3. Place a point at the intersection of the base and the perpendicular line.



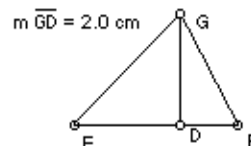
4. Click on the perpendicular line and choose Hide Line from the Display menu.

5. Select the new point on the base and the vertex opposite the base. (Remember to hold down the shift key and click on both points.)

6. Click on the Construct menu and select Segment.



7. While the new line segment is still selected (as shown above) click on the Measure menu and select Length. The length of that segment is also the height of the triangle.



Activity 8

Meets SOL 6.11

Swap jobs with your partner.

1. Open the sketch named "Activ10.gsp" and check out the triangles.
2. Measure the base and height of the Triangle in Figure 1 and record it below:

Base = _____

Height = _____

3. What is the **area** of the Triangle?

What unit of measure did you use to state your answer? Why?

4. Measure the base and height of the triangle in Figure 2.

Base = _____

Height = _____

5. What is the area of the triangle?

****Take the following steps to check your answers using the Measure Menu:**

6. Select all of the vertices of the triangle in Figure 1. Click on the Construct Menu and select Polygon Interior.

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7. Click on the Measure Menu and select Area.

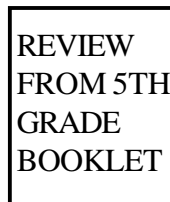
What is the measure?

8. Select the 3 vertices of the triangle in Figure 2. Click on the Construct menu and select Polygon Interior.

9. Click on the Measure menu and select Area.

What is the measure?

10. What is your definition of the area of a triangle?



1. Open the sketch called “**Activ9.gsp**”
2. Measure the **area** of the green triangle using the Measure Menu. Remember to construct the Polygon Interior first.

What is the area?

3. Drag point I back and forth.

Does the area of the triangle change?

4. Measure the area of the rectangle using the Measure Menu.

What is the area?

5. Drag the H point back and forth ?

Does the area of the rectangle change?

6. What do you notice about the relationship between the area of the green triangle and the area of the rectangle?

What do you think the area of the yellow triangle would be?
What about the area of the yellow triangle and the area of the blue triangle combined?

7. Measure the other triangle using the Measure menu to test your theory.

Did you get the results you expected? Why or why not?

8. Why do you think the formula for finding the area of a triangle is $A = \frac{1}{2}bh$?

9. The following list contains real-life situations in which either **area** or **perimeter** would be used to solve the problem. Next to each of the examples write either **P** for perimeter or **A** for area.

_____ Susie Sailor wants to carpet her living room with groovy green shag carpet.

_____ George Jungle just planted a garden for his mother. In order to keep the rabbits from eating the carrots he needs to build a fence.

_____ Bo Beavers is buying a cover for his pool. He needs to find out what size is needed.

_____ Kennedy Swoper is chalking the outside lines for the football field. He needs to know the distance around the field.

_____ Cole Riple is waxing the basketball court and needs to know how much wax to use.



Activity 10*Meets SOL 6.15*

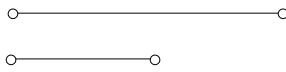
Switch jobs with your partner.

In this activity we are going to explore **Congruent and Noncongruent** figures. Here are a some examples:

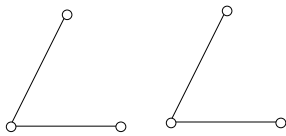
Congruent Segments



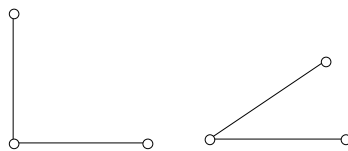
Noncongruent Segments



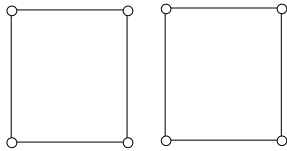
Congruent Angles



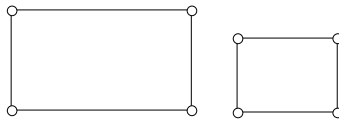
Noncongruent angles



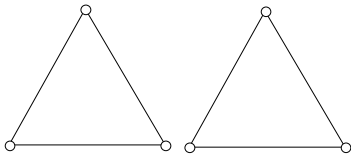
Congruent Polygons



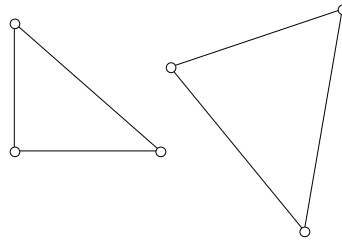
Noncongruent Polygons



Congruent Triangles



Noncongruent Triangles



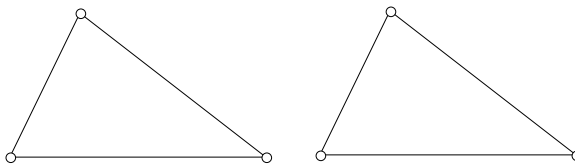
1. What do you think a good definition of **congruent** would be?

If so, what would be a good definition of **noncongruent**?

2. Open a new sketch and draw two congruent angles. Measure the angles and write their measurements below:

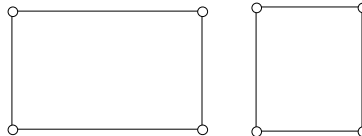
3. Now draw two congruent squares. Measure one side of the each square and write the measurements below.

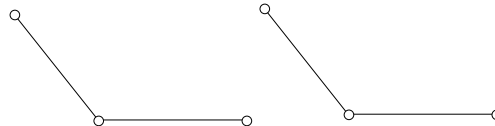
4. Look at the following sketches and label each one either "C" for **Congruent** or "N" for **Noncongruent**:

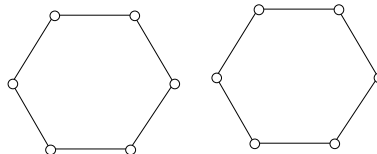


Answers:











Give yourself a big pat on the back. You are doing an excellent job.

Investigating Circles

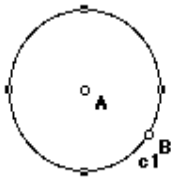
How to draw a circle

1. Click the circle tool on the toolbar.



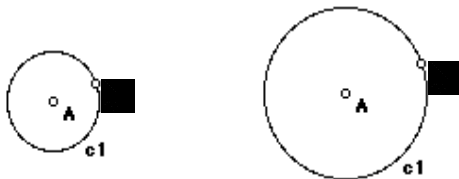
2. Click anywhere on the sketchpad and drag the mouse. You will see a circle expand around the circle tool.

Let go of the mouse when the circle is the size you want.



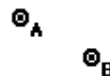
Notice the two points that you can see when you draw a circle. The point in the middle, point A above, is called the **center**.

Point B, in Sketchpad, is called the **control point**. Click and drag the control point to resize a circle.

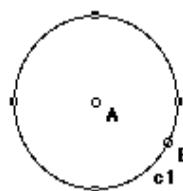


Using the Construct menu to draw a circle

1. Select two points. The first point you highlight will be the center of your circle. The second point will be your control point.

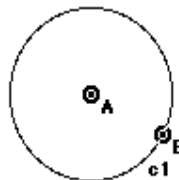


2. Choose Circle by Center + Point from the Construct menu. A circle will be constructed.



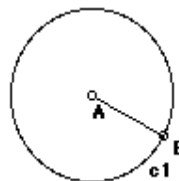
Constructing a circle's radius

1. Select the circle's center point and the control point.



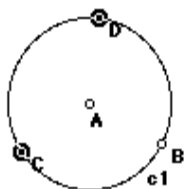
2. Click on the Construct menu and select Segment.

The new line segment is the **radius** of the circle.

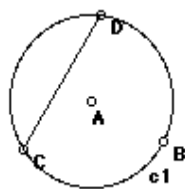


Constructing a chord of a circle

1. Place two points anywhere on the circle (not inside) and select them.



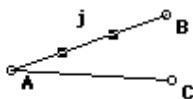
2. Click on the Construct menu and select Segment.



The new line segment is one **chord** of the circle.

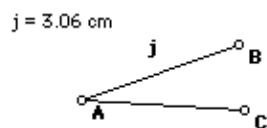
Measuring the length of a line segment

1. Click on the line segment you want to measure.



Line segment **j** is selected in the example above.

2. Click on the Measure menu and select Length. The length will appear on the sketchpad.



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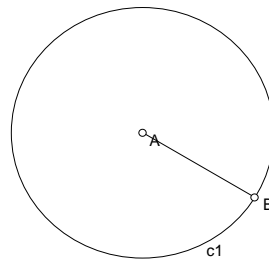


To learn more about Radius
look in your text book.

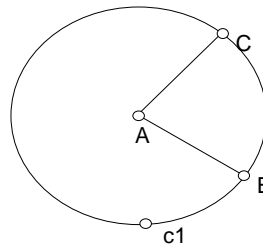
Activity 11

Part 1: Swap jobs with your partner and create a new sketch.

1. Construct a small circle.
2. Construct the circle's **radius** by drawing a segment from the center point to the control point. Your sketch should look like this:



3. Add another point on the circle, away from the control point.
4. Construct another segment to connect this new point with the center point. Your sketch should look similar to this:



Try to drag the new point. What happens?

In Sketchpad, you can only drag the center point or control point to change the size of a circle.

5. Measure the length of each segment.

What do you notice about the measures?

6. Drag the control point to change the size of the circle.

What happened to the measures?

Is the second segment you created also a radius? Why or why not?

Give your definition of a **radius** of a circle.

7. Construct a **chord** on your circle (but do not use the control point as one of the endpoints).

8. Click on one endpoint of the chord and drag it. Move the point to different places along the circle.

What happens when you drag the point of the chord?

When you move the endpoint, does the segment remain a chord? Why or why not?

To learn more about cool chords look in your text-book.

Leave your sketch open for the next activity...

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To find out more about **diameter and circumference** look in your textbook.

Activity 12

We all know that the *radius* is an important part of a circle. When you know the *radius* of a circle, you can also determine its **diameter and circumference**. Next you will measure a circle's *radius* and then use formulas to find the circle's *diameter* and *circumference*.

Swap jobs with your partner. Make sure you have the sketch from mission 4 open.

1. Click and drag the central point so that the radius of your circle is 2 cm. Using the measure of the radius in your circle and the appropriate formulas, find the following:

Radius = _____

Diameter = _____

Circumference = _____

2. Click and drag the control point to change the radius of your circle to 3 cm.. Determine the following:

Radius = _____

Diameter = _____

Circumference = _____

Formulas:

$$d = 2r$$

$$c = 2\pi r$$

Use the Measure menu to check your answers.

1. Click anywhere along the circle except on a point.
2. Click on the Construct menu and select Circle Interior.
3. While the interior of the circle is highlighted, click on the Measure menu and select Radius.
4. Click the Measure menu again and select Circumference.

5. To double-check the diameter, just multiply the radius measure by 2.
6. What measures did Sketchpad come up with?

Radius = _____

Diameter = _____

Circumference = _____

Activity 12

Meets SOL 6.12

Circumference	Diameter	Circumference/Diameter

1. Draw 5 circles, each a different size.
2. Using the measure function, measure the circumference of each circle, and place your answer in the chart above under **Circumference**.
3. Now measure the diameter, and put that in the chart under **Diameter**.
4. Using the calculator found under the Measure menu (click on Calculate), divide the circumference by the diameter.
What do you notice about the answers?

5. With the information that you get, what can you say about the relationship between Circumference and Diameter?

Congratulations! You have completed the entire booklet! Your hard work payed of-- now you can all yourself a geometery wiz!

