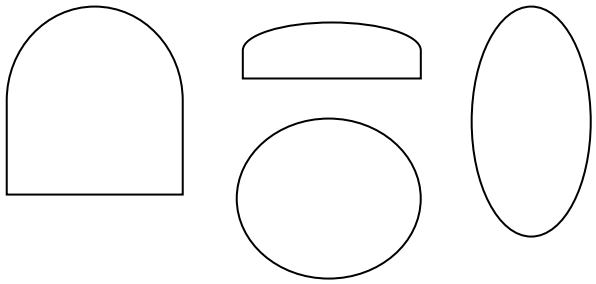
Carpentry (46.0201) T-Chart

Layout circle windows	=	Apply geometric theorems to verify properties of circles

Program Task: Layout full circle windows on plywood wall sheathing.

Program Associated Vocabulary:
DIAMETER, DIMENSION, RADIUS, CIRCLE, ELLIPSE

Program Formulas and Procedures:
Carpenters who frame houses often install windows that are the shape of half circles, full circles, quarter circles, ellipses, or segmented ovals. Carpenters use the diameter and radius dimensions to layout the rough opening and build the wall to accept the window unit.



Example: A carpenter needs to lay out a full circle window; the rough opening is 4' 3/4". To lay out the circle on the plywood wall sheathing the radius will need to be determined:

If the diameter of a circle is 48 $\frac{3}{4}$", then the radius is 24$\frac{3}{8}$".
D = 2r
48 3/4" = 2r
48 3/4" ÷ 2 = r
24 3/8" = r

Finding the center measurement of the circle window on the floor plan, the carpenter will hammer a nail at the center point. A pencil that is tied to a string line measuring 24 3/8" will be tied to the center nail. Pulling the string line snug the carpenter will draw the circular window on the plywood wall sheathing.

The radius of the circular window will always meet the jack studs, window header and rough sill at a right angle.

PA Core Standard: CC.2.3.HS.A.8

Description: Apply geometric theorems to verify properties of circles.

Math Associated Vocabulary:
RADIUS, DIAMETER, CIRCLE, CONGRUENT, CIRCUMFERENCE, AREA, VOLUME

Formulas and Procedures:
Area of a Circle: $A = \pi r^2$

Circumference of a Circle: $C = 2\pi r$

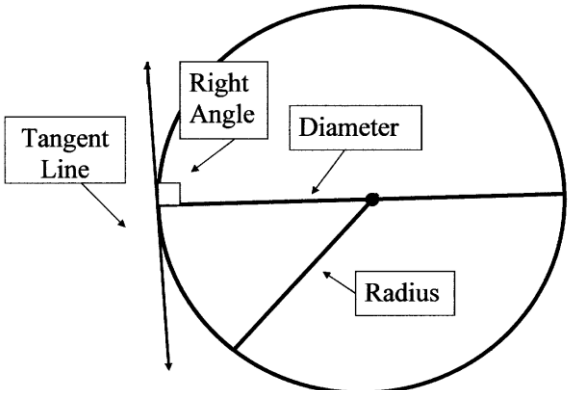
Cylinder: $SA = 2\pi r^2 + 2\pi rh$ $V = \pi r^2 h$

Sphere: $SA = 4\pi r^2$ $V = \frac{4\pi r^3}{3}$

Cone: $SA = \pi r^2 + \pi r\sqrt{r^2 + h^2}$ $V = {}^1/_3\,\pi r^2 h$

Ellipse: $A = \pi ab$

A radius always meets a tangent to the circle at a right angle and at a point that is called the point of tangency



Instructor's Script - Comparing and Contrasting
The carpentry example on page one illustrates how a carpenter uses the principles of radius and diameter to cut out an opening to install circular windows. The window header, jack studs, and rough sill form tangents to the circle and therefore form right angles with the radius to the point of contact.

Common Mistakes Made By Students
Using incorrect formula: Students may use an incorrect formula to solve a problem. To rectify these errors have the students correctly identify the type of object they are dealing with and use the appropriate formula.

CTE Instructor's Extended Discussion
Carpenters who install circle windows need to remember that the circle fits inside a standard window frame that is plumb and level. The radius of the circle will always meet the jack studs, window header and rough sill at a right angle. When laying out an elliptical or an oval window, a minor and a major radius are used for layout.

Problems	Career and Technical Math Concepts	Solutions
1. A circle window has a radius of 2' 8 ¾". The rough opening is 1" more than the diameter, what is the width of the rough opening?		
2. A contractor built a privacy fence around a round pool with a 24' diameter. The radius of the fence was 10' longer than the pool. How many feet of material did the contractor purchase?		
3. A carpenter needs to build a round table for a restaurant; he has 65 feet of flexible trim to cover the circumference of the table. What is the approximate radius of the table?		
Problems	**Related, Generic Math Concepts**	**Solutions**
4. What must the radius of a cylinder whose height is 3 inches be if the cylinder is to hold 35 $in.^3$ of fluid?		
5. A family would like to build a fence in their backyard for a riding ring for their horse. How much fence should they buy if the ring covers ½ an acre of land? (1 acre = 4840 $yards^2$)		
6. A family has 75 feet of fencing to fence in their circular garden. What is the approximate radius of the garden?		
Problems	**PA Core Math Look**	**Solutions**
7. Find the radius of a circle whose circumference is 20'.		
8. Find the radius of a circle whose area is 45$in.^2$.		
9. Find the height of a cylinder whose volume is 300 $ft.^2$ and whose radius is 6 ft.		

Problems	Career and Technical Math Concepts	Solutions
1. A circle window has a radius of 2' 8 ¾". The rough opening is 1" more than the diameter, what is the width of the rough opening?		$D = 2r \longrightarrow D = (2)(32\ 3/4") \longrightarrow D = 65\ ½"$ Rough opening = 65 ½" + 1" = 66 ½" x 66 ½"
2. A contractor built a privacy fence around a round pool with a 24' diameter. The radius of the fence was 10' longer than the pool. How many feet of material did the contractor purchase?		Radius of privacy fence circle = (½ the pool diameter ÷ 2) + 10 $C = 2\pi r \rightarrow C = 2\pi(22) \rightarrow = C = 138.23'$ The contractor had to purchase at least 139' of fencing.
3. A carpenter needs to build a round table for a restaurant; he has 65 feet of flexible trim to cover the circumference of the table. What is the approximate radius of the table?		$C = 2\pi r \rightarrow 65 = 2\pi r \rightarrow \left(\frac{65}{(2\pi)}\right) = r \rightarrow r \approx 10.35$ feet The radius is approximately 10.35 feet.
Problems	**Related, Generic Math Concepts**	**Solutions**
4. What must the radius of a cylinder whose height is 3 inches be if the cylinder is to hold 35 in.^{3} of fluid?		$v = \pi r^2 h \quad 35 = \pi r^2 3 \quad \frac{35}{3\pi} = r^2 \quad r = \sqrt{\frac{35}{3\pi}} \approx 1.93$ inches The radius of the cylinder must be about 1.93 inches.
5. A family would like to build a fence in their backyard for a riding ring for their horse. How much fence should they buy if the ring covers ½ an acre of land? (1 acre = 4840 yards^2)		½ acre = 2420 yds.^{2} $2420 = \pi r^2 \quad r = \sqrt{\frac{2420}{\pi}} \quad r \approx 27.75$ yds. $C = 2\pi r \quad C = 2\pi(27.75) \quad C = 174.36$ yds. They should buy about 175 yards of fencing.
6. A family has 75 feet of fencing to fence in their circular garden. What is the approximate radius of the garden?		$C = 2\pi r \quad 75 = 2\pi r \quad r = \frac{75}{(2\pi)} \quad r \approx 11.94$ feet The radius is approximately 11.94 feet.
Problems	**PA Core Math Look**	**Solutions**
7. Find the radius of a circle whose circumference is 20'.		$C = 2\pi r \quad 20 = 2\pi r \quad r = \frac{20}{(2\pi)} \quad r \approx 3.18$ feet
8. Find the radius of a circle whose area is 45 in.^{2}.		$A = \pi r^2 \quad 45 = \pi r^2 \quad r = \sqrt{\frac{45}{\pi}} \quad r \approx 3.78$ inches
9. Find the height of a cylinder whose volume is 300 ft.^{3} and whose radius is 6 ft.		$V = \pi r^2 h \quad 300 = \pi 6^2 h \quad 300 = 36\pi h \quad \frac{300}{(36\pi)} = h$ $h \approx 2.65$ feet