MBF 3C Unit 9 – Geometry – Outline

Day	Lesson Title	Specific Expectations
1	Real-Life applications of geometric shapes and figures	C1.1
2	Imperial and Metric systems of Measurement	C1.3
3	Representing 3-D figures using orthographic and isometric methods	C1.2
4	Representing 3-D figures using scale models	C1.2
5	Representing 3-D figures using a net, pattern or plan	C1.3
6	Creating plans	C1.3
7	Creating an individual design problem	C1.4
8	Group Design Challenge	C1.4
9	Review Day	
10	Test Day	
TOTAL DAYS:		10

C1.1 – identify real-world applications of geometric shapes and figures, through investigation (e.g., by importing digital photos into dynamic geometry software), in a variety of contexts (e.g., product design, architecture, fashion), and explain these applications (e.g., one reason that sewer covers are round is to prevent them from falling into the sewer during removal and replacement) (Sample problem: Explain why rectangular prisms are used for packaging many products.);

C1.2 – represent three-dimensional objects, using concrete materials and design or drawing software, in a variety of ways (e.g., orthographic projections [i.e., front, side, and top views]; perspective isometric drawings; scale models);

C1.3 – create nets, plans, and patterns from physical models arising from a variety of real-world applications (e.g., fashion design; interior decorating; building construction), by applying the metric and imperial systems and using design or drawing software;

C1.4 – solve design problems that satisfy given constraints (e.g., design a rectangular berm that would contain all the oil that could leak from a cylindrical storage tank of a given height and radius), using physical models (e.g., built from popsicle sticks, cardboard, duct tape) or drawings (e.g., made using design or drawing software), and state any assumptions made
(Sample problem: Design and construct a model boat that can carry the most pennies, using one sheet of 8.5 in x 11 in card stock, no more than five popsicle sticks, and some adhesive tape or glue.).

Unit 9 Day 1: Geometry			**MBF 3C**
	Description This lesson examines real life applications of geometric shapes and figures.		Materials -BLM 9.1.1 -3 ½" floppy disk BLM 9.1.2
		Assessment Opportunities	
Minds On…	**Whole Class →Discussion** - Where do we see geometry in the real world? -Lead the discussion into geometry in the classroom as well as in the areas of architecture, art, fashion, engineering, etc. - Why are certain geometric shapes important in the real world? -Lead the discussion into structure, appearance, function, etc.		Note to Teachers: some technology resources include auto cad and TABS
Action!	**Whole Class →Investigation** Work through BLM 9.1.1 as a class. Have students try to answer questions on their own, then discuss with a partner, and then share the ideas and discuss as a class. Answers may vary in terms of the uses of geometry in the different situations. Students should be able to identify different ways and by the end of the discussion have an overall sense of the place of geometry in the design of objects. **Challenge Problems** -Present the class with a 3 ½" computer floppy disk. What is the geometric shape involved? How could this shape cause problems? What has been considered in the design to avoid this problem. -Students should realize that it is a rectangular prism. It seems at first glance to be the same dimensions on all sides which could cause problems with inserting it incorrectly. But with further measurement or testing in a computer, the students can conclude that the shape was actually designed to only fit one way. -Present the students with the idea of a round sewer cover. Why was this shape used? Why not a square or a triangle? -Students should come to conclude that the circular shape prevents the cover from ever falling through, while with different shapes such as squares and triangles, the shape can be rotated and fall through.		
Consolidate Debrief	**Whole Class → Discussion** Aside from geometry, what other things need to be considered in the design of an object? -Lead the discussion into materials, measurements, plans, functionality, etc. Some of these will be the basis for the rest of this unit		(A possible extension is the investigation of the Golden Ratio and how it relates geometry in nature)
Application *Concept Practice*	**Home Activity or Further Classroom Consolidation** BLM 9.1.2		

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BLM 9.1.1

Name: ____________________
Date: ____________________

Applications of Geometry

Geometry is the foundation behind the design of many real world things. How geometry is considered in designing something can affect what the object looks like and how it works. Geometry can be seen in a variety of different contexts. We are going to look at some of these contexts in this activity.

Look at the main object in the two following pictures. Identify as many geometric shapes as you can in these objects. List them below.

Now think of the *advantages* of the geometric shapes that you identified. Identify at least one way that the geometric shape in the object affects how the object looks and how the object works.

	Geometric shape and how it effects how it looks	**Geometric shape and how it effects how it works**
Car		
Farm		

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BLM 9.1.1

Name: ____________________
Date: ____________________

Applications of Geometry (continued)

A few specific areas in which we see geometry are in architecture, fashion, product design. In all of these categories, geometry can affect both how the object looks and works.

Geometry in architecture:

Example: The Eiffel Tower in Paris

-What is the repeated shape?

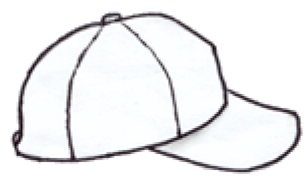
-How might the use of these repeated shapes affect the structure?

-How do these shapes affect the appearance?

Geometry in fashion:

Example: A baseball cap

-What is the primary geometric shape?



-How is this shape useful?

-How does the shape affect the appearance?

Geometry in product design:

Example: A box of cereal

-What is the primary shape?

-How is this shape useful for this product?

-How does the shape affect the appearance?

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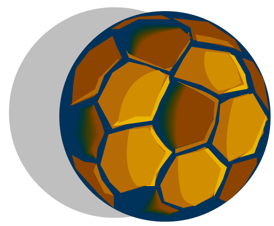
BLM 9.1.2

Shapes

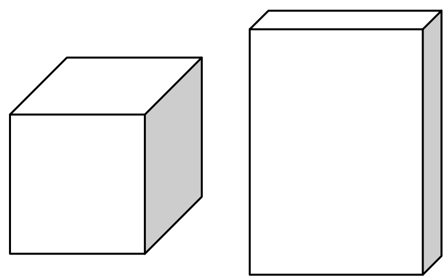
Name:
Date:

1. List all of the geometric shapes found in this object.

2. Identify two geometric shapes in this object and describe how each of these shapes effect how the object works and/or looks.



3. The two shapes shown are being considered for the packaging of a new cereal. They both have the same volume, meaning they will hold the same amount of cereal. Discuss why one of the two shapes may be a better choice for packaging and why.



4. Pick an object of your choice and write a paragraph to explain how geometry was used in the design of the object.

Answers:

1. Rectangle (house, door, chimney), trapezoid (roof), pentagon (upper windows), squares (lower windows), circle (door handle and top of trees)
2. Sphere – shape allows for the ball to roll, Pentagon – repeated pattern fits together to form structure and gives consistent appearance.
3. The rectangular prism on the right is better. Athough it holds the same amount, it looks larger and the customer might think there is more cereal. Also, there is greater surface area on the front for the logo and other information to stand out.

4. Answers will vary.

Unit 9 Day 2: Geometry		**MBF 3C**
	Description This lesson reviews the uses of the imperial and metric systems of measurement.	Materials -BLM 9.2.1 and 9.2.2. -Various rulers and objects to measure
		Assessment Opportunities
Minds On…	**<u>Whole Class → Discussion</u>** Ask the students to approximate the following measurement by showing with their hands or describing: -A foot, metre, litre, millimetre, etc. Ask the students what unit of measurement they would use for the following things: -A football field, cereal box, classroom, piece of wood used in building, etc. Do the following measurements make sense? Discuss them in terms of size of the unit of measurement and common uses of the system of measurement. -The length of a pen in miles? -The volume of water in a pool in millilitres? -The height of a wall in metres?	
Action!	**<u>Whole Class → Investigation</u>** -In design, we come across a variety of objects. The measurement of different objects is best suited by different units of measurement. There are two main systems of measurement that we use: the metric system and the imperial system. We must be able to understand the use of both systems and how to compare the two systems as both are used for different common tasks. -Give students BLM 9.2.1. Complete the handout and examples as a class on the board or overhead.	
Consolidate Debrief	**<u>Small Group → Activity</u>** Provide the students with 3 or 4 objects in the classroom to measure. Using metre sticks and rulers with inches and cm, have them measure these objects using the most appropriate imperial and metric unit of measurement. -Compare and discuss the results as a class. Reinforce any issues relating to measurement.	
Application *Concept Practice*	**Home Activity or Further Classroom Consolidation** BLM 9.2.2	

MBF 3C
BLM 9.2.1

Name: ___________________
Date: ____________________

Applying the Metric and Imperial Systems of Measurement

Systems of measurement are used to measure the length, volume, mass or temperature of an object.

The Metric System

Canada and most other countries of the world use the *metric* system of measurement.

Using the metric system, fill in the main unit of measure for each category:

Length ___________________________
Volume___________________________
Mass______________________________
Temperature________________________

Some of the commonly used units and conversions in the metric system are as follows:

Length	**Volume**	**Mass**
10 mm = 1 cm	1000 mL = 1 L	1000 g = 1 kg
100 cm = 1 m		1000 kg = 1 t
1000 m = 1 km		

1. If a wall is measured to be 450 cm long, what is the measurement in metres (m)?

2. If a container has a volume of 2.6 L, what is the volume in millilitres (mL) ?

3. Consider the following examples of objects that could be measured. *Match the examples* with the most appropriate unit of measurement by drawing lines between them.

Column A	**Column B**
Volume of a cooler	170 cm
Mass of an average person	22º C
Temperature inside a room	10 mm
Thickness of a magazine	75 Kg
Height of an average person	20 L
Distance around a running track	400 m

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BLM 9.2.1

Name: ____________________
Date: _____________________

Applying the Metric and Imperial Systems of Measurement

The Imperial System

Some other countries, particularly the United States, use a different system of measurement called the i*mperial* system. Although it is not recognized as Canada's main system of measurement, why is it still important for us to be able to understand and work with the imperial system?

In the case of the imperial system, fill in at least one example of a unit of measure for each category:

Length ___________________________
Volume___________________________
Mass______________________________
Temperature________________________

Some of the commonly used units and conversions in the imperial system are as follows:

Length	**Volume**	**Mass**
12 inches = 1 foot	16 fluid ounces = 1 pint	16 ounces = 1 pound
3 feet = 1 yard	2 pints = 1 quart	2000 pounds = 1 ton (US)
1760 yards = 1 mile	8 pints = 1 gallon	

4. If a wall is measured to be 144 inches long, what is the measurement in feet?

5. If a container has a volume of 6 quarts, what is the volume in pints?

Name: ____________________
Date: _____________________

Applying the Metric and Imperial Systems of Measurement

6. Consider the following examples of objects that could be measured. Match the examples with the most appropriate unit of measurement by drawing lines between them.

Column A	**Column B**
Volume of a cooler	½ in. (inches)
Mass of an average person	5'10" (5 feet, 10 inches)
Temperature inside a room	5 gal (gallons)
Thickness of a magazine	175 lb. (pounds)
Height of an average person	200 yd. (yards)
Distance around a running track	72º F

Converting between the Metric and Imperial Systems

The following are approximate conversions between commonly used metric and imperial measurements:

Length	**Volume**	**Mass**
30.48 cm = 1 foot	29.574 mL = 1 fluid ounce	28.35 g = 1 ounce
2.54 cm = 1 inch	0.473 L = 1 pint	0.454 kg = 1 pound
1.6 km = 1 mile	3.785 L = 1 gallon	0.907 t = 1 ton (US)

7. If a wall is measured to be 14 feet long, what is the measurement in cm?

8. If a container has a volume of 4 L, what is the volume in gallons?

MBF 3C
BLM 9.2.1

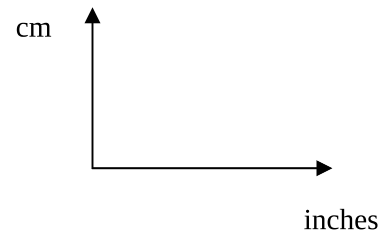
Name: ____________________
Date: ______________________

Applying the Metric and Imperial Systems of Measurement

9. In the following questions you will be creating a conversion chart, and then graphing your data.

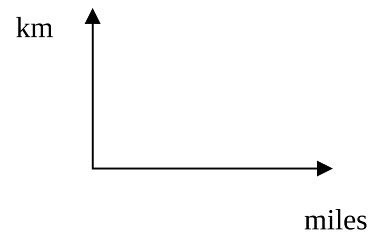
a) Inches to Centimetres (1 inch = 2.54 cm)

Inches	1	2	3			
cm				12.7	17.78	127



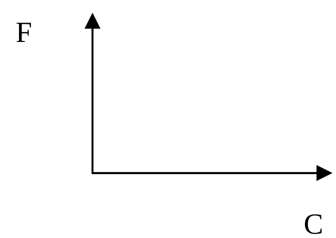
b) Miles to Kilometres (1 mile = 1.6km)

Miles	1	2	3			
km				10	20	30



c) Farenheit to Celcius ($c = \frac{9}{5}F + 32$)

F	0		100			
Celcius		0		20	26	37.4



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BLM 9.2.2

Name:
Date:

Conversions

1. Convert the following metric measures:
   a) 2400 m = _______________ km
   b) 34 cm = ________________ mm
   c) 5 L = _________________ mL
   d) 3200 g = ________________ kg

2. Convert the following imperial measures:
   a) 4 pounds = _________________ ounces
   b) 6.5 quarts = __________________ pints
   c) 42 inches = __________________ feet
   d) 3 miles = ___________________ yards

3. Convert the following metric and imperial measures:
   a) 36 inches = __________________ cm
   b) 40 km = ____________________ miles
   c) 10 gallon = __________________ L
   d) 140 g = ___________________ ounce

4. Estimate the following measures using an appropriate unit of measure:
   a) the length of your foot
   b) the volume of a carton of milk
   c) the height of the classroom
   d) the width of your thumbnail

5. Jesse needs to order flooring for his room. He measured the dimensions of the room to be 300 cm by 375 cm. However, the flooring company needs to know these dimensions in feet. Find the dimensions of the room in feet.

Answers:

1. a) 2.4 km b) 340 mm c) 5000 mL d) 3.2 kg
2. a) 64 ounces b) 13 pints c) 3.5 feet d) 5280 yards
3. a) 91.44 cm b) 24.9 miles c) 37.85 L d) 4.94 ounces
4. a) 20 cm (will vary) b) 1 L (will vary) c) 10 feet (will vary) d) 15 mm (will vary)
5. 10 feet by 12.5 feet

Unit 9 Day 3: Geometry			**MBF 3C**
	Description This lesson introduces how to represent 3-D figures using orthographic and isometric drawings.		Materials -BLM 9.3.1 and 9.3.2 -Isometric paper -Graph paper
		Assessment Opportunities	
Minds On…	**Individual → Skectching** Present the students with a real life 3-D object (e.g., a chair, a desk). Ask them to sketch a drawing of the object. Have students share their sketches with the class. -Were the drawings similar? -How many different ways could we represent the object? **Whole Class → Discussion** -Why must 3-D figures be represented in 2-D form? -Have the students brainstorm different ways that 3-D figures could be represented in drawings. -When or where have you seen such different ways? -When are certain ways more beneficial? -Why do you need to have different ways to represent 3-D figures?		
Action!	**Whole Class → Investigation** We are going to look at different ways to represent 3-D objects over the next few days. The first ways that we will look at today involve drawing the 3-D object in 2-D form. Some of these drawings should be done on paper and some on the computer with design or drawing software. The three ways of representing 3-D objects that will be looked at today are: isometric drawings, perspective isometric drawings, and orthographic drawings. Provide students with BLM 9.3.1. Have them complete the activity individually or as a class. **Part 2:** Create an isometric drawing on isometric dot paper on the overhead and ask the students to draw the corresponding orthographic drawing on their own graph paper. Compare the results. Then switch and present them with an orthographic drawing and have them draw the isometric drawing. Continue as needed. Have the students create either an isometric drawing or an orthographic drawing of an object. Ask them to switch drawings with a partner and ask the partner to try to make the other version of the drawing. Pairs can present their drawings to the class and discuss whether the views match up.		
Consolidate Debrief	**Individual →Writing** Have the students write a note to a friend who may have missed the class and outline the important concepts that were covered.		
Application	**Home Activity or Further Classroom Consolidation** BLM 9.3.2		

MBF 3C
BLM 9.3.1

Name: ___________
Date: ___________

Isometric and Orthographic Drawings

Consider a rectangular prism with these dimensions: 3m (length) x 2m (width) x 1m (height)

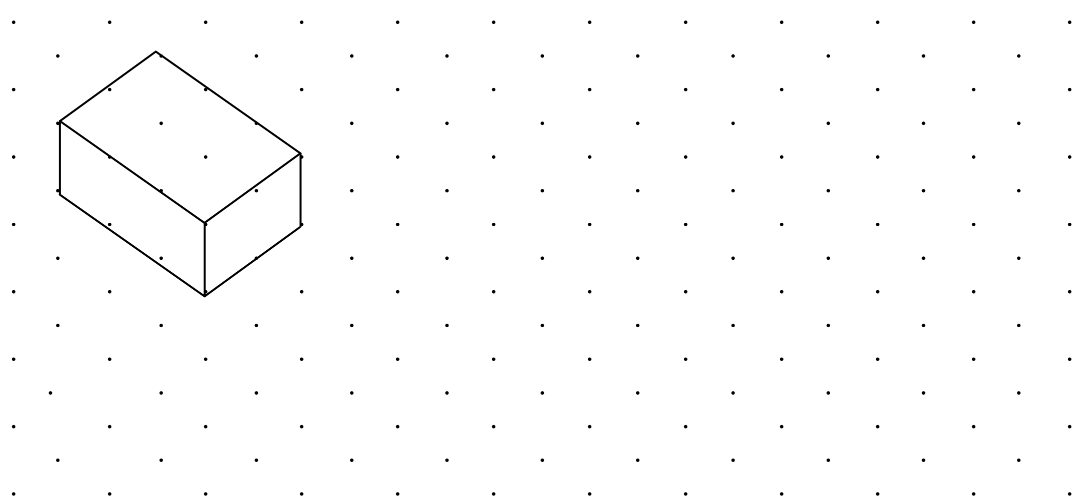
Sketch a drawing of this figure. Compare your drawing with someone next to you. How do they compare?

We are going to investigate three possible ways to accurately represent this figure.

1. Isometric Drawing

An isometric drawing is a 2-D representation of a 3-D figure. The drawing looks like the 3-D figure has been rotated to a corner view so that you can see the top, front, and right side of the figure on an angle.

This is what the given rectangular prism would look like as an isometric drawing with a scale of 1 unit = 1 metre. The scale must always be stated, or the dimensions should be shown on the drawing.



To create an isometric drawing, draw the edges of the sides of the object along the angled lines. Each segment of a line is related to one unit of measurement.

Draw an isometric drawing of a rectangular prism that is 2m x 4m x 5m in the space above.

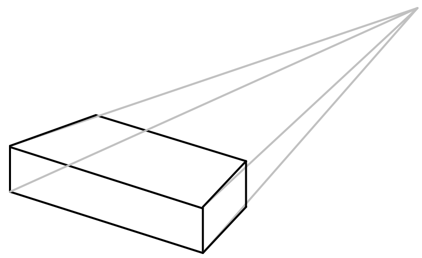
Name: ___________
Date: ___________

Isometric and Orthographic Drawings

2. Isometric Perspective Drawing

An isometric perspective drawing is another way to represent a 3-D figure in a 2-D drawing. It is similar to an isometric drawing, but all of the parallel sides of the figure are slanted off to a point to make the object look more realistic.

This is what the rectangular prism would look like as a perspective isometric drawing.



To create an isometric perspective drawing, draw the front view of the object as you would with an isometric drawing. Then pick a point away from the object and angle all other lines towards this point.

Try drawing the 2m x 4m x 5m rectangular prism in this way in the space below.

MBF 3C
BLM 9.3.1

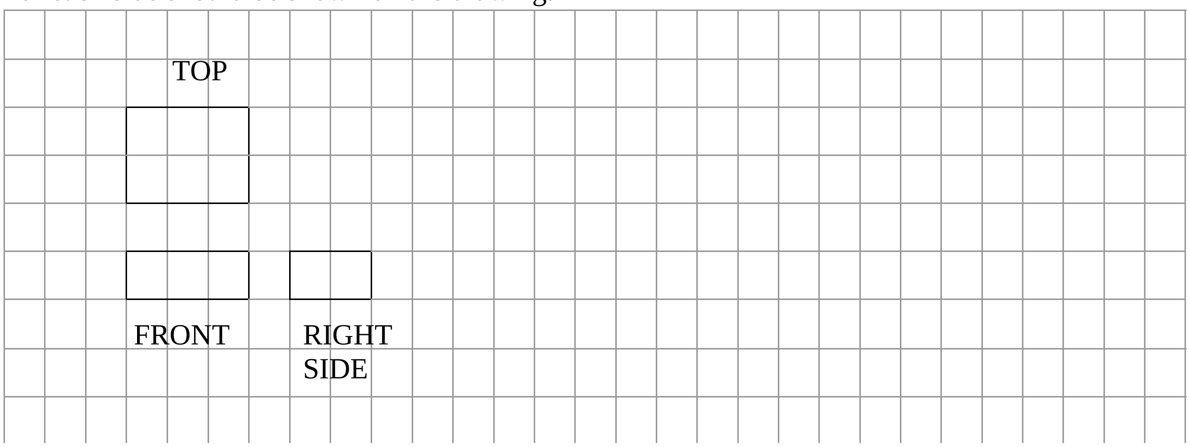
Name: ___________
Date: ___________

Isometric and Orthographic Drawings

3. Orthographic Drawing

An orthographic drawing gives a 2-D representation of a 3-D object by displaying what it looks like when viewed directly from the top, front, and right side.

This is what the rectangular prism would look like in an orthographic drawing. It is drawn on graph paper with a scale of 1 unit = 1 metre. The scale must always be stated, or the dimensions of each side should be shown on the drawing.



To create an orthographic drawing, you need to complete an individual scale drawing of each of the top, front and right views. These three views then must be oriented to that you can see which edges line up, as shown in the example above.

Try to draw the 2m x 4m x 5m rectangular prism this way in the space above.

MBF 3C

Isometric Paper

MBF3C
BLM 9.3.2

Drawings

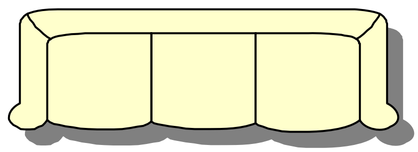
Name:
Date:

1. Draw a rectangular prism with dimensions 3m x 2m x 5m in the following forms:
   a) Isometric
   b) Isometric perspective
   c) Orthographic

2. Draw an isometric drawing of a 30cm x 30cm x 30cm cube with a scale of 1 unit = 3cm.

3. Draw an isometric drawing and orthographic drawing of a large rectangular prism with a smaller rectangular prism sitting on top. State the scale used.

4. The figure shown is the top view of a couch. Sketch the front and side view of the couch.



5. Complete the following drawings for a piece of furniture in your home of your choice (i.e., a table). State the scale.
   a) Isometric
   b) Isometric perspective
   c) Orthographic

Solutions: the completed drawings as described above.

Unit 9 Day 4: Geometry		MBF 3C
	Description This lesson demonstrates how to represent 3-D figures using scale models.	Materials -cube shaped building blocks (dice could work) -metre sticks and rulers -various materials for scale models (cardstock, popsicle sticks, anything!)
		Assessment Opportunities
Minds On…	**Partners → Activity** Present the students with a simple isometric drawing and/or orthographic drawing based on a shape that can be built from cubes (i.e., cubes stacked together to make a composite figure). -What does the figure look like that the drawings represent? -Have the students try to build the figure using cube shaped building blocks. Repeat the activity with a few different isometric and orthographic drawings. What we have just created using the blocks is a scale model. A scale model is yet another way to represent a 3-D figure.	
Action!	**Partners → Activity** Make a scale model of the classroom as a class. Begin by brainstorming all of the information that is needed to create a scale model. For example, the dimensions of the floor, walls, windows, desks, etc. Assign groups of students to measure the various parts of the room that were decided on. List all of the parts and the measurements on the board. Now brainstorm the materials needed to make a scale model. What could be used? What do we have access to? Decide on a reasonable scale for the scale model Assign members of the class to create parts of the scale model and assemble it. Discuss the main points, issues, difficulties when complete.	
Consolidate Debrief	**Whole Class → Discussion** Ask students to describe the steps that would be required to create a scale model of their textbook.	
Application	**Home Activity or Further Classroom Consolidation** Complete textbook scale model.	

Unit 9 Day 5: Geometry				MBF 3C
		Description This lesson investigates representing a 3-D figure using a net, pattern, or plan.		**Materials** -cardstock -tape BLM 9.5.1 and 9.5.2
				Assessment Opportunities
	Minds On…	**<u>Pairs → Activity</u>** Give students a piece of paper or cardstock. Ask them to make a small box to hold pencils and pens. Encourage them to construct it however they wish! **<u>Whole Class → Discussion</u>** What different methods to make the box did people use? Point out examples of nets and patterns in the different boxes. A net is results when a single piece is folded up to create the object. A pattern results when multiple pieces are joined with seams to create the object. Brainstorm examples of nets and patterns in real life. (clothing patterns, a folded-out cardboard box, etc.)		
	Action!	**<u>Small Groups → Investigation</u>** -So far, we have looked at ways to draw 3-D figures in a variety of ways and how to build scale models of 3-D figures. Now we are going to look at how to make a flat, 2-D representation of a 3-D figure. This involves creating a net or a pattern. Note that nets and patterns should be drawn by hand and on the computer. -Give students BLM 9.5.1. Have them complete the handout in small groups. **Activity** -Put the students into groups or pairs. Assign a different 3-D figure to each group (i.e., a cube, triangular prism, pyramid, etc.) Have each group construct their figure twice: once by creating a net of the shape and then folding it up and securing it, the other by creating a pattern of the shape and joining all of the pieces. -Have the students display their figures in the class!		
	Consolidate Debrief	**<u>Whole Class → Discussion</u>** Have the students think about and justify how they know a given net would be a particular 3-D figure when constructed.		
Application Concept Practice		**Home Activity or Further Classroom Consolidation** BLM 9.5.2		

MBF 3C
BLM 9.5.1

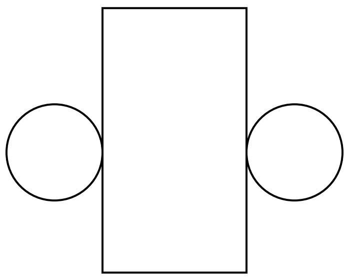
Name: _____________
Date:

Creating Nets and Patterns

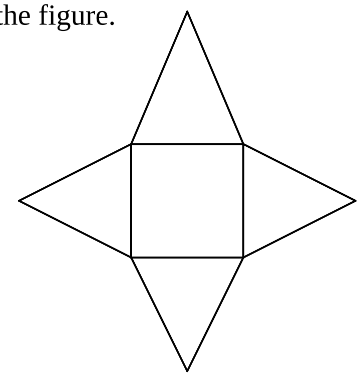
1. Nets

A net is a 2-D representation of a 3-D figure that results when the figure is unfolded. When unfolded, the original figure becomes a flat shape where all of the edges meet to keep the net as one piece.

One example of a net arises from "unfolding" a soup can. If you flipped up the two circular tops and then cut down the side and flattened it out, this would be the resulting net:



Given the following net, think of what it would form if it was folded up into a 3-D figure. Sketch the figure.



Determine another example of a net. Name the figure and then draw the corresponding net in the space below.

MBF 3C
BLM 9.5.1

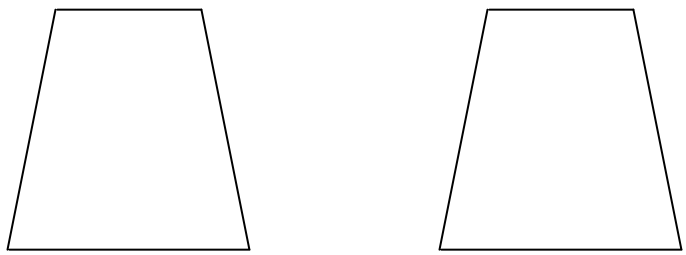
Name: _____________
Date:

Creating Nets and Patterns

2. Patterns

A pattern is another 2-D representation of a 3-D figure. It results when the figure is separated into two or more individual shapes.

One example of a pattern arises when you take a piece of clothing apart at the seams. Consider a basic skirt. If you were to separate it into different pieces, this would be the resulting pattern, representing the front and the back:



In patterns, you often have to account for seams, or flaps, that allow for the separate pieces to be attached together. Where would the seams have to be in the above example?

Determine another example of a pattern. Name the figure and then draw the corresponding net in the space below.

MBF 3C
BLM 9.5.1

Name: ______________
Date:

Creating Nets and Patterns

3. Nets vs. Patterns

Consider a basic cereal box. Sketch a net for the cereal box on graph paper. Sketch a pattern for the cereal box on graph paper. Include approximate dimensions and scales.

Does a net or a pattern make more sense in this situation?

MBF3C
BLM 9.5.2

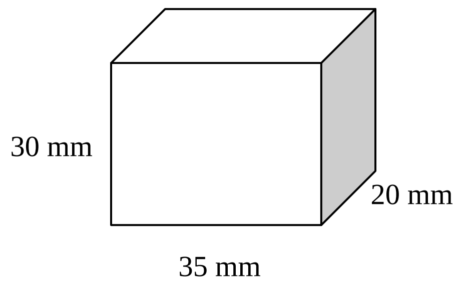
Nets

Name:
Date:

1. Draw the net of the following objects using appropriate scales on graph paper.

   a) a triangular prism with triangle side lengths 10cm and prism height 30cm.

   b)



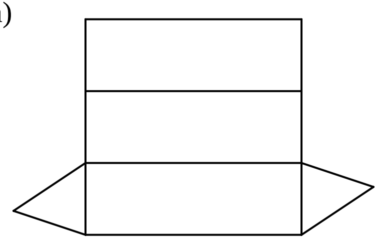
2. Create a pattern for a cube with all dimensions 5 cm. Allow for flaps to join the parts together. Assemble the pattern to form the cube.

3. How would the net of a box with a closed top differ from the net of the same box with an open top? Sketch the net for each case to demonstrate the difference.

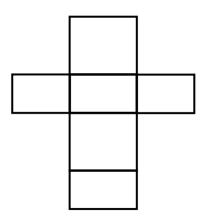
4. Draw a net that may appear to fold up into a closed 3-D object, but really does not. Explain why it does not create a closed object.

Answers:

1. a)



b)



3. A closed box would look similar to 1b). An open box would have one less square to represent one less side. Any of the squares on the top or bottom or two outsides could be removed.

4. Results will vary. It could be a net that looks like those above, but with dimensions on the edges that do not allow the sides to match up.

Unit 9 Day 6: Geometry		MBF 3C
	Description This lesson examines creating plans.	Materials -House/Homes section of newspaper -Graph paper
		Assessment Opportunities
Minds On…	**Whole Class → Discussion** Present students with house layouts/plans from a newspaper. Have them look at the plan and determine all of the information that they can get from the plan. Have them share this information Where else do we see plans? Why is an accurate plan important, just as an accurate net or drawing is important? -Lead the discussion into accuracy for producing the plan, cost associated with errors, etc.	
Action!	**Whole Class → Activity** A plan is a set of orthographic view used to describe an object to specific dimensions. Plans, or layouts, are used so that one can construct something to specific dimensions. Choose one plan from the newspaper. As a class, reproduce the plan on graph paper. Make sure the plan is to scale. Discuss importance of accuracy. Choose an object in the classroom. Have the students individually create a plan for the object. Again, stress the importance of accuracy, scale, units of measurement, etc. Compare the plans as a class to ensure all aspects of a plan are considered.	
Consolidate Debrief	**Pairs →Brainstorm** Have students brainstorm about what would be needed to create their own plan for their dream bedroom.	
Application	**Home Activity or Further Classroom Consolidation** Students can complete their dream bedroom plan.	

Unit 9 Day 7: Geometry		MBF 3C
	Description This lesson involves combining the ideas of the unit into an individual design problem.	Materials -isometric paper -graph paper -materials for scale models -rulers
		Assessment Opportunities
Minds On…	**Whole Class → Discussion** What is design? What components of design have we looked at so far in this unit? What other factors are involved in design? Today we will combine different aspects of this unit and solve a design problem. Everyone will be presented with the same problem, but everyone could possibly end up with a different solution.	
Action!	**Pairs →Design Problem** Design a container that will hold 24 cans of vegetables. Each of these cans is a cylinder with radius 8cm and height 12cm. The cans may be arranged in any way. Ask the students to come up with their own unique solution to this design problem. The students must include an isometric drawing, an orthographic drawing, and a scale model comprised of a net or pattern; any calculations; a description of why they chose this design and the advantages of it. They should treat the drawings as though someone needs to reproduce the design and write as though they are trying to sell the design. **Discussion** -Have the students "sell" their design to the class.	
Consolidate Debrief	**Whole Class → Discussion** What aspects of geometry would help or hinder the packaging companies?	
Application	**Home Activity or Further Classroom Consolidation** Complete and refine design challenge.	

Unit 9 Day 8: Geometry				MBF 3C
		Description This lesson involves a group design challenge.		Materials -pennies -cardstock -popsicle sticks -glue and tape
				Assessment Opportunities
	Minds On…	**Whole Class → Discussion** -Yesterday, we had an individual design challenge. Today we are going to have a group design challenge! -What did we learn from the design challenge yesterday? What should we remember when designing an object? What do we need to produce to demonstrate our designed object? What problems did you run into that you will avoid in this design challenge?		
	Action!	**Pairs → Strategizing** **Design Problem Students have two choices for their project** A. -In a group, design and construct a model boat that can carry the most pennies, using one sheet of 8.5 in x 11 in. card stock, no more than five popsicle sticks, and a set amount of adhesive tape or glue. or B. Design a golf hole -Give the students an appropriate amount of time to decide on a design, make the plans, and construct the model. In classes to follow - Perform the design challenge competition! -Have students take turns putting their boat in a tub of water. Keep on adding pennies until the boat sinks or breaks. Count the number of pennies that each group's boat can hold. -Discuss the aspects of the winning boat that allowed it to hold the most pennies. What design aspects were considered/left out of other designs?		
	Consolidate Debrief	**Pairs → Think/Pair/Share** Have the students put themselves in the shoes of a packaging company. What would they have to hypothesize, conjecture, test, infer, justify and conclude when dealing with a packaging design?		
Application		**Home Activity or Further Classroom Consolidation** Complete or refine design challenge.		

Name(s)
Date:

Designing a Mini-Putt Hole

Scottsdale Engineering has hired you and your partner on contract to create a mini-putt hole for their traveling golf course.

Complete the following tasks and submit in order to receive payment of a free round of golf.

Task 1: Create a plan for the design of your mini-putt hole.

Task 2: Create a prototype of the hole using cardboard for its structure and other appropriate materials(or paint) for grass, water, sand etc.

Task 3: Draw a scale diagram of the top, front, back and side views of the hole on grid paper. Label diagrams. Indicate key measurements and the scale used.

Task 4: Determine the ratio of the volume of the hole to the volume of the ball. How does your ratio compare with a ratio of the hole to ball in a miniature golf course already in existence?

Task 5: Determine the surface area of exposed cardboard.

Task 6: Determine the total cost of building a wooden-structure similar to the prototype including costs of other materials that would be used. Source the information for obtaining costs of materials needed to build the mini-putt hole.

Task 7: Write a reflection paper on the process of creating your mini-putt hole. Reflection paper should include how ideas changed and why they changed for building your prototype. The paper is to include as well any difficulties with the project and what you did to overcome those challenges.

MBF3C
BLM 9.8.1

Name(s)
Date:

Designing a Mini-Putt Hole

	Level 1	Level 2	Level 3	Level 4
Knowledge/ Understanding • scale drawing • volume • surface area	-constructs scale drawing with limited accuracy - calculates volume with limited accuracy - calculates surface area with limited accuracy	-constructs scale drawing with some accuracy -calculates volume with some accuracy -calculates surface area with some accuracy	-constructs scale drawing with considerable amount of accuracy -calculates volume with considerable amount of accuracy -calculates surface area with considerable amount of accuracy	-constructs scale drawing with a high degree of accuracy -calculates volume with a high degree of accuracy -calculates surface area with a high degree of accuracy
Thinking • planning • creation of prototype	-uses planning skills with limited effectiveness -uses limited problem solving strategies effectively in creating the prototype	-uses planning skills with some effectiveness -uses some problem solving strategies effectively in creating the prototype	-uses planning skills with considerable effectiveness -uses considerable problem solving strategies effectively in creating the prototype	--uses planning skills with a high degree of effectiveness -uses a high degree of problem solving strategies effectively in creating the prototype
Communication • information on diagrams • reflection paper	-labels diagrams with limited clarity -writes report with limited clarity	-labels diagrams with some clarity -writes report with some clarity	-labels diagrams with clarity -writes report with clarity	-labels diagrams with high degree of clarity -writes report with high degree of clarity
Application • comparison of volumes • calculation of costs	-applies ratios when comparing volumes with limited effectiveness -applies concepts of measurement in calculating costs with limited effectiveness	- applies ratios when comparing volumes with some effectiveness -applies concepts of measurement in calculating costs with some effectiveness	- applies ratios when comparing volumes with considerable effectiveness -applies concepts of measurement in calculating costs with considerable effectiveness	- applies ratios when comparing volumes with a high degree of effectiveness -applies concepts of measurement in calculating costs with a high degree of effectiveness