Alternate Assessments to Amaze!

JMB

Table of Contents

- Use patterns to find square roots of perfect squares
- Estimate square roots

Textbook Links

Text	Section(s) Related
Math Links 8	3.1, 3.3
Math Makes Sense 8	1.2, 1.4
Math Focus 8	1.1, 1.2, 1.3, 1.4

- Create and use two term ratios to make decisions

Textbook Links

Text	Section(s) Related
Math Links 8	2.1, 2.4
Math Makes Sense 8	5.5, 5.7, 5.8, 7.1
Math Focus 8	3.1, 3.6

Acknowledgements

Thank you to the BCAMT/BCTF for sponsoring this project.

Thank you to the teachers from School District 73 and 23 who contributed their ideas for projects.

Mathematics 8	Linear Relations	Date:
Name:	Name:	Name:
Balloons, Straws and Strings		

The Scenario

In groups of three, your team is going to investigate how far a breath of air makes a balloon travel along a fishing line. The team will collect data for each member, organize the date into a table and then plot that data onto a graph.

Your team needs to:

1. decide on a group name
2. collect the materials
3. head off to the experiment area

Materials

Your team needs to collect:

- 3 balloons
- 3 straw pieces
- Tape
- Fishing line
- Measuring tape
- Data sheet
- 3 different colours of pencil crayons/felts
- A ruler

The Process: Before Leaving the Classroom

1. Each member needs to tape a straw piece lengthwise onto the "axis of travel" of the balloon (the same direction that your breath goes into the balloon).
2. As a team, bring the following outside: fishing line, measuring tape, data sheet, pencil, binder to write on.

The Process: Outside the Classroom

1. Tie one end of the fishing line to the fence. Leave enough room between yourselves and the other teams so that you have room to work.
2. Each team member takes on one role to start the lab: The Inflator, The Measurer, The Anchor.
    a. The Inflator: strings the fishing line through their straw to the starting line (the fence). Blow a breath into the balloon and pinch the end of the balloon closed.
    b. The Anchor: holds the fishing line tight at the other end and says "go" to The Inflator. The Inflator releases the balloon.
    c. The Measurer: marks where the balloon stops and measures the distance the balloon traveled. Record the name of The Inflator and the distance traveled in centimeters (accurate to 1 decimal place).

    d. Repeat for 1 breath, 2 breaths, 3 breaths, 4 breaths and 5 breaths.
3. Change roles and repeat.
4. Once everyone has played each role, get the scissors from your teacher to cut your fishing line off of the fence. Make sure the fishing line makes it way back inside! (Be environmentally friendly ☺)

The Process: Back Inside the Classroom

1. Graphing
    a. Sit with your team. Choose a scale for the graph.
    b. Use the data your team collected outside as three separate tables of values. Colour code each person's data with a different pencil crayon/felt and plot onto the team's graph.
2. Equation: As a team, determine an equation for the first member's graph.
    a. Choose a variable to represent the number of breaths and a different variable to represent the distance traveled.
    b. Look at the first member's table to notice the relationship between the number of breaths blown into the balloon and the number of centimeters traveled.
    c. Write a formula that will predict the distance traveled based on the number of breaths blown into the balloon.
    d. Can you come up with another relationship (and create another formula) between the number of breaths and the distance traveled.
    e. Repeat steps b, c and d for each team member.
    f. STOP! Do not pass this point until your teacher checks the formulas!
3. Use the graphs to predict how far the balloon will travel with 1.5 breaths and 7 breaths for each person on the team. Record on the data sheet.
4. Use the graphs to predict how many breaths are needed to make the balloon travel 45 cm.
5. Use the formulas to calculate how far the balloon will travel with 1.5 breaths and 7 breaths for each person on the team. Show your calculations on the data sheet.
6. Use the formulas to calculate how many breaths are needed to make the balloon travel 45 cm.

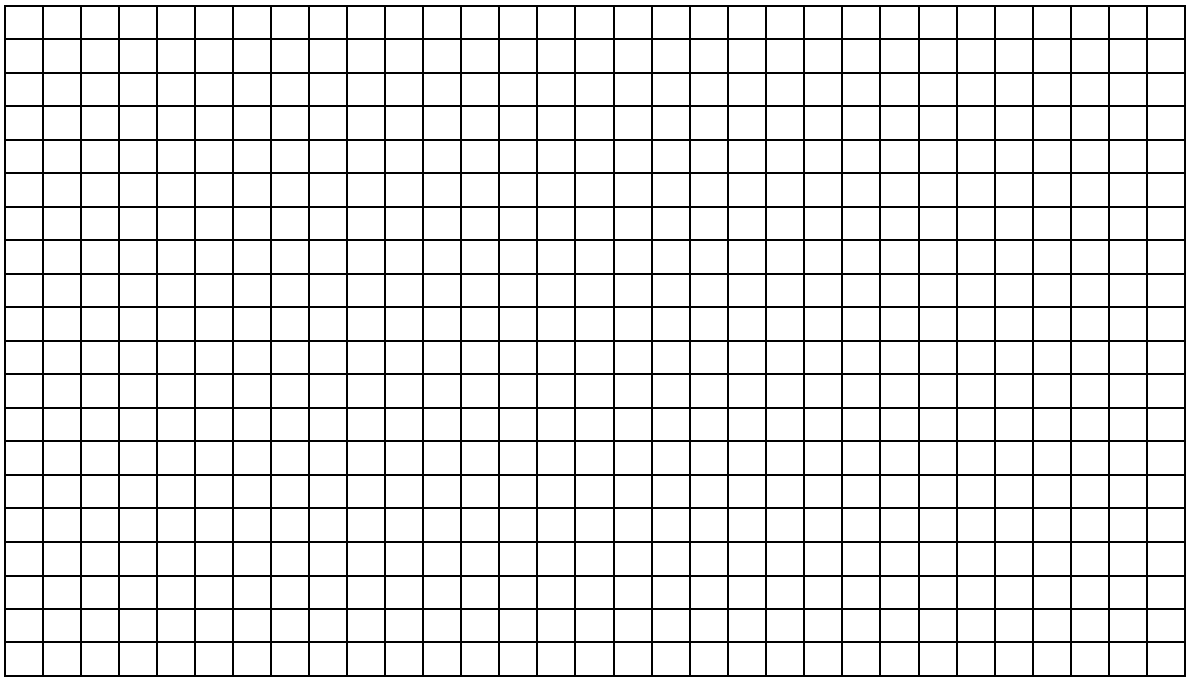
Conclusions/Questions

Did you determine if there was a relationship between the distance traveled and the number of breaths in the balloon? If you did, what was it?

1. Was the relationship the same for each member of your group? If it wasn't give a possible reason.
2. Did all of the graphs "climb" by the same amount? Whose graph was steeper? Whose graph was flatter? What does the "steepness" of the graph represent?
3. What are possible sources of error? In other words, what could you have done differently to make the experiment more accurate?

Balloons, Straws and Strings: Data Sheet

Name:		Name:		Name:	
Breaths	Distance Traveled (cm)	Breaths	Distance Traveled (cm)	Breaths	Distance Traveled (cm)
0		0		0	
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	



Predictions Using the Graphs

Name:		Name:		Name:	
Breaths	Predicted Distance Traveled (cm)	Breaths	Predicted Distance Traveled (cm)	Breaths	Predicted Distance Traveled (cm)
1.5		1.5		1.5	
7		7		7	
	45		45		45

Calculations Using the Formulas

Name:		Name:		Name:	
Breaths	Predicted Distance Traveled (cm)	Breaths	Predicted Distance Traveled (cm)	Breaths	Predicted Distance Traveled (cm)
1.5		1.5		1.5	
7		7		7	
	45		45		45

Balloons, Straws and Strings - Teacher Version

WNCP Outcomes Addressed

Strand: Patterns and Relations (Patterns)	
1. Graph and analyze two-variable linear relations. [C, ME, PS, R, T, V]	➢ Determine the missing value in an ordered pair for a given equation. ➢ Create a table of values by substituting values for a variable in the equation of a given linear relation. ➢ Construct a graph from the equation of a given linear relation (limited to discrete data). ➢ Describe the relationship between the variables of a given graph.
Strand: Patterns and Relations (Variables and Equations)	
2. Model and solve problems using linear equations of the form: $ax = b$ $\frac{x}{a} = b,\ a \neq 0$ Concretely, pictorially and symbolically, where *a*, *b* and *c* are integers. [C, CN, PS, V]	➢ Solve a given linear equation symbolically. ➢ Solve a given problem using a linear equation and record the process.

Materials

- 1 balloon for each student (plus extras!)
- Straws cut into 3cm pieces (plus extras!)
- Tape
- 3m fishing line for each team
- 1 measuring tape for each team (trundle wheel, meter stick, etc.)
- 1 data sheet for each student (plus extras!)
- Several pairs of scissors
- Pencil crayons
- Rulers

The Process: Before Leaving the Classroom

1. Take several extra balloon/straw combinations outside with you. This is an easy solution for the student that pops theirs as they don't have to go back to the class to make another combination.

The Process: Outside the Classroom

1. You will need a length of fence long enough for all students to work along. Bring several pairs of scissors to cut the fishing line to length before and off of the fence afterwards.
2. Have the students "string" their straw into their fishing line before attempting to attach the balloon.
3. Before the balloon is securely attached make sure that the straw is parallel to the axis of movement, otherwise the balloon's movement will be restricted.
4. Make sure that the student's measurement of the distance traveled by the balloon is consistent (e.g. using the neck of the balloon for both measurements).

The Process: Back to the Classroom

1. Students need determine the horizontal and vertical scale. It is important that they "spread out" their results and take advantage of the available space. It makes the process of "interpolation" and "extrapolation" easier.
2. Ask question: What variable should be placed along the horizontal axis, and what variable should be placed along the vertical axis. *Listen for statements about independent vs. dependent variables.*
3. Students need to be reassured that their "line" of best fit doesn't have to go through all of the points; it just needs to represent the approximate linear relationship between number of breaths & distance traveled.
4. Encourage students to look for patterns in the data; prompting students to talk about the breaths are multiplied by XX each time.
5. When students are using their graphs, listen for words such as "well, if I find 1.5 on the graph and I read up to the line, the distance is…"
6. When solving for distance in the formula, students need to be encouraged to show their entire solution process, not just the answer.
7. Ask the students to comment on their solutions in each of their tables. How are your answers the same? Why aren't they the same?
8. For strong students, they might want to calculate the volume of air in the balloon, by measuring the volume using the formula: $V = \frac{4}{3}\pi r^3$, and graph volume of air versus distance traveled.

Assessment

Of Learning	Teachers can assign marks to each "step" of the process. We will leave this up to your professional discretion.
For Learning	Exceeds Expectations: Data Collection: • Teacher observes student measuring distance traveled by balloon consistently (nose to nose, neck to neck). Student records distance accurately to tenth of a centimeter. Graphing: • Chooses appropriate scale. • Axis Labeled Creating Equation: • Recognizes a multiplicative relationship • Attempts to maintain accuracy for their co-efficient (rather than rounding off the number) • Creates other equations such as: $d-30t=0$ or $t=\frac{d}{30}$ Prediction: • Accurately interpolates/extrapolates information from graph Calculations: • Shows correct method. • Can substitute values into formulas, and solve for the unknown variable Conclusions • States a plausible reason for different relationships • Makes a connection between the slope of the graph and the coefficient of the variable • Notes several reasonable sources of error.
	Meets Expectations: Data Collection: • Teacher observes student measuring distance traveled by balloon consistently (nose to nose, neck to neck). Student records distance accurately to tenth of a centimeter. Graphing: • Chooses appropriate scale. • Axis Labeled Creating Equation: • Recognizes a multiplicative relationship • Attempts to maintain accuracy for their co-efficient (rather than rounding off the number) • Has difficulty creating other equations Prediction: • Accurately interpolates/extrapolates information from graph Calculations: • Shows correct method. • Can substitute values into formulas, and solve for the unknown variable Conclusions • States a plausible reason for different relationships • Has difficulty making a connection between the slope of the graph and the coefficient of the variable • Notes several reasonable sources of error.

	Does Not Yet Meet Expectations: Data Collection: • Teacher observes student measuring distance traveled by balloon inconsistently. Student records distance accurately to the nearest centimeter. Graphing: • Has difficulty choosing an appropriate scale. • Axis Labeled incorrectly Creating Equation: • Doesn't recognize the multiplicative relationship (student may write the equation as: $d = t + 30$) or may need significant assistance in creating the equation. • Cannot create other equations Prediction: • Has difficulty interpolating/extrapolating information from graph Calculations: • Shows an incorrect process. • Has difficulty substituting values into formulas, and solve for the unknown variable Conclusions: • States a implausible reason for different relationships • Cannot make a connection between the slope of the graph and the coefficient of the variable • Notes several insignificant/trivial sources of error.

Project Written & Designed by: Brad Epp & Katie Hay (based upon an article read in the "Teaching Mathematics in the Middle School" a really long time ago)
Project Edited by: Katie Hay & Brad Epp
Special Thanks go to: BCAMT & School District 73
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Race Team	Mathematics 8	Date
Team Member #1	Team Member #2	Block

"Tour de BC"

The Scenario

Your racing team is entered in a race through five BC towns. Your team needs to refuel several times and will use speed calculations to calculate the anticipated finish time.

Decisions to Make Before Arriving At Class

Before beginning the "Tour de BC", your team needs to arrive at class with the following decisions already made. Use the table "Make and Model of Car" to help you make your decisions.

Race Team Name	
Race Team Members	
The Vehicle	
Fuel Tank Capacity	Liters
Fuel Efficiency	Liters/100km

Make & Model of Car - http://ca.autos.yahoo.com/newcars/

Make	**Model**	**Tank Capacity (in litres)**	**Fuel Efficiency (L/100km)**
Ford	Focus	49	5.7
	Mustang GT Coupe	61	11.5
	F-150 XLT 4x4 SuperCab	135	11.7
GM	Aveo LS	45	5.8
	Equinox	78	8.3
	Corvette Z06	68	8.2
Honda	Civic Coupe DX	50	5.7
	Civic Hybrid CVT	46	4.3
	Honda S2000	50	8.4
Hummer	H3	87	11.4
Hyundai	Accent	45	6.2
Jeep	Wrangler	70	10.8
Lamborghini	Murcielago LP640 Coupe	100	15.1
Mazda	Mazda3	55	6.1

Required Materials

To complete the "Tour de BC", get the following materials from your teacher:

- 30 cm string
- 30 cm ruler with mm measurements
- Canadian Oxford School Atlas
- Access to the internet

The Process

1. Map Scale

- Turn to pages 34 and 35 (in the 7th edition of the Atlas)
- The scale is _____ : _____ .

- This means that 1 mm on the map equals _____ km in real life

2. Atlas Measurements

Starting in	**Distance By Road (mm) to**	**Finishing in**
Kamloops		Williams Lake
Williams Lake		Prince George
Prince George		Mc Bride
McBride		Avola
Avola		Kamloops
Total		

3. Calculations (Be sure to support your answers by showing your thought process!)
(a) Using the map scale, convert the measurements from step 2 into kilometers. Access the internet, research the actual distances using sites such as http://maps.google.ca or http://www.mapquest.com .

	Distance By Road (km). Show calculations in this column.	**Distance According to Website**
Kamloops to Williams Lake		
Williams Lake to Prince George		
Prince George to McBride		
McBride to Avola		
Avola to Kamloops		
Total		

(b) Knowing the fuel economy of your vehicle, how far can your vehicle travel on one full tank of fuel?

(c) If fuel costs $1.307 per litre, how much does it cost to fill your gas tank?

(d) Your racing team now knows how many kilometres the vehicle travels on one tank of fuel. How many refueling stops will your team make during the race? (Assume fuel is available when and where you need it! Use the "Distance According to Website" kilometres.)

(e) How much fuel is required for the race?

(f) If fuel costs $1.307 per litre, what is the total cost of the fuel for the trip?

(g) In this race, it is required that each pit stop is 10 minutes in length.

(i) Calculate the total time spent in pit stops.

(ii) Convert the pit stop time into hours. Express this time as a fraction in lowest terms and as a decimal accurate to two decimal places.

(h) Traveling at an average speed of 80 km/h, how long will your team spend driving?

(i) How many hours will it take your team to finish the race? Express your answer in hours to two decimal places.

(j) Convert the race time into hours and minutes.

Bonus:
If you drive at a speed of 100 km/h, how much faster will it take you to complete this course? What other factors would change if your team chose to do this?

"Tour de BC" – Teacher Version

WNCP Outcomes Addressed

Strand: Number (Develop number sense)	
4. Demonstrate an understanding of ratio and rate. [C, CN, V]	➢ Express a two-term ratio from a given context in the forms 3:5 or 3 to 5. ➢ Express a three-term ratio from a given context in the forms 4:7:3 or 4 to 7 to 3. ➢ Identify and describe ratios and rates from real-life examples, and record them symbolically. ➢ Express a given rate using words or symbols, e.g., 20 L per 100 km or 20 L/100 km.
5. Solve problems that involve rates, ratios and proportional reasoning. [C, CN, PS, R]	➢ Provide a context in which $\frac{a}{b}$ represents a: rate, ratio ➢ Solve a given problem involving rate, ratio or percent.

The Scenario

Your racing team is entered in a race through five BC towns. Your team will need to refuel several times and will use speed calculations to calculate the anticipated finish time.

Decisions to Make Before Arriving At Class

Before beginning the "Tour de BC", your team needs to arrive at class with the following decisions already made. Use the table "Make and Model of Car" to help you make your decisions.

Race Team Partner	
Race Team Name	
The Vehicle	
Fuel Tank Capacity	Liters
Fuel Efficiency	Liters/100km

Make & Model of Car - http://ca.autos.yahoo.com/newcars/

Make	Model	Tank Capacity (in Litres)	Fuel Efficiency (L/100km)
Ford	Focus	49	5.7
	Mustang GT Coupe	61	11.5
	F-150 XLT 4x4 SuperCab	135	11.7
GM	Aveo LS	45	5.8
	Equinox	78	8.3
	Corvette Z06	68	8.2
Honda	Civic Coupe DX	50	5.7
	Civic Hybrid CVT	46	4.3
	Honda S2000	50	8.4
Hummer	H3	87	11.4
Hyundai	Accent	45	6.2
Jeep	Wrangler	70	10.8
Lamborghini	Murcielago LP640 Coupe	100	15.1
Mazda	Mazda3	55	6.1

Time Required

Approximately 1-2 class periods (Depending if material has been taught or students are learning the material as they proceed through the activity)

Required Materials

To complete the "Tour de BC", you need to collect/create

- 30 x 30 cm strings *(Have the students place a knot at each end – prevents fraying & ease of measuring)*
- 30 x rulers with mm measurements
- 15 x Canadian Oxford School Atlas (or any other atlas you can borrow from your Social Studies Department – don't forge to ask first.)
- Access to the internet – Don't forget to book a computer lab.
- Calculator use is optional – use with adapted/modified students

1. Map Scale
    - Turn to pages 34 and 35 (in the 7th edition of the Atlas)
    - The scale is 1 : 5 000 000 *(map scale is on the middle right hand side of page)*

Remind students that 1000 mm = 1 m and 1000 m = 1 km

1 mm : 5 000 000 mm
1 mm : 5 000 m (since there are 1000 mm in 1 m)
1 mm : 5 km (since there are 1000 m in 1 km)

- This means that 1 mm on the map equals *5* km in real life

2. Atlas Measurements:
Discuss legend so that students are using Highways for their calculations, not minor roads, rivers or railways.

Students should measure from the "middle" of each city to the "middle" of the next city.

Feel free to edit the locations in this table to make it relevant for your students.

Starting in	**Distance By Road (mm) to**	**Finishing in**
Kamloops		Williams Lake
Williams Lake		Prince George
Prince George		Mc Bride
McBride		Avola
Avola		Kamloops
Total		

3. Calculations
(a) Using the map scale, convert the measurements from step 2 into actual distances (in km). Accessing the internet, look up the actual distances using sites such as http://maps.google.ca or http://www.mapquest.com .

	Distance By Road (km). Show calculatons in this column.	**Distance According to Web Site (*according to Google maps)***
Kamloops to Williams Lake		*286 km*
Williams Lake to Prince George		*241 km*
Prince George to McBride		*208 km*
McBride to Avola		*211 km*
Avola to Kamloops		*192 km*
Total		*1138 km*

Encourage students to show their understanding of rate & ratio by displaying their solutions in as many ways as possible. Possible questions you might ask to prompt this is:
Is there another way to show your solution? Can you use a rate/ratio?

(b) Knowing the fuel economy of your vehicle, how far can your vehicle travel on one full tank of fuel?
Possible student work:

$\frac{8L}{100km} = \frac{56L}{700km}$	$8L:100km = 56L:700km$	$\frac{8L}{100km} = \frac{1L}{12.5km} = \frac{56L}{700km}$
$\frac{100km}{8L} \times 56L = 700km$		

(c) If fuel costs $1.307 per litre, how much does it cost to fill your gas tank?

Possible Student work:

$1.307 * 56 = \$73.192$	$\frac{\$1.307}{1L} * 56L = \$73.19$	$1.307:1 = 73.19:56$

(d) Your racing team now knows how many kilometres the vehicle travels on one tank of fuel. How many refueling stops will your team make during the race? (We are going to assume that fuel is readily available when and where you need it! Use the "Distance According to Website" kilometers.
(Ease of marking)

Possible Student work:

$700\overline{)1138}^{1.625}$, therefore 2 stops are required	*700 km + 700 km =1400 km.* *Since 1400>1138 we need 2 stops*
700 km: 1 stop = 1138 km : 1.625 stops	

(e) How much fuel is required for the race?
Possible Student work:

$\frac{5.7L}{100km} = \frac{64.866L}{1138km}$	$5.7:100 = 64.866:1138$	$\frac{5.7L}{100km} \times 1138km = 64.866L$

(f) If fuel costs $1.307 per litre, what is the total cost of the fuel for the trip?

Possible student work:

$1.307 * 64.866 = \$84.78$	$\frac{\$1.307}{1L} * 64.866L = \$84.78$	$1.307:1 = 84.78:64.866$
Or: 2 tanks of gas. They cost 73.192 each so… it would cost $146.38		

(g) In this race, it is required that each pit stop is 10 minutes in length.
(i) Calculate the total time spent in pit stops.

Possible student work:
2 stops = 20 minutes

(ii) Convert this time into hours. Express as a fraction in lowest terms and as a decimal accurate to two decimal places.

Possible student work:

$\frac{20}{60} = \frac{1}{3}$ *and* $60\overline{)\,20}$ 0.333

(h) Traveling at an average speed of 80 km/h, how much time will you spend driving?

Possible student work:

$\frac{80km}{1h} = \frac{1138km}{14.225h}$	$80x = 1138$ $\frac{80x}{80} = \frac{1138}{80}$ $x = 14.225h$	$80km : 1h = 1138km : 14.225h$

(i) How many hours will it take your team to finish the race. Express your answer in hours, to two decimal places.

Possible student work
14.225h+0.333h=14.558 h

(j) Convert the race time into hours and minutes.

Possible student work:
*0.558 * 60 = 33 minutes*

Total time for race is 15 hours and 33 minutes

Bonus:
If you drive at a speed of 100 km/h, how much faster will it take you to complete this course? What other factors would your team have to consider if your team chose to do this?

Driving at 100km/h, you would finish the course in 11.38 hours. You would save 14.225-11.38=2.845 hours or 2 hours and 51 minutes.

Students should talk about: Fuel consumption increasing, need to stop more, cost increases, speeding tickets…

Assessment

Of Learning	Teachers can assign marks to each "step" of the process. We will leave this up to your professional discretion.
For Learning	Exceeds Expectations: • Student can measure & convert distances within 5% of acceptable values • Student will represent their solution in a variety of ways (eg. As a rate, ratio, multiplication of a rate by a unit. • Student calculations (where appropriate) demonstrate an acceptable reasoning process and are correct
	Meets Expectations: • Student can measure & convert distances within 5-10% of acceptable values • Student will represent their solution to a problem in 1 way • Student calculations (where appropriate) demonstrate an acceptable reasoning process and are correct
	Does Not Yet Meet Expectations: • Student measurement and conversions are greater than 10% of acceptable values • Student requires significant assistance in representing their solution. I.e. layout of solution, or selecting a strategy. • Student calculation (where appropriate) does not demonstrate an acceptable reasoning process and are incorrect

Project Written & Designed by: Katie Hay, Jenn Filek, Jane Wolfram
Project Edited by: Katie Hay & Brad Epp
Special Thanks go to: BCAMT & School District 73
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Prop Designer 1:	Mathematics 8	Date
Prop Designer 2:		Block

Containing The Cryptex

The Scenario

The DaVinci Code II is looking for set props. As a set design team of two people, you need to build a cryptex that can contain the magic crystal as well as a strongbox to bury it in.

Required Materials

To design these props, your design team needs:

- ruler (mm measurements)
- 3 pieces of paper per set design team (allow more for mistakes!)
- glue sticks
- clear tape
- scissors
- calculator
- compass

Building The Model

The Strongbox

The strongbox is a right rectangular prism.

The strongbox is made out a special super strength wood that is very difficult to find. The most material you can find is a 21 cm x 28 cm sheet. Draw a net of the largest rectangular prism that fits on this sheet.

2. Cut out the net.
3. Use tape to build the model. Keep in mind that you'll need to take this apart to do calculations later on … so use small pieces of tape!!!

The Cryptex

The cryptex is a right cylinder.

- Use paper to create the net of the cylinder. Ensure that the cylinder touches the top and the bottom of the strongbox so it doesn't rattle around.
- Cut out the net.
- Use tape to build the model (Only tape one end of the cylinder closed. Leave the other end open so that you can make sure that the magic crystal fits inside.) Keep in mind that you'll need to take this apart to do calculations later on … so use small pieces of tape!!!
- Ensure that the cryptex fits inside the strongbox.

The Magic Crystal

The magic crystal is a right triangular prism.

1. Use paper to create a net of a right triangular prism that fits inside the cryptex cylinder. The triangular faces may be equilateral, isosceles or scalene.

Cut out your net.

Use tape to create the model. Keep in mind that you'll need to take this apart to do calculations later on … so use small pieces of tape!!!

Ensure the crystal fits inside the cylinder.

The Calculations

As the set design team, you need to know how much of each material is required to construct each item. For each model …

1. Unfold the model, carefully cutting only the pieces of tape that need to be cut in order to lay the model flat.
2. Measure the dimensions of each face and number them.
3. Using the worksheet on the next page, show the area calculations.
4. Calculate the total surface area of each model.
5. Determine the material cost of each prop.

The Final Step

1. Colour the outside of each prop, making sure that the face number can be seen. Creativity will be appreciated by your teacher ☺
2. Assemble the completed prop but don't tape the strongbox or cryptex closed.
3. Print your names on the completed prop and the calculation pages. Hand in.

Prop Designer 1:	Mathematics 8	Date
Prop Designer 2:		Block
Strongbox -- Rectangular Prism: Total Area= _____		
Face 1	Face 2	Face 3
Face 4	Face 5	Face 6
Cryptex -- Cylinder: Total Area= _____		
Top	Bottom	Side
Crystal -- Triangular Prism: Total Area= _____		
Face 1	Face 2	Face 3

Face 4	Face 5

Cost Calculations

Your strongbox is made out thin pieces of Sassasfras that costs \$0.0018/ cm^2 . Determine the material cost of this prop.

Your cryptex is made out of thin sheets of platinum that costs \$70/ cm^2 . Determine the material cost of this prop.

Your crystal is made out of kryptonite and costs \$80/ cm^3 . Determine the material cost of this prop.

Containing The Cryptex – Teacher Version

WNCP Outcomes Addressed

Strand: Shape and Space (Measurement)	
2. Draw and construct nets for 3-D objects. [C, CN, PS, V]	➢ Match a given net to the 3-D object it represents. ➢ Construct a 3-D object from a given net. ➢ Draw nets for a given right circular cylinder, right rectangular prism and right triangular prism, and verify by constructing the 3-D objects from the nets. ➢ Predict 3-D objects that can be created from a given net and verify the prediction.
3. Determine the surface area of: • right rectangular prisms • right triangular prisms • right cylinders to solve problems. [C, CN, PS, R, V]	➢ Explain, using examples, the relationship between the area of 2-D shapes and the surface area of a given 3-D object. ➢ Identify all the faces of a given prism, including right rectangular and right triangular prisms. ➢ Describe and apply strategies for determining the surface area of a given right rectangular or right triangular prism. ➢ Describe and apply strategies for determining the surface area of a given right cylinder. ➢ Solve a given problem involving surface area.
4. Develop and apply formulas for determining the volume of right prisms and right cylinders. [C, CN, PS, R, V]	➢ Determine the volume of a given right prism, given the area of the base. ➢ Generalize and apply a rule for determining the volume of right cylinders. ➢ Apply a formula to solve a given problem involving the volume of a right cylinder or a right prism.

Required Materials

For the students to design these props you will need to collect:

- 30 rulers (mm measurements)
- Minimum 45 sheets of 8.5 x 11 blank printer paper. (3 pieces of paper per team. Allow more for mistakes!)
- 15 x glue sticks
- clear tape
- 15 x pairs of scissors
- 15 x calculators
- 15 x compasses
- pencil crayons and/or felts
- 15 x empty paper towel rolls

Construction Tips

Constructing The Strongbox

1. To restrict the number of possibilities for the strongbox, advise the students to fold their paper in half lengthwise and then in half again lengthwise. This makes a long rectangular "tube".
2. Discuss with students how to fold the ends to finish making the strongbox. Scissors will be needed to cut off the extra paper.
3. Stronger students may benefit from leaving this step of the construction process open, allowing a wider variety of strong boxes to be constructed and allowing deeper mathematical conversations.

Constructing The Cryptex

1. Paper towel rolls can enable concrete students to transition to the abstract. The paper towel rolls help students to estimate the height of the required cylinder and form an understanding that the side of the cylinder is indeed rectangular. Or … Advise the students to roll a piece of paper, slide it into their strongbox keeping the paper rolled up, let the rolled paper expand to fill the box, use a piece of tape to hold the rolled paper in its cylindrical shape, and remove the cylinder from the box.
2. Discuss with students that in order for the cylinder to come in contact with two faces of the strongbox, the cylinder's diameter is equal to the shorter edge of the strong box's base. This has a special term: "the circle is inscribed in the square".
3. Advise the students to roll a piece of paper, slide it into their strongbox keeping the paper rolled up, let the rolled paper expand to fill the box, use a piece of tape to hold the rolled paper in its cylindrical shape, and remove the cylinder from the box.
4. To construct the ends, you can advise students one of two ways: place the cylinder on another piece of paper and trace, or use a compass. If you have covered circle properties prior to this activity, students could create perpendicular bisectors of two chords to determine the location of the center and the radius.

Constructing The Magic Crystal

1. Fold a piece of paper into thirds (two folds). Does it slide into the cylinder? If not, adjust the size of the folds.

Costing Calculation Tips

1. The first two calculations require the surface area to be computed, however the third requires the volume. Some students may assume the calculation for the cost of the crystal requires the surface area.
2. Students may be unfamiliar with cost calculations with unit rates that are less than 1 cent, and may incorrectly move the decimal point.
3. Students who are finding this "activity" easy, you can challenge them by:
    1. Requiring each object being made out of at least 2 materials.
    2. Requiring that each joint on the strongbox & cryptex being sealed with lead.

Assessment

Of Learning	Teachers can assign marks to each "step" of the process. We will leave this up to your professional discretion.
For Learning	Exceeds Expectations: • Student will design objects that fit "tightly" within each other • Student will correctly determine area of each face of each object using correct units • Students will correctly determine the cost of each object with multiple materials
	Meets Expectations: • Student will design objects that fit "reasonably tight" within each other • Student requires some assistance to design objects. • Student will correctly determine area of each face of each object using correct units • Students will correctly determine the cost of each object with a single material

	Does Not Yet Meet Expectations:
	• Student requires significant assistance to design the objects that fit within each other.
	• Student correctly determines area of some faces
	  ○ Rectangles
	  ○ Circles
	  ○ Triangles
	• Student requires assistance to determine the cost of each object.

Project Written & Designed by: Katie Hay, Tanja Illic, Jane Wolfram
Project Edited by: Katie Hay & Brad Epp
Special Thanks go to: BCAMT & School District 73
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Mathematics 8	Squares & Square Roots	Date:
Name:	Name:	

Investigating Square Numbers and Square Roots

Scenario

We are going to investigate the pattern in square numbers and square roots.

Materials

To complete this activity you need:

- Felt pens/pencil crayons
- calculator

The Task

In groups of 2:

1. Colour coordinate squares and their square roots on the sheet of paper that are numbered 1 through 225. For example, you can colour the number 2 square and the number 4 square the same colour, because:
   $\sqrt{4} = 2$ and $2^2 = 4$
2. Colour the rest of the numbers on the sheet the same way, where possible.

Questions/Observations

1. What do you notice about the distance between a number and its square as the numbers increase?
2. What do you notice about the distance between the number and its square root as the numbers increase?
3. Using your coloured chart, determine square roots of the following numbers (Hint: find two perfect squares that have the given number as their product):
   a. 400
   b. 900
   c. 3600
   d. 8100
   e. What pattern are you using to get the answers in a-d?
   f. Do a-d again, but use two different perfect squares.
4. Find the square root of the following numbers using as many different pairs of perfect squares:
   a. 144
   b. 324
5. Find the square root of:
   a. $\frac{9}{16}$
   b. $\frac{25}{81}$
   c. $\frac{1}{10000}$

6. Find the square root of:
    a. $\sqrt{0.0144}$ (Hint: 5c)
    b. $\sqrt{0.0004}$
    c. $\sqrt{0.0169}$
7. Estimate the square root using the coloured sheet (to 1 decimal place), and explain your reason why. Check your answer with a calculator.
    a. 27
    b. 45
    c. 60
    d. 85

Investigating Square Numbers and Square Roots – Teacher Version

WNCP Outcomes Addressed

Strand: Number Sense	
Demonstrate an understanding of perfect square and square root, concretely, pictorially and symbolically (limited to whole numbers). [C, CN, R, V]	➢ Determine the factors of a given perfect square, and explain why one of the factors is the square root and the others are not. ➢ Determine whether or not a given number is a perfect square using materials and strategies, such as square shapes, grid paper or prime factorization, and explain the reasoning. ➢ Determine the square root of a given perfect square and record it symbolically. ➢ Determine the square of a given number.
Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers). [C, CN, ME, R, T]	➢ Estimate the square root of a given number that is not a perfect square using the roots of perfect squares as benchmarks. ➢ Approximate the square root of a given number that is not a perfect square using technology, e.g., calculator, computer. ➢ Identify a number with a square root that is between two given numbers

Suggestions for Use

Due to the amount of pre-teaching involved for this activity, this assessment is better suited as a summative assessment than a formative one.

Materials

To complete this activity you need:

- Felt pens/pencil crayons
- 15 calculators
- Blackline master 1-225 about 1 copy per pair of students; run off a couple of extras because students will make mistakes.

The Task

In groups of 2:

1. Colour coordinate squares and their square roots on the sheet of paper that is numbered 1-225. For example, you can colour the number 2 square and the number 4 square the same colour because: $\sqrt{4} = 2$ and $2^2 = 4$.

2. Colour the rest of the numbers on the sheet the same way, where possible.
    a. *Students will need to make some sort of accommodation with the numbers 2, 4, 16 as well as 3, 9, 81. Have them come up with their own solution.*

Questions/Observations

1. What do you notice about the distance between a number and its square as the numbers increase?
   Possible student response: The distance will increase between the number and it's square. E.g. 2 and 4 are only 2 units away from each number, but 3 and 9 are 6 units away.
2. What do you notice about the distance between the number and its square root as the numbers increase?
   Again, the square root of 4 is 2 and those numbers are only 2 units apart. However, the square root of 9 is 3 and those two numbers are 6 units apart, so we can conclude that as the number we are taking the square root of increases, the distance to it's square root will also increase.
3. Using your coloured chart, determine square roots of numbers:
    a. 400 *since the square root of 4 is 2, and the square root of 100 is 10, the answer is 20*
    b. 900 *since the square root of 9 is 3, and the square root of 100 is 10 the answer is 30*
    c. 3600, *since the square root of 36 is 6, and the square root of 100 is 10 the answer is 60*
    d. 8100, *since the square root of 81 is 9, and the square root of 100 is 10 the answer is 90*
    e. What pattern are you using to get the answers in a-d? *Students need to say something like we all of these numbers are 100 times a perfect square. And we know the square root of 100 is 10 and we can multiply that to the square root of the other perfect square.*
    f. Do a-d again, but use two different perfect squares. *Ex. 400=25*16*
4. Find the square root of the following numbers using as many different pairs of perfect squares:
    a. 144= 12*12 or 144=9*16 or 144= 4* 36
    b. 324= 18 * 18 or 324=36 * 9 or 324=81*4
5. Find the square root of:
    a. $\frac{9}{16}=\frac{3}{4}$
    b. $\frac{25}{81}=\frac{5}{9}$
    c. $\frac{1}{10000}=\frac{1}{100}$
6. Find the square root of:
    a. $\sqrt{0.0144}$. *The square root of 144 is 12 and since* $.0144=144*\frac{1}{10000}$ *and the square root of 10 000 is 100 the answer is* $12\times\frac{1}{100}=\frac{12}{100}$ *or* 0.12

b. $\sqrt{0.0004}$. *The square root of 4 is 2 and since* $0.0004 = 4 \times \frac{1}{10000}$ *and the square root of*

10 000 is 100 the answer is $2 \times \frac{1}{100} = \frac{2}{100} \quad or \quad 0.02$

c. $\sqrt{0.0169}$.*The square root of 169 is 13 and since* $0.0169 = 169 \times \frac{1}{10000}$ *and the square root of 10 000 is 100 the answer is* $13 \times \frac{1}{100} = \frac{13}{100} \quad or \quad 0.13$

7. Estimate the square root using the coloured sheet, and explain your reason why.
   a. 27. *since 27 is closer to 25 than 36 the answer must be closer to 5 than 6, so about 5.2*
   b. 45. *since 45 is closer to 47 than to 36 the answer must be closer to 7 than 6, so about 6.7*
   c. 60. *since 60 is closer to 64 than to 39 the answer must be closer to 8 than 7, so about 7.7*
   d. 85. *since 85 is just bigger than 81, the answer must be close to 9, so about 9.2-9.3*

Assessment

Of Learning	Teachers can assign marks to each "step" of the process. We will leave this up to your professional discretion.
As Learning	Exceeds Expectations: Colour Coordination: • Student has a coding strategy that with 2, 4, 16, and 3, 9, 81. Finding/Evaluating Square Roots: • Student is able to find multiple pairs (3)of perfect squares • Student is able to express a decimal number into the product of two numbers, each of which are perfect squares (one is a fraction the other a whole number) Estimating Roots: • Student has a successful strategy to estimate the square root of non-perfect squares
	Meets Expectations: Colour Coordination: • Student may need assistance or requires multiple attempts to create a coding strategy that with 2, 4, 16, and 3, 9, 81. Finding/Evaluating Square Roots: • Student is able to find multiple pairs (2)of perfect squares • Student may need assistance in recognizing the relationship between a decimal number and its fraction equivalence. But then is able to express the product of two numbers, each of which are perfect squares (one is a fraction the other a whole number) Estimating Roots: • Student has a successful strategy to estimate the square root of non-perfect squares
	Does Not Yet Meet Expectations: Colour Coordination: • Student requires explicit directions to create a coding strategy. Finding/Evaluating Square Roots: • Student is able to find one pair of perfect squares • Student requires assistance in recognizing the relationship between a decimal number and its fraction equivalence. • Student requires assistance to express the product of two numbers, each of which are perfect squares (one is a fraction the other a whole number) Estimating Roots: • Student lacks a successful strategy to estimate the square root • Student relies on calculator to estimate square roots of non-perfect squares

Project Written & Designed by: Dean Coder, Katie Hay & Brad Epp
Project Edited by: Katie Hay & Brad Epp
Special Thanks go to: BCAMT & School District 73
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1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120

121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220
221	222	223	224	225					

Nutritionist:	Mathematics 8	Date
		Block

A Healthy Diet

The Scenario

As our bodies grow, we need to be concerned with the amount and types of food we put in our bodies. The Canada Food Guide can help us make good decisions with respect to how much and what type of food we eat.

Materials

To complete this project you need:

- a computer with a spreadsheet program & a word processing progra.
- a copy of *Canada's Food Guide*.
- Technical "How To", if required.

Recommended Servings

1. Start a new spreadsheet document. Save as "Healthy Diet *your name*" (your teacher will tell you where: disk, flash drive, school server). Keep track of the written answers on paper or using a word processing document, as directed by your teacher.
2. Input the headings as shown below:

	A	**B**	**C**	**D**	**E**
1		Vegetables and Fruit	Grain Products	Milk and Alternatives	Meat and Alternatives
2	Teen minimum				
3	Teen maximum				
4	My consumption				

3. Look up the minimum and maximum recommended number of servings of each food group for someone your gender and age. Input these numbers into the appropriate cells.
4. Use the spreadsheet's charting options to draw two circle graphs.
    a. circle graph #1: displays the minimum number of servings for someone your age and gender.
    b. circle graph #2: displays the maximum number of servings for someone your age and gender.
5. Increase the number of servings of grain products in cell B2 by 1. Do not change any of the other numbers. How does the circle graph change? Explain your observation.
6. SAVE!

My Consumption

1. Estimate the number of servings you ate yesterday for each of the four food groups. Enter your estimates in cells B4 to E4.
2. Use the spreadsheet's charting options to draw circle graph #3 (displaying your daily food consumption). How does it compare to circle graphs #1 and #2? Explain.
3. Are there foods that you ate yesterday that do not fit in any of the four food groups? If so, which ones?
4. Why do you think that these foods are not included in *Canada's Food Guide?*
5. Think of a name to describe these foods and add them to your spreadsheet as a new food group in column F.
6. Construct circle graph #4 (displaying your daily food consumption, including this fifth group).
7. SAVE!
8. Ask your teacher for permission to print.

My Consumption: Making Connections

1. Determine the ratio of the number of food servings you consumed from the fifth group to:
    a. the total number of minimum food servings recommended by *Canada's Food Guide*.
    b. the total number of minimum food servings recommended by *Canada's Food Guide*.
2. Based on your answers to question #1, would you classify yourself as a healthy eater? Explain.
3. Why do you think that the *Canada's Food Guide* recommends different servings for boys than they do for girls?
4. The ratio of the maximum number of servings of grain products to the maximum number of servings of meat and alternatives is 6:4, or 3:2 for a girl and 7:4 for a boy. If you're a girl, for every 1.5 servings of grains you should eat one serving of meat. If you're a boy, for every 1.7 servings of grains you should eat one serving of meat.
    a. Write a ratio that compares the minimum number of servings of grain products to the minimum number of servings of meat and alternatives.
    b. Using the recommended ranges, write at least three other ratios that compare the number of servings of grain products to the number of servings of meat and alternatives.
    c. Express your ratio from part **a** with a second term of 1.
5. Choose a different pair of food groups. Repeat question #4 for these two groups. Be sure to state the groups you selected.
6. Copy and complete this table on a separate piece of paper. Express the ratios using a "1" as the second term. You will need a calculator.

	Vegetables and Fruit:Total	Grain Products:Total	Milk and Alternatives:Total	Meat and Alternatives:Total
Minimum Ratios				
Maximum Ratios				
My Ratios				

7. Reflect on your findings from the above table. Do you think you are a healthy eater? Explain.

Technical "How To": Making a Circle Graph in MS Excel
(other spreadsheet programs have similar options)

1. Enter the data.
2. Select "Insert", "Chart", "pie", "next".
3. Data Range: click and hold down the left mouse button on the cell in the top left corner of the data group. Drag the mouse until the cells you want to graph are selected. Let go of the mouse button. Select "next".
4. Select "Titles", type in a title for the circle graph.
5. Select "Legend", check "Show Legends".
6. Select "Data Labels", check "Show label and percent", "next".
7. Place chart in: check "as object in" Sheet 1. "Finish"
8. Click the left mouse button and drag the chart to a suitable place on the page.

A Healthy Diet – Teacher Version

WNCP Outcomes Addressed

Strand: Number	
4. Demonstrate an understanding of ratio and rate. [C, CN, V]	➢ Express a two-term ratio from a given context in the forms 3:5 or 3 to 5. ➢ Express a part to part ratio as a part to whole fraction, e.g., frozen juice to water; 1 can concentrate to 4 cans of water can be represented as $\frac{1}{5}$, which is the ratio of concentrate to solution, or $\frac{4}{5}$, which is the ratio of water to solution. ➢ Identify and describe ratios and rates from real-life examples, and record them symbolically

Required Materials

For the students to complete this project you will need to collect/do:

- Book a computer lab for 1-3 classes
- Print off sufficient copies of *Canada's Food Guide (page 5 – found at end of this document)* or provide the following link: http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/educ-comm/index_e.html

Assessment

Of Learning	Teachers can assign marks to each "step" of the process. We will leave this up to your professional discretion.
For Learning	Exceeds Expectations: • Student can write either term, in a two term ratio, as a 1. • Student can extract meaning from a ratio • Student can compare ratios to extract meaning • Student can evaluate their eating habits based upon their findings
	Meets Expectations: • Student can write either term, in a two term ratio, as a 1 • Student may need assistance in extracting meaning from a ratio • Student can compare ratios, but needs assistance in extracting meaning • Student can evaluate their eating habits based upon their findings
	Does Not Yet Meet Expectations: • Student needs assistance writing either term, in a two term ratio, as a 1. Student may be proficient as writing x:1 but has significant difficulty when the ratios are written as 1:x • Student needs assistance in extracting meaning from a ratio • Student needs assistance in comparing ratios and/or extracting meaning • Student can evaluate eating habits, but conclusions are not based upon findings from this activity.

Canada's Food Guide: Page 5

WHAT **AMOUNT** OF FOOD SHOULD PEOPLE EAT?

Canada's Food Guide recommends how many Food Guide Servings people should eat from each of the four food groups, plus a small amount of added oils and fats. The recommended number of servings is different for people at different stages of life and is different for males and females. The recommended number of Food Guide Servings is an average amount that people should try to eat each day.

RECOMMENDED NUMBER OF FOOD GUIDE SERVINGS PER DAY

	Children			Teens		Adults			
	2-3	4-8	9-13	14-18 Years		19-50 Years		51+ Years	
	Girls and Boys			Females	Males	Females	Males	Females	Males
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3

The eating pattern also includes a small amount (30 to 45 mL or about 2 to 3 tablespoons) of unsaturated fat each day.

People who are at a healthy weight but need more food, such as those who are very active, should be encouraged to choose extra servings from the four food groups to continue to follow a healthy eating pattern that is lower in fat, sugar and salt.

Project Written & Designed by: Monique Lopes
Project Edited by: Katie Hay & Brad Epp
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