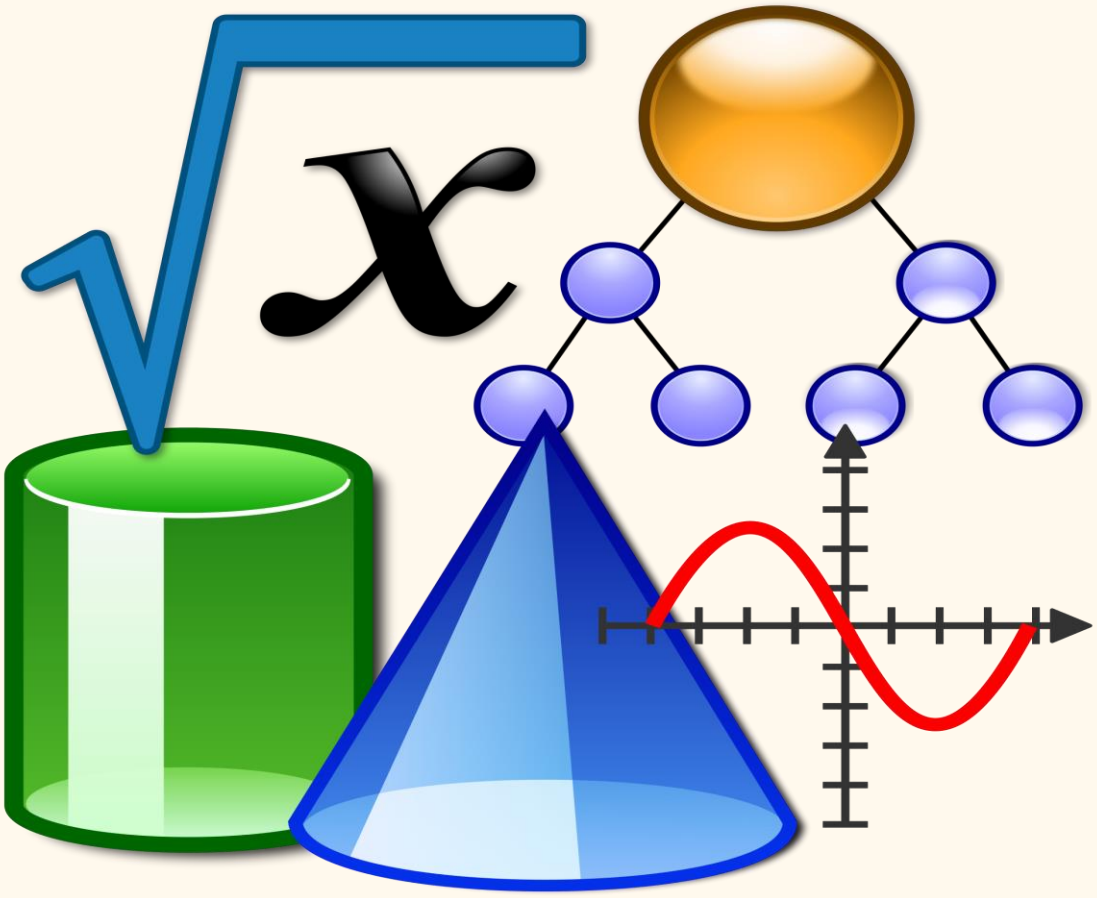
Meeting the Needs of GIFTED CHILDREN IN MATHEMATICS



Jenny Dewan (VP, Learning Support Services OCDSB)

Julie Corrigan (Teacher, Math Lead OCDSB)

Beyond Just Depth & Complexity

Author: Ian Byrd
Excerpt from: *http://www.byrdseed.com/depth-complexity-alone-not-enough/?icn=srs*

Dr. Kaplan's prompts of depth and complexity are an *incredible* tool to begin differentiating learning objectives. Teachers can quickly modify a lesson's goal to increase the challenge. But I frequently see the prompts used at a surface level in classrooms.

Sure, you can drop "patterns" into an objective to raise the level of the content, like so:

- Before: "Look for a character's actions"
- After: "Look for *patterns* in a character's actions."

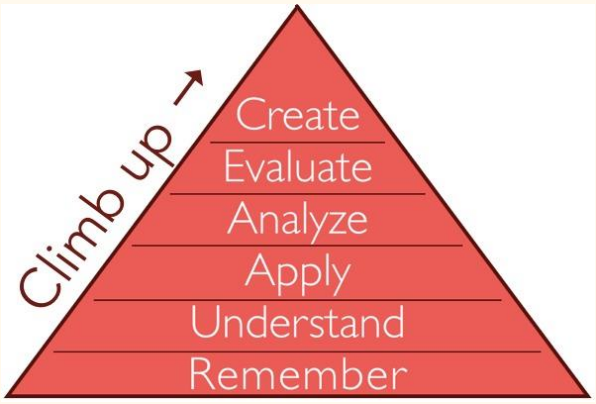
Note, however, that the *thinking skill* is unchanged. Students are still "looking for."

Often, I see students working with a grid that simply asks them to "identify details, identify patterns, identify rules…" and so on. But on Bloom's Taxonomy, "identify" is a bottom level skill. Yes, kids are identifying more advanced content, but we shouldn't let them stay at the bottom of Bloom's for too long.

Climb The Taxonomy

Instead, climb Bloom's Taxonomy in combination with a prompt of depth and complexity. Here's an example:

1. Look for patterns in a character's actions.
2. Compare the patterns in this character's actions with another character's.
3. Judge the ethics of the patterns we see in this character's actions.
4. Create a new situation that would continue this pattern.



At each step, students are forced to *think harder* about the patterns they've uncovered. They're no longer just "identifying".

Finding The Conflict in Math

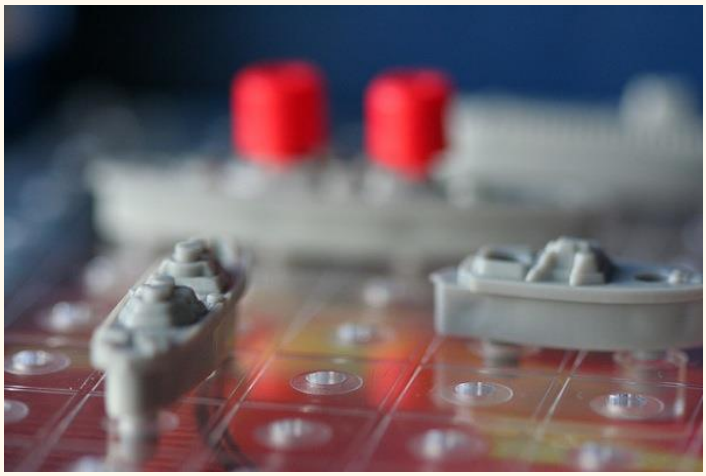


Photo by John-Morgan

As I've been thinking about how to develop useful math projects, I settled on a four-item checklist:

- Authentic Data
- An Intriguing Conflict
- An Expert's Perspective
- A motivating product

If you know where to look, the web is rich with authentic data, but it doesn't necessarily have an intriguing conflict. The measurements of the Great Pyramid are cool, but where's the conflict? Where does the project go? What draws students in if they're not inherently interested in pyramids?

Let's find the conflict in our data and get students asking questions that require math to answer.

As always, a never-ending hat tip to Dan Meyer for inspiration.

Combine

If we've got one interesting piece of information, we can jam it together with another. This juxtaposition often shines light on otherwise hidden conflicts.

Usain Bolt's Olympic record for the 100m dash is impressive, but does it have a juicy conflict? Combine it with the fastest mammals on earth and one has to wonder how Bolt would compare. Is he still the fastest? Is he even on the list? How much faster is the fastest mammal?

These are all "math questions" that can lead to an interesting investigation for our students.

Take the the Dallas Cowboys' total attendance for home games in 2011: 684,096. Ok. So what? Combine it with the Bears attendance of 497,166 and an intriguing conflict blooms. Why do so many more people attend Cowboy games? Is it always like this? Is the comparison fair? How do the other teams compare?

Look Across Time

We can also find conflict by look at the changes in data over time.

Here's the history of the 100m olympic record. The fastest humans keep getting faster. So how quickly is this record changing? Is there a point where humans will out-sprint the fastest mammals? How long will this take? Is it physically possible for our bodies to get much faster?

Look at the Cowboys' attendance over three years:

Year	Attendance
2011	684 096
2010	696 377
2009	718 055

New questions jump out: why is attendance going down? Is a 30k drop significant? Is the decrease speeding up? When will there be *no one* at a Cowboy's home game?

Combine this with the Bears' attendance over the same period and even more conflict arises:

Year	Cowboys	Bears
2011	684,096	497,166
2010	696,377	497,561
2009	718,055	498,000

Why are the Bears maintaining their attendance while the Cowboys aren't? How long until the Bears' games are better attended than the Cowboys? Why is this happening!?

Zoom Out

Finally, we can take data and then zoom out, looking at it from a larger context.

The United States has a population of 314,785,000 people. That's a lot of people, but now look at the bigger picture: this is only 4.5% of the earth's population. I can't help but ask: what countries make up the biggest chunk of the other 95.5%? How many countries are more populated than the US? What percent does China represent? How many USs make a China?

Let's look at the Cowboy's attendance from the zoomed out perspective of the city of Dallas.

Cowboys	Dallas
684,096	1,223,229

How about Chicago?

Bears	Chicago

497,166	2,707,120

Even though I'm not a football fan, there's a natural conflict that draws me in. Chicago's a significantly larger city, yet fewer people attend Bears games. Why?

Finding The Data

I'm cataloging authentic data that I've come across, but what if you want to find your own? Where do you start? The internet's a big place.

My richest source of data is Wikipedia. To dive straight into that richness, simply search Google for "wikipedia fastest" or "wikipedia best selling" or any other combination of "wikipedia" and a superlative. You'll find some great data.

- smallest
- longest
- oldest

From these types of searches, I find

- The world's tallest people
- A list of the longest tunnels
- The smallest fish in the world
- A list of the world's oldest trees
- The best selling video game franchises of all time

Start bookmarking the ones that really interest you. Print them out and collaborate with your colleagues. Share them on Twitter. Once you find a truly intriguing conflict, the project will build itself.

There's a video related to this article at Byrdseed.TV →

http://www.byrdseed.com/finding-the-conflict-in-math/

Three-Part Math Lessons

A three-part math lesson allows the use of an open question which either allows for various possibilities in the responses and/or several ways in which one may attempt to solve the problem. Through the method of exploration of math, the teacher would consolidate his/her main points at the end of the lesson. Allow time within the lesson for students to persevere through the math, build math vocabulary and develop critical and creative thinking skills. Teachers may use the Target sheets to gain insight into students own thinking about the math, the assessment for learning sheet will help teachers track any misconceptions in students' mathematical understanding and help to inform a plan to move student learning forward.

Gifted students can thrive in this kind of environment because their thinking process is not constrained to one way of solving a problem.

Sketch of a Three-Part Lesson

Source: **Capacity Building Series, The Literacy and Numeracy Secretariat, May 2007**

Before: Getting Started: 10–15 minutes

The purpose of this preliminary part of the lesson is to get the students to be cognitively prepared for the lesson problem by having them think about ideas and strategies they have learned and used before. The teacher organizes a revisit to a concept, procedure or strategy related to the lesson's learning goal. The revisit might be a class discussion of the previous lesson problem, students demonstrating methods or strategies that were developed to solve previous problems, or students solving a smaller problem that evokes prior knowledge, skill and strategies.

During: Working on It: 30–40 minutes

For this part of the lesson, the students are actively solving the problem. They work in small groups, in pairs, or individually to solve a problem and record the mathematical thinking they used to develop solutions. Students develop independence and confidence by choosing the methods, strategies and concrete materials they will use, as well as ways to record their solutions. When students are given sufficient time to solve a problem, they learn to develop perseverance and come to expect that solutions will not be immediately apparent and that it takes time to solve a math problem.

While the students are making a plan and carrying it out to solve the lesson problem, the teacher circulates, making observations about the ways students are interacting and taking note of the mathematical models of representation, methods, strategies and mathematical language the students use to develop their solutions. If students are stuck, the teacher might pose questions to provoke further thinking or have other students explain their plan for solving the problem.

After: Consolidation and Practice: 10–15 minutes

In this phase, the teacher strategically coordinates student sharing of solutions to the lesson problem, using a mathematical instructional strategy like bansho or math congress or a gallery walk. By using such a strategy, the teacher can facilitate a whole-class discussion whereby students explain the mathematics in their solutions, methods, and strategies and discern whether classmates used the same or different strategies.

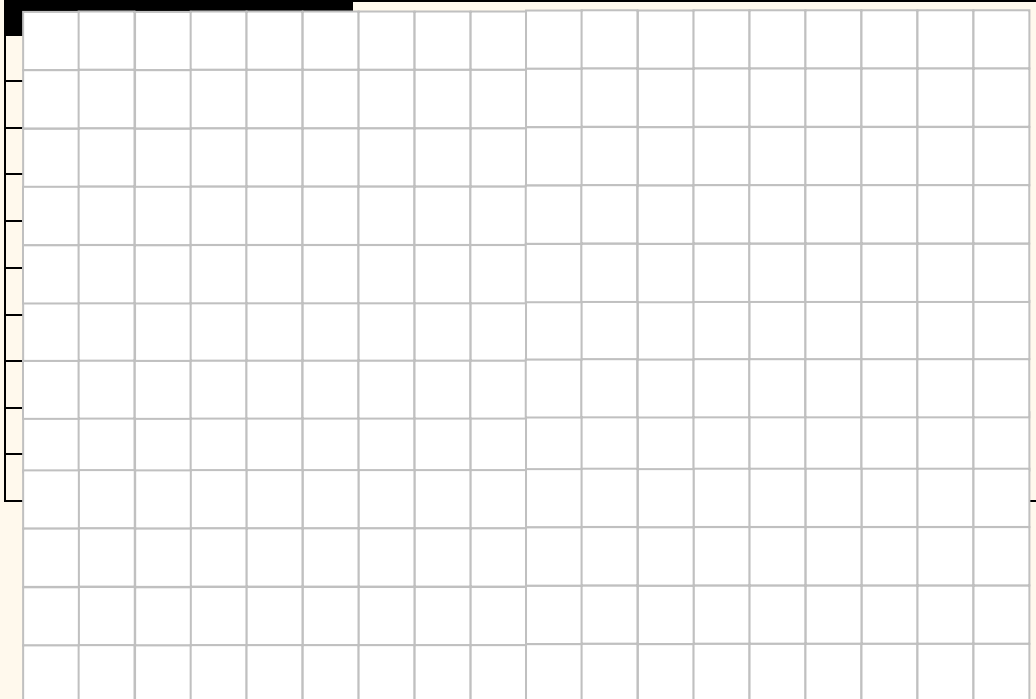
Through such co-ordinated sharing and discussion, students can hear and analyze their classmates' mathematical thinking. Also, the students learn to discern similarities and differences in the mathematics, methods and strategies inherent in other students' solutions. Such discernments provoke students to make connections between their own mathematical ideas and the ideas of others and to understand the mathematics within and across math strands.

Further, through such rich mathematics classroom discourse, students develop and consolidate their understanding of the learning goal of the lesson in terms of making connections to prior knowledge and experiences and making generalizations.

New methods and strategies derived from student solutions are posted on the class's strategy walls or used to develop a class mathematics anchor chart. What the teacher learns from students about their understanding is directly related to the types of questions asked. What the teacher learns from this discussion will guide the direction of future lessons or activities.

Assessment for Learning Sheet

Lesson/Unit of Study Title		Grade		Date
Activation: **Problem:** **Consolidation:**		Learning Goal/Curriculum Expectations -		



Questions About Students' Mathematics Learning		Students' Mathematical Errors	

Target Sheet

Date(s): (From-To)	**Target** (SMART Goal)	**Reflection of Target** (Have I achieved my target? How? What do I need to continue to develop?)
		Student: _____ _

		Teacher Feedback:
		Student: _____ _ Teacher Feedback:
		Student: _____ _ Teacher Feedback:
		Student: _____ _ Teacher Feedback:
		Student: _____ _ Teacher Feedback:

Activities

For Engagement

The following are activities you may wish to try in your classrooms. Adapt these activities to suit the needs of your students.

Top 5 Creative/Critical Thinking Activities: *Math*

1. Real life scenarios. Have students attempt to create budgets for real life scenarios. Then present and justify their budgets to the class. Did they forget about any expenses? What types of decisions were they forced to make? What makes budgeting easy/more difficult?

2. Create your dream home. Have students create a blueprint of their dream home. They then must decide what it would cost for the flooring and drywall of their dream home. They must justify their responses using sound mathematics. Steps- 1) Design the blue print. 2) Calculate the area of the rooms. 3) Decide on what materials they wish to use for the flooring in each room. 4) Find out the price for the flooring 5) Have students discover how much it would cost THEN you may work on the dry wall. How much wall space/surfaces are to be covered in their home? Are there doors/windows that would

take away from this wall space? How much does drywall cost? How many floors will they have? Do they have the blueprint design for each floor? What would the total drywall cost be? See attached resource.

3. Stock Market. Hand out a photocopy of a current newspaper that has printed stock prices. Students will have a specific dollar amount that they may spend on stocks. They may buy all one companies stocks or diversify. They are to justify how they decided to spend their money. Weekly they will calculate their new stock value. At this time they will be able to buy and sell at the current prices based on their new financial situation. They must again justify their decisions. You will collect these each week. At the end of the month the person who has earned the most money buying and selling stocks will be the stock market champion💻 (This may also be done in groups)

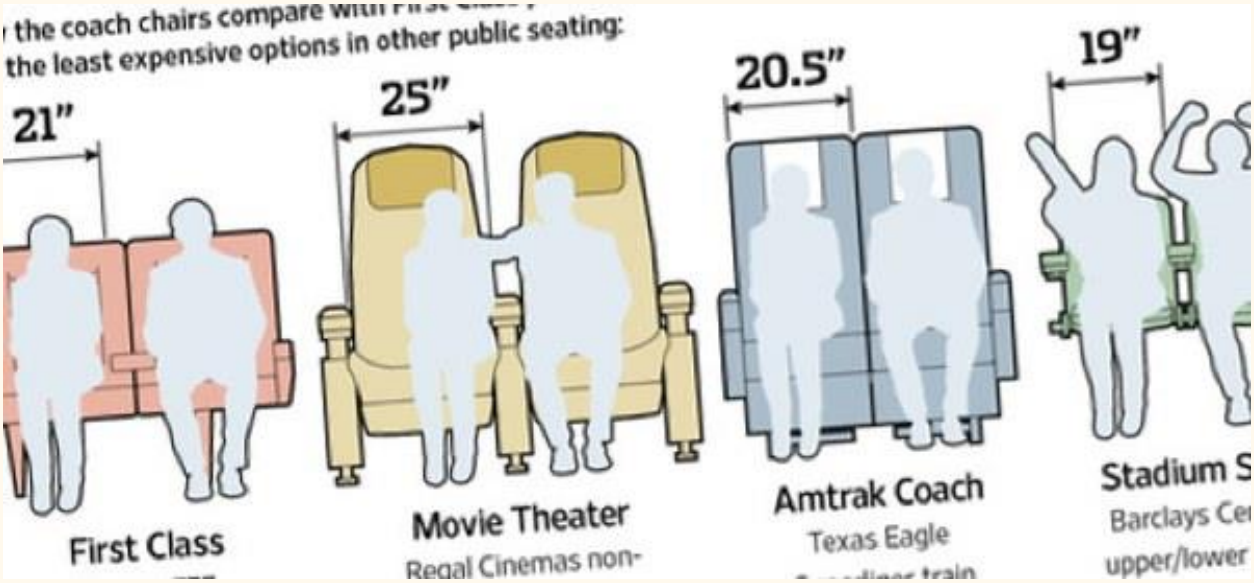
4. Create an amazing race. Each group will be given a math strand. They will have to develop the questions for an amazing race game (like the example provided). They will also have to provide an answer key. What makes a good math question? Are the questions appropriate to the grade/curriculum level?

5. Design a *colour by number* piece of art using mathematical calculations/questions. You may focus on one particular strand in the curriculum or several. Test out your activity by giving other classmates your *colour by number* art activity to see if they are able to recreate your piece of art.

Math Project: Shrinking Airline Seats

Photo by Kevin Dooley

The Wall Street Journal has an article about airline seats shrinking over time. It's packed with measurements which scream "math project" to me. (http://online.wsj.com/news/articles/SB10001424052702304384104579141941949066648)



Full image at the Wall Street Journal

Some relevant data from the article:

- There are ten seats per row in economy on a Boeing 777 with two aisles
- Economy seats are 17″ wide
- Aisles are 17″ wide, plus two 2″ armrest spaces on each side (so 21″ except at your knees)
- First class seats are 21″ wide
- Regal movie theater seats are 25″ wide
- Amtrak seats in coach are 20.5″ wide
- Stadium seats at Barclays Center are 19″ wide
- In the 1990s, Boeing 777s had 18.5″ seats in coach
- Update! Another article from the Sydney Morning Herald, explaining the sleep benefits of a one inch increase in seat width.* (http://www.smh.com.au/travel/sleeping-on-planes-why-one-extra-inch-makes-all-the-difference-20131029-2wdns.html)

What's The Project?

I want to hear what you might do with this intriguing data, but here were a few quick ideas I had:

- Find the width of school chairs and compare to airline seats.
- Build a scale model of coach and first class seats.
- Multiply across the rows to find its total width, compare with the actual data http://en.wikipedia.org/wiki/Boeing_777

What kind of a project would you build around this data? Remember to think about conflict in math.

Grade 6 math Project!
Making a BOOK!

Name:_____

DUE DATE:_____

Your job is to write a Math book about fractions for your friends. This book should be written as a teaching tool for your peers who need to know more about fractions.

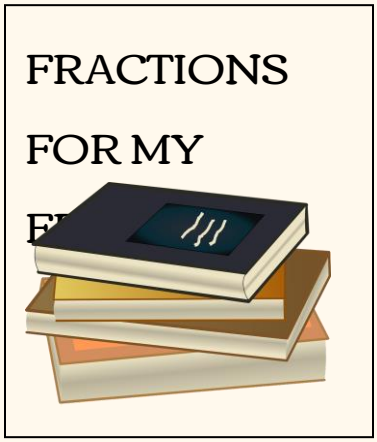
You will have to cover the following chapters:

Chapter ONE

-Fractions; what are they?
-What is a LCM and GCF?

Chapter TWO

-Adding and subtracting fractions; common denominators are are your friend!



Chapter THREE
-'Honey, I shrunk the Fraction'; How to reduce to simplest expression.

Chapter FOUR:
-Multiplication and Division of Fractions; challenging? Not really!

Chapter FIVE:
-Fractions, ratios, decimals and percents. We are all related!

In each chapter, you will need to make sure explanations are clear, short and to the point! Include examples, practise questions and word problems for each chapter.

Checklist:

I have illustrations in colour for each concept	I have given explanations to the readers as 'Steps to Follow'…	My explanations include plenty of examples.
I have a -cover page and table of content -glossary at the end.	My page layouts are neat and clear.	I have included practice questions for each concept.

Fraction Book Rubric

Name:_____

	Level 4	**Level 3**	**Level 2**	**Level 1**
Concept Explanations: I have given explanations to the readers as 'Steps to	Concepts are communicated with exceptional clarity. All readers could understand	Concepts are communicated with considerable clarity. Readers would understand	Concepts are communicated but lack the required clarity. Readers would likely need further help to	Concepts are difficult to understand. Much more detail is needed in order for a reader to

Follow'…	ideas with no need for further clarification.	ideas, requiring minimal clarification.	understand ideas outlined in the book.	understand concepts clearly.
Examples: I have included practice questions for each concept…	Practice questions are relevant and include many word and number problems.	Questions provide a good level of practice for the reader. Includes number and/or word problems	Some review questions are included for the reader.	There are a limited number of review questions for the reader.
Book Requirements: I have a -cover page and table of contents -glossary at the end	Exceeds expectations	Meets most expectations	Some expectations are met	Limited number of expectations are met.
Book Layout: Fulfill chapter requirements as identified in project outline.	Student has taken exceptional care to divide concepts into appropriate chapters. Titles and subtitles divide ideas clearly.	Chapters contain appropriate content. Titles and subtitles are used with considerable effectiveness.	Most chapters contain appropriate content. Titles and subtitles are used with some effectiveness.	Material is divided into chapters with limited effectiveness. Titles and subtitles are not effectively used.

Candy Question Option 1

Sara and Jessica have a bag with 173 candies. They would like to put the candies in 12 bags. How many candies would be in each bag? Justify your thinking.

Candy Question Option 2

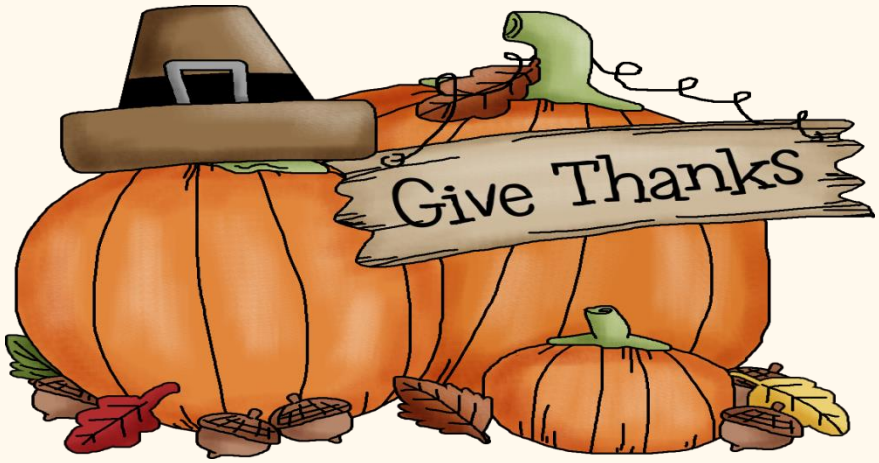
Sara and Jessica have a bag with 473 candies. They would like to put 12 candies in each bag.

- How many candy bags could be made?
- What if every third bag had an extra candy and every fifth bag received a sticker? How many bags would have 13 candies and a sticker?

Amazing Race Activity

This activity may draw a link between Physical Activity and Math. At each station, students can be asked to complete a physical task before being given the question. This activity can be used as a unit review, to commence a unit or as a summative exercise. Gifted student can be tasked with the challenge of creating the questions that will be solved. Either way, students will have fun racing to the finish.

QUESTION 1 **Symbol**



Mena wanted to give thanks by holding a fundraiser to raise money to buy food for the Ottawa Mission. Mena decided to buy bracelets that say “I gave thanks” as her fundraiser. Each bracelet cost her $0.75. She sold each bracelet for $2.00. At the end of the fundraiser she had sold 280 bracelets. If a turkey costs $35.00 how many would she be able to buy for the Mission with funds raised from this event?

m) 10

n) 5

0) 12

P) 30

QUESTION 2 **Symbol:**

My puppy Hattie wanted to find an equation that would determine how many leaves would fall next year, if the number of leaves that fall from each tree were to double each year. We currently have 3 trees with leaves that fall on our property.

Below are four equations, which one could be used to determine the number of leaves to fall next year given the information above?

A) If X1, X2 and X3 represent the three trees then:
2(x1)+2(x2)+2(x3)=

B) If X1, X2 and X3 represent the three trees then:
2+x1+2+x3+2+x3=

C) 2X+2X+2X+2X=

D) 2 (x+x+x) =

Question 3 **Symbol**

The basket above holds several fruits and vegetables. If the total weight of the basket is 10kg and apples account for 20% of the weight of the basket, how much do the apples in the basket weigh?

R) 3000g

S) 4000g

T) 2kg

U) 5kg

Question 4 **Symbol:** 

Five Looney Toon characters are coming to Thanksgiving dinner. If the turkey weighs 14kgs and you want to share the turkey equally amongst the 5 guests how much turkey should each character get?

E) 2.5kgs

F) 2.6kgs

G) 2.7kg

H) 2.8kg

Question 5 **Symbol:**

Snoopy and Woodstock started with 1 pumpkin. Each day they planted three more pumpkins. What equation below can help to represent this pattern?

H) 1(3+N)

I) 1+ 3N

J) 3+ N

K) (3+n)X

Question 6 **Symbol**

I went to buy flowers for Thanksgiving dinner, I need 48 flowers total. Costco sells flowers in a bouquet of 48 for $15.45. Rose Country sells bouquets of 24 for $7.99. Market Flowers sells a dozen for $4.25. Finally, Shelly's Budding Business sells a bouquet of half a dozen for $2.00, which store is the best value?

P) Shelly's Budding Business

Q) Market Flowers

R) Rose Country

S) Costco

Question 7 **Symbol**:

Students are writing Thanksgiving notes for their friends around the world. If a class of thirty students is able to write 40 cards an hour, how many cards can be written in an hour if all 270 students (writing at the same speed) were to participate?

F) 360

G)370

H)380

I)390

Question 8 **Symbol:**

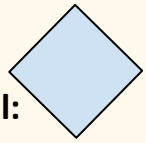
My mom owns a pie company and Thanksgiving is one of her busiest times of year. If she travels an average of 40km/hour delivering pies and she has to travel a total of 220km to complete all her deliveries, how long will it take her to deliver all the pies?

U) 5.5hours

V) 20 hours

W) 40 hours

X) 7 hours

Question 9 **Symbol:** 

For Thanksgiving I bought each student in the class a treat. The treats cost $2.00 each. I have 30 students in my class. If tax is 15% how much tax will I pay on my total purchase?

M) $5.00

N) $9.00

O) $3.00

P) $6.50

THANKSGIVING AMAZING RACE!

Let the race begin! Choose a partner and try to decode the mystery sentence. Remember you need to place the symbol beside each question in order to complete the race. Good luck!

Question Number	Symbol	Answer

Below place your letter answers in order to make a sentence. Race back to meet your teacher!

The SENTENCE: ___ ___ ___ ___ __ __ ___ ___ ___!

Guess the Question

1. The answer is 48 what is the question?
2. The first integer is the sum of (20% of 70) and the (prime number whose two divisors are 1 and 17).
3. The second integer is the first odd prime number.
4. The final integer is difference between the second number in this equation and the number one.
5. The first operation used is the operation used when a product is the response.
6. The second operation used is the operation used when a quotient is the response.

Answer: 32X3÷2

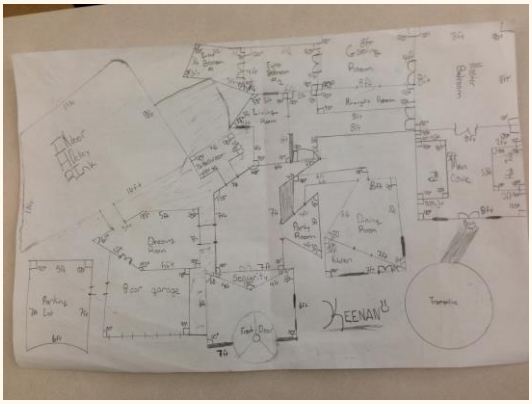
Dream Home Project

Create your dream home! Design a floor plan for a builder which outlines the lengths of your walls and angles of your corners. Your dream home must include:

- Living room
- Dining room
- Kitchen
- 1 octagon/pentagon/hexagon room (you choose the shape)
- 1 isosceles triangle room
- front entrance
- windows (labeled)
- doorways
- hallways
- special rooms of your choice (basketball court, pool room, arcade)

Be sure that all of your wall lengths are measured correctly and all interior angles are labeled. A rubric is included for your reference.

Have fun and be creative!



Sample floor plan

Sample dream home with 3D walls

More Critical/Creative Thinking based Math Activities
Grade 7

Rocket Ship Activity:

Activity 1a- Creating a blueprint

Design the inside of a rocket ship (control room, sleep quarters, viewing room, bathroom…) Provide the measurements (height, width, length) of each room so that you provide the calculations of the area of each space.

Activity 1b- Designing the exterior of the ship

Considering the inside space of the rocket ship what would the surface area of the outside of the rocket ship be? Show and justify these calculations.

What type of materials would you need for the outside of the rocket ship?

How much would it cost for all of the materials required to cover the outside of the rocket ship?

Create an itemized price list with calculations explaining the costs of all the materials needed for the outside of the ship.
Using google 3-D sketch or another similar program create the outside of your rocket ship
Activity 1c- Using your 3-D sketchup model as a guide create a miniature scaled down version of your rocket ship using materials of your choosing? Calculate the dimensions of your scaled down rocket ship and prove how it is an accurate representation of your original sketch.

Creating a Game Activity:

Sudoku is a popular pattern-based math game

Your objective is to create your own pattern-based math games in hopes of taking away some business from Sudoku. Your games must include:

- Directions on how to play
- The games
- An answer key showing how the game is solved
- A teacher guide explaining all the math patterns

Note: By the end of this activity you should have created one math activity pack with all your games, a separate answer key for those playing, a separate teacher guide so that teachers may use this as a patterning teacher tool.

Hockey or Ballet?

Using information found on the internet you must prove whether or not a boy living in Ottawa has a better percentage chance (likelihood) of making it to the NHL or to the Royal Winnipeg Ballet.

In your response you must determine the percentage likelihood of a boy from Ottawa making it into the NHL and the percentage likelihood of a boy from Ottawa making it into the Royal Winnipeg Ballet. Show your calculations and justify your response.

Items to consider:

- How many ballet schools we have in the Ottawa area? Percentage of boys in Ballet?
- How many ballerinas enter into the Royal Winnipeg ballet school each year? How many of those are boys?
- Statistically, how many Ottawa Boys have ever worked for the Winnipeg Ballet? How many are hired from elsewhere?
- How many hockey programs do we have in the Ottawa area? Percentage of boys in these programs?
- Statistically, how many Ottawa hockey players have been in the NHL?
- How many hockey players enter into the NHL every year? How many are from Ottawa vs. Other?

In your response include:

-All items you considered, facts/information

-All calculations used

-Your final response, percentage likelihood for both scenarios

-Final reflection paragraph, is this an exact science? Is there anything else that one should consider that may impact likelihood in these cases?

Number-line Activity

In this activity students are each given a card with a specific number.

Students are asked to pair up or find cards with equivalent values.

Then, students are asked to create a number line that places these

values with their equivalent value onto the number line. Number-lines should be created on a large chart paper with a marker in order to share/discuss as a whole group at the end of the activity. This activity allows students to compare numerical values and critically think about numbers as they relate to a number line. Depending on the grade of your learner, the values of the cards may change but the premise remains the same.

Sample number cards are included in this package.

½	0.5

50%	20%
1/5	0.2

1/10	0.1
10%	30%
3/10	0.3

24/60	0.4

40%	60%
72/120	0.6

343/490	0.7
70%	80%
16/20	0.8

27/30	0.9

90%	35%
21/60	0.35

54/120	0.45
45%	65%
78/120	0.65