Mathematics Newsletter

Probability

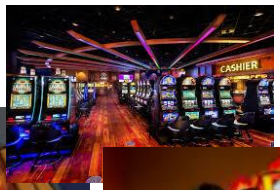
Pages 1 - 6

Probability is often taught in June. This is a great time to teach this fun topic, except for the following cautions:

- It is hot. Really hot. It can be too hot to really talk about what is important mathematically about probability.
- We run out of time for teaching the "important math", put off teaching probability and we wind up not really giving probability much time and attention.

Aside from the concern that we are not really teaching the curriculum, there is a much deeper caution that matters to our students' lives as future citizens:

Our study of probability is the only study of probability most students will ever get in their entire educational career.



We have a moral responsibility to ensure that, by the end of Grade 8, our students can reason about probability situations in ways that allow them to make responsible decisions into their adulthood!

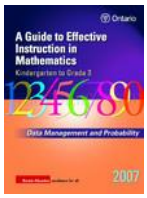
Investigating Probability with Students in Kindergarten and the Primary Grades

There is not a section in the Van de Walle K-2 and 3-5 books for Probability. In the United States, the Common Core Curriculum does not formally study probability until Grades 6 to 8. Ontario has followed a different route; we very slowly introduce students to the language and some big ideas about probability so that students use the vocabulary correctly and have a firm foundation once they get into a more in-depth study of probability in Grades 5 to 8.

Big Ideas from Dr. Small Grades K-3, p.197

1. Categorizing events using terms such as *likely, certain, impossible*, and *unlikely* is a way of describing probability. (Kindergarten – only Big Idea #1)
2. In experimental situations, we base our predictions on past events.
3. In a probability situation, you can never be sure what will happen next.

"Simple games and experiments help students explore concepts related to probability. Such experiences allow students to make predictions about the outcomes of games or experiments, examine actual outcomes, and discuss reasons for these outcomes. Probability games and experiments also encourage students to confront their misconceptions about chance (e.g., that there are lucky numbers in a game)." Guide to Effective Instruction K-3 Data Management and Probability, p.31



Since Van de Walle does not have a chapter on probability for primary grades, other resources that will support this learning cycle include:

Guide to Effective Instruction in Mathematics, K-3, Data Management and Probability - Full Lessons

- Kindergarten - What will we see on our walk? p.67
- Grade 1 - Predictions for the Week, p.85
- Grade 2 - Game Testers, p.107
- Grade 3 - Take Off, p.129

Questioning students about probabilistic situations gets them thinking and using the vocabulary of probability. Be sure that students are given the opportunity to justify and communicate their reasoning.

(from *Good Questions for Math Teaching* by Peter Sullivan and Pat Lilburn)

- Someone asked the teacher a question and she replied, "Maybe." What might the question be?
- Child: Can I go out with my friend in one hour?"
  Mom: It is possible (or certain, unlikely); it will be dark then.
  What might the time be?
- My older sister was talking to Dad and asked him a question. His reply was, "It is more likely, than unlikely." What might the question be?

Younger children believe that their preferences will influence the outcome and it takes many experiences with random outcomes and lots of conversations to unseat this misconception. ***You can never be sure what will happen next in a probability situation!***

Investigating Probability with Students in the Junior and Intermediate Grades

Big Ideas from Teaching Student Centered Mathematics Grades 6-8, Van de Walle, p. 354
Reminder: Van de Walle does not have a chapter on Probability for junior grades. You may want to ask to borrow your Intermediate colleague's book – a great opportunity for professional collaboration! *There is also a copy of the VdW chapter from the 6-8 book in First Class → Mathematics →Newsletters 2014-2015; it has great ideas for all grades.*

1. Chance has no memory! The chance occurrence of six heads in a row has no effect on whether another head will occur on the next toss of the coin. That chance remains 50-50.
2. The probability that a future event will occur can be characterized along a continuum from impossible (0) to certain (1). A probability of ½ indicates an even chance of the event occurring.
3. The relative frequency of outcomes (of experiments) can be used as an estimate of the probability of an event. The larger the number of trials, the better the estimate will be.
4. In a probability situation, you can never be sure what will happen next.

(Big Ideas by Dr. Small 4-8)

What kinds of probability experiments should I do with my students?

Overall Expectations:

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
1m71 • describe the likelihood that everyday events will happen.	**2m75 •** describe probability in everyday situations and simple games.	**3m77 •** predict and investigate the frequency of a specific outcome in a simple probability experiment.	**4m87 •** predict the results of a simple probability experiment, then conduct the experiment and compare the prediction to the results.	**5m73 •** represent as a fraction the probability that a specific outcome will occur in a simple probability experiment, using systematic lists and area models.	**6m69 •** determine the theoretical probability of an outcome in a probability experiment, and use it to predict the frequency of the outcome.	**7m72 •** compare experimental probabilities with the theoretical probability of an outcome involving two independent events.	**8m67 •** use probability models to make predictions about real-life events.

simple probability experiment – an experiment with the same possible outcomes each time it is repeated, but for which no single outcome is predictable; for example, tossing a coin, rolling a number cube. (Ontario Mathematics Curriculum (2005), Glossary: p. 132)

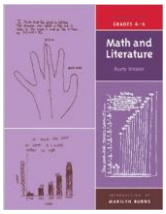
independent events – two or more events where one does not affect the probability of the other(s); for example, rolling a 6 on a number cube and drawing a red card from a deck.

(Ontario Mathematics Curriculum (2005), Glossary: p. 126)

Instructional Ideas:
The NCTM (National Council of Teachers of Mathematics) has a wonderful online tool which allows you (or students) to set up a spinner with equal regions and set the spinner for as many

spins as you desire. The spinner can be spun one spin at a time or a button can be clicked that takes you to the results of a desired number of spins. In this way, you can compare the experimental probability of a few spins with the experimental probability of a great many spins without having to conduct the experiment 1000 times! What a time-saver!!!

Adjustable Spinner - http://illuminations.nctm.org/adjustablespinner/



Jumanji by Chris Van Allsburg - Read aloud and solve the math problem. See the full lesson in *Math and Literature Grades 4-6* by Rusty Besser (Introduction by Marilyn Burns)
Grade 4 - predict the outcome, conduct the experiment and investigate how the number of repetitions can affect conclusions
Grade 5 - determine all possible outcomes and represent with the fractions

Guide to Effective Instruction in Mathematics, Grades 4-6, Data Management and Probability

Full Lessons

- Grade 4 - Heads or Tails?, p.55
- Grade 5 - Lost Socks, p.81
- Grade 6 - Rock-Paper-Scissors, p.104

Questions to get students thinking and using the vocabulary of probability - be sure that students are given the opportunity to justify and communicate their reasoning.

(*Good Questions for Math Teaching Grades 5-8,* L. Schuster and N. Anderson, p. 121)

- The probability of a particular event happening is ⅗. Explain the probability of the event not happening. What could the event be?

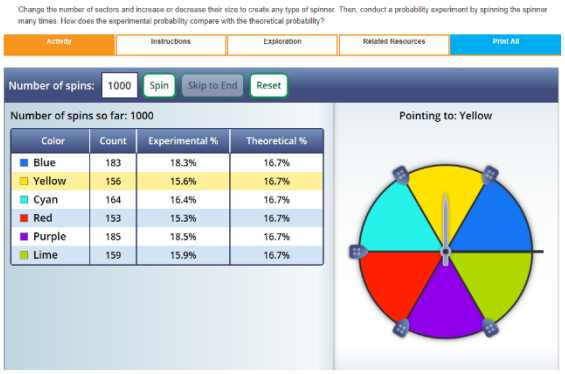
A number line can be a helpful visual aid to support students' thinking about the relative certainty of an event happening.

	25%	50%	75%	
0	¼	½	¾	1
	0.25	0.5	0.75	
impossible	less likely		more likely	certain

In what ways can we use probability to reinforce skills and understandings from previous strands?

Grade 6 - predict the frequency of an outcome of a simple probability experiment or game, by calculating and using the theoretical probability of that outcome (e.g., the theoretical probability of spinning red is ¼ since there are 4 different-coloured areas that are equal. If I spin my spinner 100 times I predict the red should come up 25% of the time). Sample problem: create a spinner that has rotational symmetry. Predict how often the spinner will land on the same sector after 25 spins. Perform the experiment and compare the prediction to the results. → Geometry, Number Sense (fractions and percents)

Intermediate Learning Experiences:



Since the Grade 7 and 8 expectations build from those in the Junior grades, similar experiences will form the starting point of a learning cycle for Probability. The Adjustable spinner, described on page 3, will help as students compare theoretical and experimental probability:

Adjustable Spinner -
http://illuminations.nctm.org/adjustablespinner/

The Ministry of Education also outlines a unit of study of probability, available at the **TIPS 4RM** website: Grade 8 Unit: Probability.

From Teaching Student-Centered Mathematics Grades 6-8:

- Activity 16.5 Design and Trade, p.357 Van de Walle
- Bulls Eye Question, p.361 Van de Walle (a great opportunity to revisit area of circles!)
- Activity 16.10 Lu-Lu, p.367 Van de Walle

Questions to get students thinking and using the vocabulary of probability - be sure that students are given the opportunity to justify and communicate their reasoning.

(*Good Questions for Math Teaching Grades 5-8* by L. Schuster and N. Anderson p.129, 130*)*

- Pete wants to play a game at a carnival where he'll open one of several boxes. Inside one of these boxes are some envelopes. Inside one of these envelopes is a hundred-dollar bill. Pete figured out correctly that he has a 1/12 chance of winning. How many boxes and how many envelopes might there be?
    - Encourage students to use an organizational tool, such as a tree diagram or an area model, to answer this question.
- A weather reporter predicts that there is approximately a 40 percent chance of having rain on both days of the weekend. What might be the chance of rain each day?
    - Weather reporters rely heavily on probability. Therefore, instruction on probability should help students make sense of what they hear and read in these reports.

In Grade 7, students are to research and report on real-world applications of probabilities expressed in fraction, decimal, and percent form. Using these data, students are to make predictions about a population. The curriculum gives the following example of using probabilities in this way:
The probability that a fish caught in Lake Goodfish is a bass is 29%. Predict how many bass will be caught in a fishing derby there, if 500 fish are caught.

Prizes and the chance of winning

Number of matches	Win	Probability of winning on one play
6/6	Jackpot win or Share of 79.5% of the Pool's Fund	1 in 13,983,816
5/6 + Bonus	Share of 6% of the Pool's Fund	1 in 2,330,636
5/6	Share of 5% of the Pool's Fund	1 in 55,492
4/6	Share of 9.5% of the Pool's Fund	1 in 1,033
3/6	$10 prize	1 in 56.7
2/6 + Bonus	$5 prize	1 in 81.2
2/6	Free Play	1 in 8.3
Guaranteed Prize Draw (10 of 10) (exact match only)	$1,000,000	Variable

Overall odds of winning a prize are about 1 in 6.6, though the great majority of prizes consist of a free ticket for the next draw (a break-even scenario at best, not a win in the strictest sense).

The probability of winning some prize [money] in one play is 1 in 32.3.

Data: http://en.wikipedia.org/wiki/Lotto_6/49 "Lotto 649 logo" by Source. Licensed under Fair use via Wikipedia – http://en.wikipedia.org/wiki/File:Lotto_649_logo.svg#/media/File:Lotto_649_logo.svg

What questions do these data stir in your thinking?

Some questions might be:

- If each ticket costs $2.00, what is the yearly cost of NOT winning a $5.00 prize, if the theoretical probability is used? What is the likelihood of winning compared to the likelihood of NOT winning?
- If I know that tossing a coin gives me a 50/50 chance of getting heads **every** time I toss the coin, no matter what I have already tossed, will buying more tickets increase my chances of getting my numbers?
- Who benefits from gambling?

As you consider the data, judge whether spending your money on lottery tickets is a wise investment.

There is a great newspaper article which compares the returns on buying lottery tickets vis-à-vis making standard investments. Please see: http://www.theglobeandmail.com/globe-investor/personal-finance/home-cents/make-money-from-a-lottery-dont-be-a-fool/article613164/

Gambling can be a very sensitive topic among some cultures.
It is wise to discuss how to approach this topic with your principal prior to beginning discussions with your class.