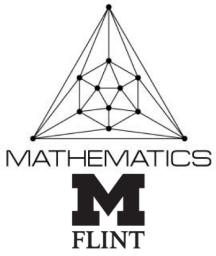
Activity Resource Guide

Family math Night

Fall 2013



ACTIVITY 1

BODY BENCHMARKS

Overview

Certain body measurements are about close to the same size as certain metric units of measurement. For example, your handspan (the distance from your little finger to your thumb) is a convenient way to measure length. Once you measure your handspan, you can use that length to estimate the length of other body parts (such as your height or the length of your arm). Those new lengths can then be used to measure things such as the height of a door or chair or the width of a room. When you have come up with your estimates, use a metric ruler to see how close your estimates were to the actual lengths.

Core Mathematical Concepts

Estimation, measurement, unit conversion

Age/Grade Level Appropriateness

Kids at all ages can generate their body benchmarks and use them to measure different lengths. In particular, kids in early elementary grades are asked to:

- describe and compare measurable attributes (Kindergarten)
- measure lengths indirectly (grade 1)
- measure and estimate lengths in standard units (grade 2)

At Home

All you need is yourself, a ruler, and things to measure! Kids enjoy playing around with measurement and seeing how big they are in comparison to objects. Together you can track how big your child's handspan is getting (for example) in relation to a particular thing such as the height of door to document their growth. Then, you can help your child how to use a ruler to measure the height of the door and practice understanding when it is appropriate to estimate a length and when it is appropriate to be more precise.

ACTIVITY 2

CIRCLES AND LINES

Overview

Draw a circle and some number of lines across the circle (just don't let more than two lines cross at the same point). Then count up how many different regions (or areas) you created inside the circle with the lines. Try to find the maximum number of areas within such a drawing. Can you find a pattern in the maximum number of areas there are when you increase the number of lines drawn? What is your prediction for how many areas would be created by 8 lines?

Core Mathematical Concepts

Area, Shapes, Patterns

Age/Grade Level Appropriateness

Younger kids (grades pre-k and k) work on identifying, creating, and composing shapes, as well as to count the number of objects. Kids in grades 4 and 5 are asked to generate and analyze patterns.

At Home

To do this At Home, you can use anything that creates circles and lines - paper and pencil will work great or you can get creative and use, for example, dry spaghetti or string for the lines and plates for the circles. With this activity, you can help your child understand what is meant by area in mathematics. You can also discuss the importance of finding and using patterns in everyday life.

ACTIVITY 3

HORSE RACE

Overview

Each player chooses a 'horse' (or several horses), where each horse has a number 2 through 12. All horses must compete in every race. One person rolls a pair of dice. The horse with the number equalling the sum of the dice moves forward one space. Continue the game until one horse wins the race. Keep track of how many times each horse wins as the information will help you decide which horse you would like to choose for the next race (this is why you want every horse to compete in every race).

Core Mathematical Concepts

Probability, addition

Age/Grade Level Appropriateness

Kids from kindergarten on up will be able to play the game as the biggest sum they will be finding is 6 + 6. Understanding the likelihood of an event occurring (which horse 'should' win based on how many times each horse has won previously) is something that kids starting in grade 7 start to grapple with.

At Home

All you need is a paper, pencil, and a pair of dice. For younger kids, this activity is a great way to practice basic addition facts. Further the activity starts to explore the idea that a player is more likely to roll two numbers that sum to 7 then say numbers that sum to 12. So you can help your child understand why this is true for a standard pair of dice and to connect that idea to the probability of a particular horse winning. To extend this game, you can change up the dice that you use by changing the operation that you use to create the horse number, the number of dice that you use, or the sides that are on the dice (for example, you can have your child imagine that you have a pair of dice with sides numbering 1,1,2,6 and another with sides 2,3,5,6). Just be careful to change the horse numbers that enter the race to correspond to what you are doing (for example, if you are subtracting the numbers on the dice you might want to include negative number horses). This will further their practice of basic operation facts as well as add to the difficulty of determining the probability of a horse winning.

ACTIVITY 4

FOLDING TETRAHEDRONS

Overview

Make your own tetrahedron (a 3-dimensional shape that it made up of four triangular sides) that can fold flat in an instant. Like origami, this is a fun paper folding activity that is built on the properties of mathematics.

Core Mathematical Concepts

Three-dimensional shapes, critical thinking

Age/Grade Level Appropriateness

Kids are asked build shapes that possess defining attributes, something they start in grade 1 and continue through grade 12 where they are asked to make formal geometric constructions with a variety of methods (such as paper folding).

At Home

You can either go online to find already pre-made ones to fold, or you and your child can draw one out yourselves. All you need is a rectangle that is 28 cm long and 4 cm long. Divide this long rectangle into four smaller equal rectangles (each of length 7cm). Then mark in one diagonal (corner to corner) per square, where the diagonals in each square join at the corners and starting with the diagonal that is 'rising up' . Then crease each line drawn and join the two ends of the long rectangle together using tape to form a band. The band can then be folded into a tetrahedron.

ACTIVITY 5

LETTER SYMMETRY

Overview

A number of objects in our everyday life contain symmetries. Having a symmetry means that one half of the object is exactly the same as another half. We can see this quite easily in some of the letters of the English alphabet. For example, the uppercase letter 'A' has vertical symmetry; if you fold the letter in half matching up the two diagonals, both halves will line up. (Another way to see this symmetry is to flip the letter over side to side; your letter should look exactly the same.) Other letters have 'horizontal' symmetry (folding a letter in half by matching top portion of the letter to the bottom portion). Other letters have rotational symmetry by turning the letter halfway around (imagine turning a doorknob).

Core Mathematical Concepts

Symmetry

Age/Grade Level Appropriateness

Kids of all ages/levels can begin to develop this recognition of symmetric figures. However, kids in grade 4 specifically are asked to recognize a line of symmetry for a two-dimensional figure and to identify line-symmetric figures, concepts that continue well into high school.

At Home

What capital letters of the alphabet have symmetries? Which have more that one kind of symmetry? Try to visually organize (many people use a Venn diagram to do this, but you can pick your own way) which capital letters have vertical symmetry. Which have horizontal? Which have rotational? Which have both vertical and horizontal? Both rotational and vertical? All three? After doing this for capital letters, you can try to do this for lots of other objects: lowercase letters, numbers, items around the house. Have your child go on a treasure hunt around the house or yard and see what they can find. You can also turn this into a restaurant game for when you are waiting for your food to come. Take turns looking around the restaurant and see what items have symmetry and what kind of symmetry. Or use it as a part of playing 'I, spy!'

ACTIVITY 6

MÖBIUS STRIP

Overview

A Möbius Strip (named after August Ferdinand Möbius) is a surface that has only one side. In other words, imagine if you were an ant crawling on a piece of paper. If you started on a möbius strip, then you would return to your starting position having covered the entire length of the paper (on both sides) without ever having crossed an edge.

Core mathematical concepts

Topology

Age/Grade Level Appropriateness

All ages can discover the properties of this strip, although it is not until grade 12 that kids are asked to make geometric constructions with a variety of tools.

At Home

Take a strip of paper, give it half-twist, and tape the two ends together - you now have a möbius strip! (Note that you can do with any type of object - a rubber band that has been cut, a shoelace that you tape the ends together, etc.) Now, you and your child can explore some properties of the the strip. See what happens when you draw a line down the center of the strip until you get back to where you started. What happens when you cut along the line you drew? What about if you cut your strip about one-third of the way from an edge (going all the way around the strip)? You can also make other types of similar objects - take a strip of paper and make and then cut one that has two half-twists or three half-twists. Then explore the properties of those new strips together!

ACTIVITY 7

SIEVE OF ERATOSTHENES

Overview

The Sieve of Eratosthenes (named after Eratosthenes of Cyrene, a Greek mathematician) is a way to find all prime numbers (numbers that only can be divided evenly by two different numbers, 1 and itself - for example, 3 can only be divided evenly by 1 and 3) up to a certain limit. This sieve works by crossing out all numbers that are multiples of a prime.

The specific rules to using the sieve to find all of the prime numbers less than or equal to a given number, say 100, are as follows:

1. Create a list of consecutive integers from 2 to 100. (Note that 1 is not considered to be a prime number since it can't be divided evenly by two different numbers. So we leave it off the list.)
2. Start with the first prime number 2 and mark all of the multiples of 2, except for 2 itself (in other words, 4,6,8,10,etc.)
3. Find the first number greater than 2 that is not marked and repeat step 2 for that number.
4. Repeat step 3 until there is no number greater that has been marked.

Core Mathematical Concepts

Factors, Multiples, Prime Numbers, Composite Numbers, Tests for Divisibility, Pattern Observations

Age/Grade Level Appropriateness

Starting in grade 4, kids are asked to gain a familiarity with factors (numbers that divide into another number evenly) and multiples. Specifically, kids begin looking at whether a specific number is prime or composite.

At Home

Create (or find online) a grid of numbers from 2 to any limit you choose (say 100). (You can also just google 'Sieve of Eratosthenes' to find worksheets to fill out.) Don't worry if the grid you found online has the number 1 on it; you can ignore it. Then get some crayons, or better yet some stickers, to cross out your numbers. Make sure to use the same sticker or color for each round of marking out of numbers. After you have determined that you have found all of the prime numbers up to 100, see if you can find patterns that you created with the crayons or stickers.

ACTIVITY 8

TWO'S ENOUGH

Overview

Start with a 6×6 grid (so 36 small squares to form a board) and color in 12 of the small squares. Your goal is to try to find a way to color in 12 squares so that there are two colored squares in each row and each column and no more than two on any diagonal line.

Core Mathematical Concepts

Seeing structure in puzzles

Age/Grade Level Appropriateness

Younger kids will enjoy the coloring aspect of this puzzle, but may become overwhelmed when trying to satisfy all the conditions. With kids at the kindergarten level, you could modify the puzzle so they only have to satisfy two of three conditions until they get comfortable with what is asked. For older kids who have found a solution, encourage them to find others (there is more than one) and to argue how they know they have found all the solutions.

At Home

Paper and crayons are all you need to complete this activity. You can work with your child to understand the different conditions on the puzzle, as well as understanding the notion that a diagonal line is any straight line that is on an angle (and doesn't necessarily have to touch corner to corner).

ACTIVITY 9

KALIEDOCYCLE

Overview

Kaleidocycles (or Flexahedrons) are three-dimensional "moving" objects that you make by folding paper in a particular way. Specifically a kaleidocycle is a twistable ring of tetrahedra. (Fun fact: the word 'kaleidocycle' comes from the Greek words kálos meaning beautiful, eîdos meaning form, and kyklos meaning ring - so in Greek a kaleidocycle means 'beautiful form ring'.)

Core Mathematical Concepts

Tetrahedra

Age/Grade Level Appropriateness

The mathematics behind kaliedocycles is quite advanced and more appropriate for juniors or seniors in high school. There is an informative website at `http://www.kaleidocycles.de/pdf/kaleidocycles_theory.pdf` that describes this mathematics in more detail and answers some questions associated with kaleidocycles. However, kids of all ages will enjoy making the kaleidocycles and making observations about the structure of the created object.

At Home

This is something that you will want to go online to find some templates for. Luckily there are a lot of them available. There is a really neat site that allows you to make your very own photo kaleidocycle... `http://foldplay.com/kaleidocylcle.action`. You and your child can have fun creating these - all you will need is some scissors and glue and you'll have the perfect presents to give out to family and friends.

ACTIVITY 10

TOKEN INTERCHANGE

Overview

Have you ever played those games at restaurants where there is one peg missing from the puzzle and you have to jump over other pegs to eliminate all the pegs? This activity is similar. Start by placing tokens (or coins or any object really) in one of the following starting patterns:

● (blank space) ○

● ● (blank space) ○ ○

● ● ● (blank space) ○ ○ ○

The goal is to completely reverse the positions of the tokens by moving only one token at a time. So the first pattern should turn into

○ (blank space) ●

A token may jump over one adjacent token into an empty space or it may be moved one space into an empty space. You may not move a token backward!

Core Mathematical Concepts

Seeing structure, critical thinking, pattern recognition

Age/Grade Level Appropriateness

Kids of all ages will be able to understand the"jumping" tokens aspect, but younger kids may have difficulty with the rule that a token cannot be moved backward. This rule can be ignored for younger kids until they have gotten the hang of what is being asked. For older kids, see if they can discover a pattern in the number of moves needed to solve the puzzle when there are one, two, or three tokens per side.

At Home

This activity is easily created with a pen and paper. But even if you don't have a pen and paper, you can still entertain and challenge your kids while out to dinner at a restaurant, and you don't need to have the pre-made games with the pegs! Just grab some coins from your pocket or some sugar and equal packets from the table, set up the puzzle, and you're all set!

ACTIVITY 11

TOWER OF HANOI

> In the great temple at Benares (India) beneath the dome which marks the centre of the world, rests a brass plate in which are fixed three diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed sixty-four discs of pure gold, the largest resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the Tower of Bramah. Day and night unceasingly the priests transfer the discs from one diamond needle to another according to the fixed and immutable laws of Bramah which require that he must place this disc on a needle so that there is no smaller disc below it. When the sixty-four discs shall have been thus transferred from the needle on which at the creation God placed them to one of the other needles, tower, temple and Brahmins alike will crumble into dust, and with a thunder-clap the world will vanish.
>
> - "Mathematical Recreations and Essays," by W.W. Rouse Ball (1905)

Overview

With a board that has three pegs and seven discs of different sizes starting on the center peg (in order of size, biggest on the bottom), shift all of the discs from the center peg to one of the outside pegs. Always place a smaller disc on top of a larger one and never place a larger one on top of a smaller one. Move only one disc at a time.

Age/Grade Level Appropriateness

Around grade 4, kids start to be able to understand and master this puzzle. However, the puzzle can be adapted for younger or older kids.

At Home

There are lots of websites that have this puzzle as an online game. But what might be more fun is to create your very own tower! In the summertime at the beach, playing in your background, or even on a rainy day inside, a tower can be generated with little effort. Find three sticks that will work for your pegs - perhaps you have popsicle sticks placed into dirt. Then find 7 discs of varying sizes... either look around the house to see what you can use (treasure hunt time!) or create your own with different size paper plates or construction paper. And there you go. You and your child will have fun both creating the game and then challenging each other to solve it. For further difficulty, what happens when there are more discs? Or more pegs?

ACTIVITY 12

TETRAHEDRAL TEASE

Overview

Fit four sphere structures (see the 'At Home' section to see how to make the structures) together to form a tetrahedron (a 3-dimensional shape that it made up of four triangular sides).

Core Mathematical Concepts

Three-dimensional shapes, critical thinking, seeing structure

Age/Grade Level Appropriateness

Kids of all ages love putting puzzles together. This puzzle allows kids to begin building shapes that possess defining attributes, something they start in grade 1 and continue throughout their mathematical life.

At Home

This is a project that can be undertaken by the entire family! You can make this puzzle from 20 wooden or polystyrene (or any solid) spheres following these steps:

1. Glue 6 spheres together to create a 3×2 rectangle. Do this step two times to create two rectangles.
2. Glue 4 spheres together to create a a string of four spheres (a 4×1 rectangle). Do this step two times to creates two rectangles.

To make the structures strong, it is a good idea to drill small holes into the spheres where the spheres will touch and insert sticks into two holes to join them together.

ACTIVITY 13

VOLUME COMPARISON

Overview

Compare the volumes of different sized containers by picking 5 (or any number really) containers and arrange them from what you think is smallest to largest in terms of how much each container will hold. Then fill the smallest container with rice (or some other type of small substance). Then take the rice from the smallest container and pour it into the next smallest container - all the rice should fit and there should be some room left over for more. Keep going to see if your guesses about how much each container would hold is accurate. Then pick two containers, one smaller than the other. Guess how many small containers full of rice it will take to fill up the large one.

Core Mathematical Concepts

Volume, Comparisons, Estimation, Prediction

Age/Grade Level Appropriateness

Starting in grade 3, kids are asked to measure and estimate liquid volumes and masses of objects.

At Home

Using any type of containers will work (pots, bowls, cups, etc) with rice, cereal, or water will be a great way to do this activity at home. For an added challenge, pick containers that are very close in size or containers that have very opposite characteristics (for example, a very tall, skinny glass and a very short, fat glass).

ACTIVITY 14

STORYTIME

Overview

Books are, or should be, an integral part a kid's life. Reading fosters imagination and improves concentration and vocabulary. They also teach kids about the world and further allow them to experience the lives, feelings, and beliefs of other people, which teaches them empathy. What is especially neat is that while books do all of these wonderful things, they can also teach kids about mathematical concepts in ways that are fun and engaging.

Math Books

- The Sir Cumference series (A series that focuses on different aspects of geometry)
- What's Your Angle, Pythagoras?
- The Greedy Triangle
- A Place for Zero
- Spaghetti and Meatballs for All
- Amanda Bean's Amazing Dream
- A Fly on the Ceiling (This is a great one that tells the "story" of how the coordinate plane was created.)
- One Grain of Rice (A story that focuses on exponential growth.)
- Full House: An Invitation to Fractions
- Pythagoras and the Ratios: A Math Adventure

At Home

Make sure to set aside time each day to read with your child, whether it is you helping your child to read for him/herself or you reading to your child. For mathematics in particular, reading with your child will help them develop the literacy skills that are essential to understanding more complicated mathematics problems that focus on context (in other words, story/word problems).

ACTIVITY 15

BOARD GAMES

Overview

Kids at any age love to play board games. While many games do rely on luck, just as many of them rely on the skill of strategical thinking. These games that do not rely totally on chance are the ones that have the most educational benefit because they require kids to make decisions. When kids are faced with making a decision, questions such as "What happens when I move here?"come up. These types of questions encourage kids to logically reason their way through a situation. Further they force kids to consider the consequences of the choices they make, something that is a life skill beyond mathematics.

Core Mathematical Concepts

There are many specific mathematical concepts at play in board games, concepts such as number and shape recognition, item counting and grouping, probability, pattern recognition, and operations on numbers.

A short list of some good math board games

- Blokus
- Settlers of Catan
- SET
- Qwirkle
- Logic Links
- Equate
- Sequence Numbers
- Head Full of Numbers
- Dino Math Tracks
- Pay Day

Note that many of the games listed above have junior editions that are good to use with younger kids. Additionally, going to garage sales or places such as GoodWill are a great way to pick up games for cheap. Or you can just create your own! Lots of websites have available for you to download game rules and all the pieces you need to play a game.

ACTIVITY 16

ONLINE MATH GAMES/MATH APPS

Overview

Learning via online math games can make learning a lot of fun for kids. Many, many sites are now dedicated to free educational games. These sites allow kids to strengthen specific math and reading skills through challenging and engaging activities and games.

Websites to visit

- `http://www.pbskids.org/cyberchase` - Appropriate for about 8 years of age or older.
- `http://www.pbskids.org/games/math`
- `http://coolmath-games.com` - Check out the games Ninja Painter and Sticky Ninja Academy
- `http://www.math-play.com`
- `http://nlvm.usu.edu` - This is a digital library containing math activities for kids in kindergarten all the way through grade 12.
- `http://www.mathplayground.com`
- `http://funbrain.com`

Math Apps

- TallyTots (for toddlers and pre-schoolers)
- BugMath (for kindergarten and grade 1)
- Playful Minds: Math (ages 5-8 years)
- Cash Cow (ages 6-7)
- Mystery Math Town (ages 7-10)
- Slice It! (ages 10-11)

Note that not all of the apps listed are free (though they are all at most a few dollars), so you should check out the cost before getting the app. All of the apps are available on multiple platforms (iphone, ipad, android, etc.)