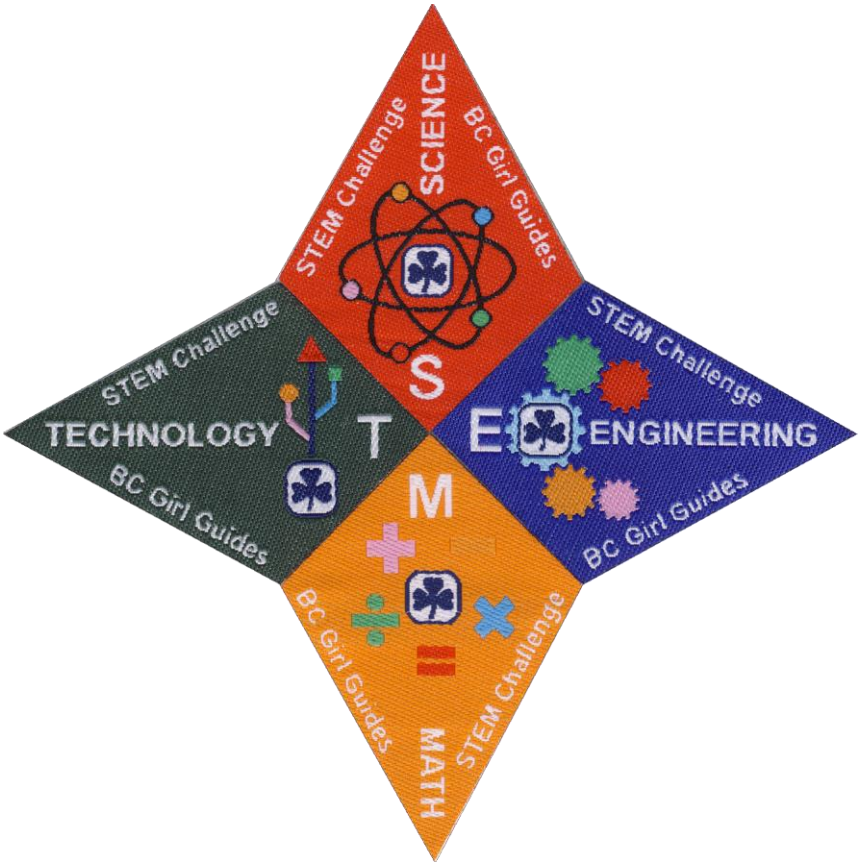
Girl Guides
BC Council

STEM CHALLENGE: MATH

A FOUR-PART STEM CHALLENGE
FROM THE BC PROGRAM COMMITTEE



BC Program Committee (Sept 2010; Rev. 2014, 2015, June 2019)

CONTENTS

Introduction to the STEM Challenge 1
Objectives 1
Outcomes 1
You're Kidding, Right? 1
Challenge Requirements 2
STEM Challenge: Math Tracking Sheet 4
Activities 5
Butterfly Symmetry 5
Chinese Abacus 6
Bubble Pictures 8
Sudoku 9
What's the Rule? 10
What's Your Shape? 11
Flexagon 12
Sundial 14
Bedroom Budgeting 16
Go Shopping 17
Mathematical Card Trick 19
Chess Games 20
Tangrams 23
Code Breakers 24
Odds and Evens Tag 28
Norwegian Number Game 30
Dice Games 31
Matchstick Puzzles 33
Pi Day 35
Dot-to-Dot Puzzles 39
Throwing Fists 40
Nim 41
Adding to 100 and 1000 42
One to Nine 43
Mancala 44
Tic-Tac-Toe 45
Program Connections 47

INTRODUCTION TO THE STEM CHALLENGE

Welcome to the new, updated Science, Technology, Engineering and Math Challenge from the BC Program Committee. This is a four-part challenge: one booklet, and one ribbon crest, for each of Science, Technology, Engineering and Math. Do just the parts that interest you, or tackle all four and proudly display the complete crest on your camp blanket.

The STEM Challenge is an update of the Science in a Box and Girls Exploring Technology (GET) challenges that were launched by the BC Program Committee several years ago.

As you work on the challenge, please remember: We'd love to hear from you! Please feel free to let us know what activities you've done and what you thought of the STEM Challenge.

Sincerely,

The BC Program Committee

Objectives

To engage girls in STEM

To have fun experimenting with mathematics, logic and problem-solving.

Outcomes

At the completion of this challenge, girls will demonstrate an improved awareness of and interest in:

1. the concept of quantity.
2. concepts of structure and/or geometry.
3. the concept of logic.
4. the concept of problem solving.

You're Kidding, Right?

"Seriously, *math*? As part of the girls' program? Come on – we want these girls to stay in Guiding, after all!"

Well, yes, we're serious. And we really believe it can be done. Of course, we're not talking about "doing" math like in school – you'll notice none of the activities in this booklet include multiplication drills or worksheets of algebra word problems. Nobody wants that at Brownie camp. But let's look at math in another way: rather than seeing it as just a bunch of numbers and arcane symbols, think of it as a process of logical thinking and creative problem-solving. Even those word problems many of us disliked so much in school were just a way of training our brains to work through a problem or a process to achieve a goal. In that light, adding some math to the program isn't just something that *can* be done – it's something that *should* be done, and that probably is being done already in some way or other. Don't believe it? Have you ever:

- Cooked with the girls? Recipes are all about measuring, counting, adding, multiplying and following prescribed steps toward an end result. Just like an algebra problem, only much tastier.
- Gone camping/touring/hiking/etc., and had to figure out how many tents/vehicles/packages of trail mix/etc. you would need? That's math with a practical application, which is always the most interesting kind.
- Played card games or board games? Games that require counting and adding, like cribbage, have very obvious connections to math, and strategy games like chess, checkers, *Risk* or *The Settlers of Catan* (to name just a few) take plenty of logical thinking. Jigsaw puzzles count, too—there is a lot of geometry and spatial awareness involved in putting together a jigsaw puzzle.

These are just a few ways that you can, and probably have, helped your girls develop math-related skills. This booklet provides lots more.

The activities in this booklet are pretty broad in scope, and many are only distantly related to the kind of math you did in school. We have done that intentionally: we recognize that math is not everyone's favourite subject, and hardly anyone's first thought in planning a fun, engaging program for a meeting or a camp. Therefore, we've included a range of activities in the hope that there is something in here that everyone can see themselves doing with the girls. As much as possible we've made the activities active and interactive, and for good measure we've thrown in some puzzles and board games that would be good for gathering time at the start of a meeting or for quiet time at camp. In many cases, we've also provided suggestions for increasing the "Math Factor", if you really want to emphasize the math-related skills behind the activities. So read on, dive in and do some math with your girls!

When you have completed the activities, complete the BC Challenge Crest, Pin, and Camp To Go Order Form which can also be found on the BC Girl Guides website (click on Girl Engagement > Program > Program Challenges). Before filling out the Order form, please read the BC Challenge Crest, Pin, and Camp To Go Information document in order to understand the pricing and payment for the various crests, pins and merchandise.

Challenge Requirements

To earn the ribbon crest for this part of the STEM Challenge, you need to complete activities in order to earn "challenge credits", depending on your branch of Guiding. You can select these activities from this booklet, or you can choose activities from the Internet, books or magazines, other Guiders or people in your community, or any other resources. As long as the activities are challenging for your group and fit the objectives of this part of the STEM Challenge, go ahead and use them. (And if you come across something really cool, please let us know so we can add it to any future STEM-related challenges!)

The "challenge credit" system is new – activities that require more time to complete will earn more credits than the quick activities. The number of challenge credits per activity is listed on the challenge tracking sheet. If you would like to complete an alternate activity, which requires more time and in-depth study, you can use your judgment to determine how many credits the activity should be worth.

	Sparks	Brownies	Guides	Pathfinders	Rangers/ Adults
Total number of credits required.	3	4	5	5	5

STEM CHALLENGE: MATH TRACKING SHEET

Sparks	Brownies	Guides	Pathfinders	Rangers/ Adults
3	4	5	5	5

Except where indicated, activities in this challenge are worth 1 credit each.

- ❑ Butterfly Symmetry
- ❑ Chinese Abacus
- ❑ Bubble Pictures
- ❑ Sudoku
- ❑ What's the Rule
- ❑ What's Your Shape?
- ❑ Flexagon
- ❑ Sundial
- ❑ Bedroom Budgeting
- ❑ Go Shopping (2 credits)
- ❑ Mathematical Card Trick
- ❑ Chess Games
- ❑ Tangrams
- ❑ Code Breakers
- ❑ Odds and Evens Tag
- ❑ Norwegian Number Game
- ❑ Dice Games
- ❑ Matchstick Puzzles
- ❑ Pi Day
- ❑ Dot-to-Dot Puzzles
- ❑ Throwing Fists
- ❑ Nim
- ❑ Adding to 100 and 1000
- ❑ One to Nine
- ❑ Mancala
- ❑ Tic-Tac-Toe

Other Math Activities

Alternate activities that meet the objective of this challenge.

- ❑ _____
- ❑ _____
- ❑ _____
- ❑ _____
- ❑ _____
- ❑ _____

ACTIVITIES

Butterfly Symmetry

Butterflies are a natural example of symmetry: their right and left wings are mirror images of each other. Make your own symmetrical butterfly in this simple craft activity.

Directions

5. Fold a sheet of construction paper in half lengthwise. Draw a butterfly wing on it, placing it so the fold is where the butterfly's body would be.
6. Cut out the wing, without cutting the fold. When you unfold it, you should have two identical wings attached in the middle.
7. Fold another sheet of construction paper, in a different colour, in half lengthwise. Then fold it in half lengthwise again.
8. Cut out a random shape that starts at one end of the folded edge and ends a little bit higher up the fold. Do not cut the fold itself. When you unfold your shape, you should have two identical, symmetrical shapes.
9. Position your shapes, one on each wing, in the same place. Trace around them with the pencil to mark where they should go.
10. Dab a little glue onto the back of the shape, then glue it into the positions you marked.

Continue adding different shapes until your butterfly looks how you want it to. Just remember: the goal is to make each wing the mirror image of the other.

Supplies

- ❑ construction paper in a variety of colours
- ❑ pencil
- ❑ scissors
- ❑ glue
- ❑ craft stick

Chinese Abacus

For centuries before the days of cheap digital calculators, people used abacuses to do calculations. Build your own, and use it to add up your cookie revenue!

Directions

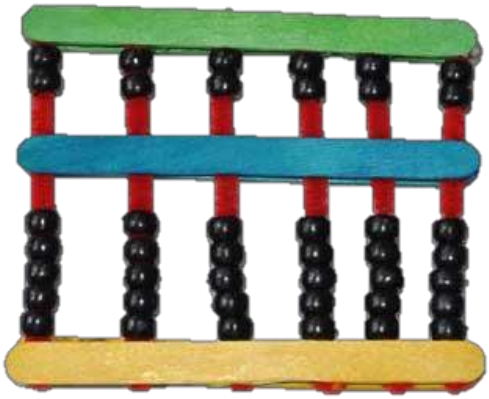
1. Marking with a pencil, divide one craft stick so that the 6 pieces of pipe cleaner will be evenly spaced (about 2 cm apart).
2. Glue the ends of the pipe cleaners onto the marked locations on the craft stick, then glue another craft stick on top to make a "sandwich". Note that we used hot glue to do this, but you could use white glue. If you do, remember it needs time to dry.
3. Thread two "colour 1" beads onto each pipe cleaner.
4. Leaving space for your beads to move up and down (see picture), glue another craft stick sandwich onto the pipe cleaners.
5. Thread five "colour 2" beads onto the pipe cleaners.
6. Glue a craft stick sandwich to the bottom of the pipe cleaners.

Supplies

- ❑ 6 craft sticks
- ❑ 2 pipe cleaners cut into thirds (6 x 10 cm long pieces)
- ❑ ruler
- ❑ pen or pencil
- ❑ glue
- ❑ 12 "colour 1" pony beads
- ❑ 30 "colour 2" pony beads

How it works:

Lay your abacus on a flat surface with the two beads at the top. These are called the "heaven" beads. Starting from the right-hand side of your abacus, the lower beads (called the "earth" beads) on each pipe cleaner are worth multiples of 10. Specifically, the lower beads on the right-most pipe cleaner are each worth 1, the lower beads on the second pipe cleaner from the right are worth 10, the lower beads on the third pipe cleaner are worth 100, and so on up to 100,000 on the left-most pipe cleaner.

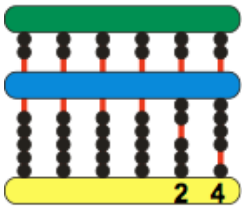


The top beads on each skewer are worth five times the bottom beads: again starting on the right, the top beads are worth 5, 50, 500, 5000, etc.

To set the abacus to zero:

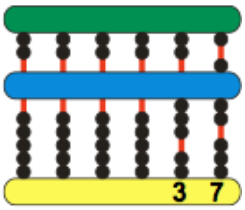
1. Lay the abacus on a flat surface with the two "heaven" beads at the top.
2. Move all the "heaven" beads to the top of the top section. Move all the "earth" beads to the bottom of the bottom section.

To show a number, for example 24, on the abacus:



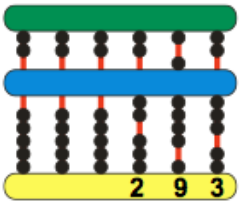
1. Break the number up into single digits. For example, 24 becomes 2 tens (20) and 4 ones (4).
2. On the right-hand pipe cleaner (the "ones" pipe cleaner), move four bottom beads up to represent the 4 ones.
3. On the second pipe cleaner from the right (the "tens" pipe cleaner), move two bottom beads up to represent the 2 tens (20).

To show 37:



1. Break 37 up into single digits: 3 tens (30) and 7 ones (7).
2. On the "ones" pipe cleaner: move one top bead down to make 5, and move two bottom beads up to make 2 (5+2=7).
3. On the "tens" pipe cleaner: move three bottom beads up to make 3 tens (30).

To show 293:



1. Break 293 up into single digits: 2 hundreds (200), 9 tens (90), and 3 ones (3).
2. On the "ones" pipe cleaner: move three bottom beads up to make 3.
3. On the "tens" pipe cleaner: move one top bead down to make 50, and move four bottom beads up to make 40 (40+50=90).
4. On the "hundreds" pipe cleaner: move two bottom beads up to make 200.

How to increase the Math Factor:

1. To add two numbers together, e.g., 24 and 32:
2. Show the first number on the abacus. For example, show 24 by moving four bottom beads up on the "ones" pipe cleaner and two bottom beads up on the "tens" pipe cleaner.
3. Move more beads to represent the second number. Use the top beads, if necessary, to show totals that are greater than five. For example, to add 32 to the 24 you already have, you need to show a total of 6 on the "ones" pipe cleaner (4+2=6), so move one top bead down and leave only one bottom bead up.
4. Move three more bottom beads up on the "tens" pipe cleaner. You should now have five "tens" and six "ones", which gives you the total of 56.

Can you figure out how to subtract using your abacus?

Bubble Pictures

Use coloured bubble solution to investigate the geometry of bubbles.

You can use either store-bought or homemade bubble solution for this investigation. Recipes for homemade solution are plentiful and varied; typically, they are a mixture of one-part liquid dish soap and three to five parts water, often with a bit of glycerin or sugar added to make the bubbles a little longer-lasting. Experiment a bit to find the formula that works best for you.

Directions

1. Pour some bubble solution onto a plate.
2. Stir in tempera powder to make a thick paint. You need an intense colour for good bubble pictures, so you are aiming for the thickest, brightest colour that you can still blow bubbles with. You can use more than one colour in a plate for multi-coloured bubble pictures.
3. Put one end of the straw into the bubble paint and blow through it to make bubbles in the plate.
4. Gently touch the paper to the bubbles in the plate. Don't squash the paper down; you just want to pop the bubbles onto the paper.

Supplies

- ❑ bubble solution
- ❑ small plate
- ❑ tempera paint powder
- ❑ spoon
- ❑ straw
- ❑ paper

How to increase the Math Factor:

Take a good look at your bubble picture.

- What shape are the bubbles?
- How do the shapes change when two bubbles of the same size touch?
- If a big bubble touches a small bubble, what happens?
- What happens when three bubbles touch? Four? More?
- When three or more bubbles meet, what angle is formed where their walls meet? (Measure it with a protractor, if you have one.) Is this angle always the same?

Sudoku

These popular puzzles are a great way to practice your logical thinking skills. Sudoku puzzles are good gathering or quiet-time activities.

You can find books of Sudoku puzzles virtually anywhere paperbacks are sold--bookstores, drug stores, grocery stores, newsstands...There are also plenty of websites with free Sudoku puzzles (many with solutions) that you can play online or print out; a quick search on "Sudoku" will turn up dozens of sites. For younger girls, look for the smaller 4x4 or 6x6 puzzles.

The same sources are often good for tutorials and tips on solving Sudoku puzzles, if you need some pointers to get you started.

Directions

1. Try to solve the Sudoku puzzle. For added excitement (?), time yourself.

Supplies

- ❑ Sudoku puzzle with an appropriate level of difficulty
- ❑ pencil or pen

How to increase the Math Factor:

Make blank Sudoku grids and get the girls to create their own Sudoku puzzles for their friends.

If you've already got the hang of standard Sudoku, try one of the many variants (giant Sudoku, jigsaw Sudoku); or try a Kakuro puzzle instead.

What else you can do with this

Even very young kids can do Sudoku! Instead of grids of numbers, use simple pictures. You'll need four copies of each of four pictures. Arrange the pictures in a grid so that each picture shows up only once in each row and column. Then remove one picture from each row and column. Ask the girls to figure out which picture is missing from the empty spaces.

What's the Rule?

This is a great game for filling gaps in a camp or event schedule. Keep a collection of small objects handy and pull it out when you're waiting for a meal, waiting for the rest of your group to arrive, waiting for a bus, waiting for the rain to stop.

Directions

1. One person selects a few objects according a rule that she makes up. For example, she might choose things that are yellow, or things that are longer than her pinky finger. She puts her selected objects in a group separate from the rest of the objects, but she does not disclose her rule for choosing them.
2. Everyone else in the group tries to guess the rule.
3. If the guessers need hints, they can ask if one of the remaining objects could go into the selected group. The person who did the selecting can only answer "Yes" or "No".
4. When someone guesses the rule, put all the objects back together. The person who guessed the rule then gets to select objects based on her own rule.

Supplies

- ❑ 15-20 small objects: crayons, paper clips, bottle caps, bandanas, shoes, coins, pocket lint--whatever you have handy

How to increase the Math Factor:

If you don't have a bunch of random objects, or if you're in an environment where you can't all see the objects, you can play a similar game using numbers:

1. One person thinks of a rule, then gives three sets of numbers that obey that rule. For example, if her rule is "Pick a number, and add seven to it to get the second number", she might say "9 and 16", "27 and 34", and "3 and 10".
2. Everyone else tries to guess the rule. If needed, they can suggest other sets of numbers that they think fit the rule. The rule-maker can only answer "Yes" or "No".
3. The first person to guess the rule is the next rule-maker.

What's Your Shape?

You may have heard of people being "pear-shaped" or "apple-shaped", both of which refer to someone's waist and hip measurements. But did you know you can also classify people as squares or rectangles? Try this activity to find out which one you are.

Directions

1. Measure your partner's height. You can measure in centimeters or inches, whichever you prefer, as long as you use the same units in the next step as well.
2. Ask your partner to stretch her arms out to the sides. Measure the distance from one fingertip to the other.
3. Compare the two measurements. If they are nearly the same, your partner is a square. If one measurement is longer than the other, she is a rectangle.
4. Switch places and do it again.

Supplies

- ❑ tape measure, ideally at least 180 cm (6 feet) long
- ❑ partner

How to increase the Math Factor:

Survey your unit or your family. How many people are rectangles and how many are squares? Do you see any patterns – for example, does a person's age or gender help predict whether they'll be a square or a rectangle?

Flexagon

You might not have heard the name, but you might have seen one. A flexagon is a strip of paper folded up in a special way to make a flat shape – often hexagonal (six-sided), but not always. The shape has two surfaces: a front and a back. If you pinch, fold, and unfold (or flex, hence the name) the flexagon in just the right way, you reveal another surface that was hidden before.

Mathematicians refer to flexagons as "mathematical oddities." That's because flexagons have very complex mathematical structures. As the flexagon is flexed, sections shift position to create an almost kaleidoscopic effect, and different faces come into view, in cyclic order. Mathematicians enjoy analyzing the structure and dynamic behavior of flexagons.

There are lots of flexagon patterns to try; some are fairly simple to make, while others are very complex. Look for books of flexagon templates (they can be hard to track down, but they do exist; your local bookstore may be able to order one for you), or search the Internet. A good site is The Flexagon Portal (*http://flexagon.net*). Print out a pattern you like (the Trihexaflexagon Classic is a good one to start with) and follow the directions to fold.

Below are the instructions for a simple flexagon.

Supplies

- ❑ 8 ½ x 11 paper
- ❑ flexagon pattern and folding instructions
- ❑ scissors
- ❑ glue or tape

Directions

1. Fold the paper so that the long edge is in quarters and the short edge is in thirds (as shown in the diagram).
2. Number the squares as shown.
3. Flip the paper over and number the back as shown.

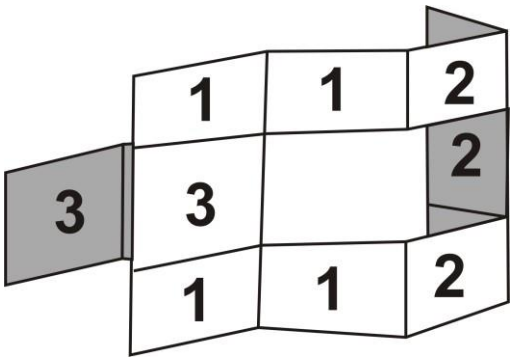
front:

1	1	2	3
3	2	1	1
1	1	2	3

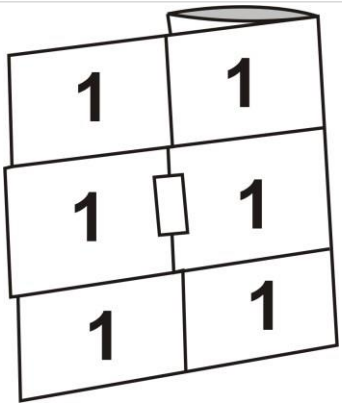
back:

4	4	3	2
2	3	4	4
4	4	3	2

4. With the front side showing, cut along the dotted line.
5. Fold the “door” back behind the far left 3.
6. Fold the 3 on the left side on top of the other 3 so you get a vertical line of 1s.
7. Then fold the right hand side back between the 2s and 3s and then fold again between the 1s and 2s so you should get six 1s showing.



8. Stick a piece of tape between the two middle 1s (make sure it is only on the middle squares!) On the back should be the 2s. Fold this back to get the 3s. Fold it again to get the 4s.



What else you can do with this

Draw pictures on the completed flexagon to fit any theme. Some ideas for things to put in your flexagon book:

- A calendar, with three months on each surface.
- The life cycle stages of a butterfly or other insect (egg, larva, pupa, adult).
- Instructions for four different knots.
- Lists of gear to put in a backpack for hiking in each of the four seasons.
- The Promise, Law, and Motto, plus what WAGGGS stands for.
- Menus or recipes for four different camp meals.

Pathfinders and Rangers may enjoy an added challenge by making a flexahedron instead. Try searching online for a hexagonal photo kaleidoscope flexahedron.

Sundial

Use the Sun and some simple materials to make your own sundial.

If you don't have a convenient piece of pavement to set up your sundial on, you can use small rocks instead of sidewalk chalk to mark the hours on dirt, outdoor carpeting or short grass.

Supplies

- ❑ modeling clay
- ❑ long pencil or similar dowel
- ❑ compass
- ❑ watch
- ❑ sidewalk chalk
- ❑ ruler

Directions

1. Roll the modeling clay into a ball and poke the end of the pencil into it so it stands at about a 45° angle. This is the pointer, or *gnomon*, of your sundial.
2. Set the pointer in a sunny spot on your driveway or front walk. If you use the driveway, keep your sundial to the side so it doesn't get run over when your parents come home from work.
3. Use the compass to find North, and turn the gnomon so that it is pointing North.
4. Keep checking your watch. Every hour on the hour, use the ruler and sidewalk chalk to draw a line along the gnomon's shadow, starting at the base of the gnomon and going out about 30 cm. Mark the hour at the outside end of the line. Depending on the clouds and what time you start, it might take a couple of days to mark all the daylight hours.
5. Your sundial is complete! Practice telling time with it – can you tell time to the nearest 15 minutes, or even more accurately than that?

Explanation

As the Earth rotates, the Sun appears to move across the sky. As the Sun moves, so does the shadow of the gnomon – in one hour, the shadow will move through an arc of 15°. At noon, when the Sun is directly in the south, the gnomon's shadow will be pointing due north (0° on your compass); at 1:00 p.m., it will be pointing to 15°. By 6:00 p.m., when the Sun is in the west, the shadow will be pointing due east, or 90° on your compass.

How to increase the Math Factor:

You might notice some inaccuracy in the time your sundial tells you, or in the direction of the Sun at various times of day as shown by your compass. There are a couple of reasons why that might be:

- The path that the Sun follows through the sky changes during the year. As the days pass by, you might notice that your sundial is becoming less accurate, because the Sun is not in exactly the same position at noon today as it was on the same day last week. This error is small and comes on gradually, but if you have your sundial set up for several weeks you might notice it.

- The Sun's path is based on geographic directions – that is, when the Sun is directly in the south, the gnomon's shadow points toward the geographic north pole, or *true north*. Your compass, however, points to the magnetic north pole, which is not in the same place. This difference is called *magnetic variation* or *magnetic declination*, depending on who you ask. The difference can be quite significant; in most of BC, the declination is between 20° and 25° East (meaning that the magnetic north pole is east of true north).

See if you can figure out how to correct these errors and make your sundial more accurate.

Bedroom Budgeting

This activity is intended for older girls. It can take place at a department store, furniture store, or at the meeting place. If you are going to a store, make sure that you talk to the girls ahead of time about courtesy in a public place, safety, and appropriate behaviour. Also ensure that you contact the store to let them know that you will be bringing a group to their store and what they will be doing.

Directions

1. This activity assumes that all the girls have a bed and a dresser in their bedrooms. It will help girls understand shopping on a budget, and how to get the most from their money.
2. Explain that each girl (or group of girls) will choose a card which has a budget on it. With that money, they need to purchase a place to study, bedding and light for their room. They can choose anything else that they would like for their room that fits into their budget.
3. If using catalogues or flyers, they can cut out the pictures of what they would like to buy with their money.
4. If going to the store, they should take pictures of the items that they would like to buy, recording the item name and cost on a piece of paper.
5. At the end of the meeting, they can share what their rooms will look like, and how difficult or easy it was to live within their budget.

Supplies

- ❑ catalogues or flyers that contain furniture, bedding, etc. (if being done at the meeting place)
- ❑ paper & pencil
- ❑ calculator
- ❑ camera
- ❑ budget cards (cards with $200, $400, $700, $800, and $1000)

Go Shopping

If you have a camp, sleepover, or similar event coming up, get the girls involved with the planning, budgeting and shopping for it.

This activity works well if you can split it up over a couple of meetings – one to do the planning, and another to do the shopping. When you give the girls a budget to work with for their planning, it might be an idea to keep a little money back so that you have some reserves in case certain supplies are more expensive than expected when you go do the shopping.

What to do at the planning meeting:

1. Divide the girls up into small groups. Assign each group a small part of the event to plan (e.g., one meal for a camp, snacks for a hike, a craft activity for a sleep-over, etc.). Give each group fliers or price lists from stores appropriate to the meal/activity they are planning.
2. Give each group a budget for their meal/activity. Make sure they are aware of any other limitations on what they can plan (e.g., nut-free meals or snacks, light-weight supplies, etc.)
3. Each group must figure out what they will eat/do, how much of all the supplies they will need, and how much it will all cost (based on prices in the fliers).

   Note: Make sure you give lots of time and adult support for this. The girls may need to try a few different ideas before they come up with something that will work with the budget. Suggestions and assistance from an adult who has done it before will help prevent the whole process from breaking down in frustration.
4. Make a detailed shopping list including prices of everything required for the meal/activity.

Supplies

- ❑ event plan and budget
- ❑ flyers or price lists from grocery store, craft store, etc., depending on what you are planning
- ❑ paper and pens or pencils
- ❑ calculators (optional)

What to do at the shopping meeting:

1. Hold your next meeting at the store(s) where you will buy the supplies. Make sure each group brings their list from the planning meeting.
2. Remind the girls how much money they have to spend.
3. Buy all the supplies for the meal/activity. As you shop, pay close attention to the actual prices of supplies, and compare them to the ones you used for budgeting. If one item is more expensive than expected, can you save somewhere else, or substitute something less expensive? If you have kept some money back as a reserve, make sure the girls understand that it is to be used only if absolutely necessary—the first goal is to stay within their means and stick to the budget.

How to increase the Math Factor:

The planning part of this activity can be quite complex and is best suited to older girls. If you want to adapt this activity for younger girls, or if you want to focus on the budgeting and math aspects, you could:

- Do the planning yourself and the shopping with the girls. Give them a list, tell them how much money they can spend and have them keep a running total as you shop. If the total creeps up over the budget, get them to decide what to do without or suggest alternatives to reduce costs.
- Skip the planning altogether. Instead of shopping for an event, try shopping for toys to donate to your local Christmas Bureau or women's shelter. Again, give the girls a budget, have them keep a running total as they shop, and make them decide what they can afford to buy. If they choose something that needs accessories, like batteries, they must include the accessories in their budget too. Another idea for older girls would be birthday party kits. Plan to include everything for a birthday party – cake mix and icing, party supplies like tablecloths, and balloons, and then supplies for take away bags.

Mathematical Card Trick

Many card tricks are based on mathematics. Some are simple, like this one; others are considerably more complex. If you like this one, look for others in books of magic tricks or on the Internet.

Directions

Supplies

- ❑ 21 playing cards, all different
- ❑ an audience

1. Lay out three cards face-up in a row, going from left to right. Lay the next three in the next row, overlapping the first row and again going from left to right. Continue until you have laid out all 21 cards in three columns of seven cards each.
2. Ask a volunteer from your audience to pick one of the cards, without telling you what it is. She should just point to the column that it is in.
3. Pick up each column in turn, making sure that the second column you pick up is the one your volunteer has pointed to.
4. Holding the stack of cards facedown, lay them out again row by row in three columns of seven cards each, exactly as you did in step 1.
5. Ask your volunteer to find her card again and point to the column it is in (not to the card itself).
6. Repeat steps 3-5 one more time.
7. Gather up the cards column-by-column again, making sure the column your volunteer has pointed to is the second one.
8. Holding the stack of cards facedown, count out 10 cards, turning them face-up as you count. Hold up the 11th card and ask your volunteer if this is the card she picked.

How to increase the Math Factor:

Figure out why the chosen card always ends up as the 11th card in the stack.

Chess Games

Chess is a great game for teaching critical-thinking and problem-solving skills, which are fundamental skills for any future mathematician (or anyone else, for that matter). If your girls are chess players already, or if you're up for the job of teaching them, go ahead and play a full game of chess. But if that's too much, try out some of these simpler games that use chess pieces.

Battle of the Pawns

In this game, you play with just the pawns. The goal is to get one of your pawns all the way across the board from your side to your partner's.

Note: In chess, the player with the white pieces always goes first. Decide who gets them by putting one piece of each colour behind your back and asking your partner to choose a hand.

Directions

Supplies

- ❑ chessboard
- ❑ all the pawns
- ❑ partner

1. Set the pawns up as you would for a regular chess game: all the white pawns on the second row (called a rank) of the chessboard, and all the black pawns facing them on the seventh row (rank). In other words, leave one blank row at each end of the board and set the pawns up on the next row.
2. Taking turns with your opponent, advance your pawns across the board. Try to get one pawn all the way across to your partner's end of the board. Pawns can move as follows:
   - Pawns can move only forwards, not backwards or sideways.
   - You can only capture your opponent's pawn by moving diagonally. If your opponent's pawn is one square ahead and to the right (or left) of your pawn, you can move diagonally onto that square and take her pawn.
   - On any pawn's first move (i.e., when it leaves its starting position), it can move forward one square or two squares. After that, that pawn can move only one square at a time.
   - Pawns can capture "*en passant*": if you move a pawn two squares forward from its starting position, and if your opponent's pawn could have captured it if you had moved it only one square forward, she can still capture it. She can move her pawn diagonally and take your pawn, exactly as if you had moved it only one square forward, capture the pawn as if taking it "as it passes" through the first square. However, your opponent must make the *en passant* capture on her very next turn, or she loses the opportunity to do so.
   - You cannot skip a turn.
3. The game ends when one of these things happens:
   - One player's pawn reaches the other side of the board.
   - Neither player has a legal move left. (But note: if you have a legal move, you must take it. You cannot skip a turn to avoid making a move you don't want to make.)

Rook's Maze

In this game, only the rooks (castles) can move. Other pieces are on the board to make an obstacle course for the rooks as they move from one corner of the board to the other.

Note: In chess, the player with the white pieces always goes first. Decide who gets them by putting one piece of each colour behind your back and asking your partner to choose a hand.

Directions

Supplies

- ❑ chessboard
- ❑ chess pieces, including one white rook, one black rook, and a variety of other pieces
- ❑ a partner

1. Place the rooks in diagonally-opposed corners of the board.
2. Place the other pieces around the board in random locations. The more pieces you have, the more challenging this game is.
3. Taking turns with your partner, try to move your rook from your corner to your partner's corner. Rooks can move as follows:
   - Rooks can move up and down (vertically) and side to side (horizontally). They cannot move diagonally.
   - Rooks can cross one or more squares in a single move, as long as they are not blocked by another piece.
   - Rooks can stop on squares of either colour.
   - Rooks can capture an opponent's piece by landing on the square occupied by that piece.
   - Rooks cannot move past one of their own pieces; they must stop before it.
4. The game ends when one player's rook has reached the opposite corner.

Knights to the Rescue!

Two knights race to reach the Queen first. It's a contest, though, so each knight must make sure the other does not capture him!

Note: In chess, the player with the white pieces always goes first. Decide who gets them by putting one piece of each colour behind your back and asking your partner to choose a hand.

Directions

Supplies

- ❑ chessboard
- ❑ one white knight (horse) and one black knight
- ❑ one queen (either colour)
- ❑ partner

1. Place the knights in diagonally-opposed corners of the board. Set the queen on a square near the middle of the board, or in one of the remaining corners.
2. Taking turns with your partner, try to get your knight to the queen the fastest. Knights can move as follows:
   - Knights always move in an L-shape: two squares forward or back and one square to

either side (or two squares to the side and one square forward and back).
- Knights can stop on a square of either colour.
- Knights can pass over other pieces of either colour.
- A knight captures an opponent's piece by stopping on the square occupied by that piece.

3. The game ends when one knight rescues (or captures) the queen, or when one knight captures the opponent's knight.

What else you can do with this

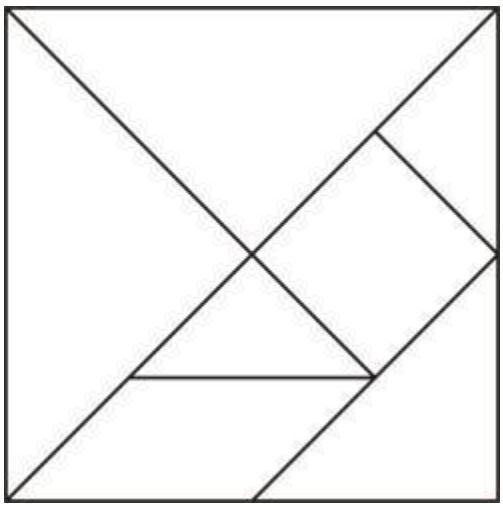
To make this game even more challenging, use two knights each. Put them in the corners of the board, put the queen in the middle, then try to capture your opponent's knights as you race to rescue the queen.

Tangrams

A tangram is an ancient Chinese shape puzzle, using 7 pieces made out of three shapes. The earliest known Chinese book about tangrams is dated 1813 but the puzzle was very old by then. The puzzle interests the math-inclined with the geometry and ratios of the pieces. You find them used in classrooms around the world to teach basic math ideas in an interesting way. The classic rules are as follows: You must use all seven tans, they must lay flat, they must touch and none may overlap.

Directions

1. Either print off sets of tangrams, or make your own tangram set – start with a 4" square piece of fun foam (thicker is better), and cut as follows:



Supplies

- ❑ 4" squares of fun foam or heavy cardstock, marked with the tangram pattern
- ❑ scissors
- ❑ tangram patterns

2. Show the girls some puzzles and see if they can figure them out. You can find puzzles online – see: http://ideas.gstboces.org/programs/tangrams/printables.cfm

How to increase the math factor:

Explore how shapes can be combined to form other shapes. For example:

- Find which pieces can be made from three other pieces.
- Find how many ways the largest triangle can be made using other pieces.
- Choose any two shapes and see how many different shapes you can make with them.

Learn about geometric vocabulary:

- Find all the triangles.
- Find all the squares
- Find the parallelogram.
- Find the shapes with a right angle.
- Find the shapes with parallel sides.

What else you can do with this:

Read "Grandfather Tang's Story" by Ann Tompert
https://www.google.ca/search?q=grandfather+tang's+story – or make up your own story using tangram shapes.

Code Breakers

Cryptograms are mathematical puzzles where letters of the alphabet are substituted with other letters or with numbers. Following are some sample cryptograms to show how they work.

Numbers Stand for Letters

This is a very easy code to solve! Each number stands for a letter. This simplest one is sequential, such as: 1 stands for A; 2 stands for B; 3 stands for C; and so on...

To help solve this code a bit quicker you can write out the whole alphabet, and then write out the numbers from 1 to 26 below it on an index card for the girls. Now, whenever you see a number, you can either count that many letters, or look up the number and write down the letter above it.

See if you can figure this one out:

7 9 12 18 – 7 21 9 4 5 19 – 9 19 – 1 23 5 19 15 13 5

(Solution: Girl Guides is awesome)

Cryptogram

This is similar to "Numbers Stand for Letters" except that the number substitution is in random order. There is often no clue on how to solve the puzzle, so you need to use your detective skills to solve it.

- Single letter words are either "A" or "I".
- There are limited letters that can come after an apostrophe – for example in the words "WON'T", "SHE'S", "I'D", "I'M", "THEY'RE"… etc.
- Think about possible 2 or 3 letter words – for example "OF", "TO", "IS", etc. or "THE", "AND", "FOR", "HER", etc.
- Look for words with double letters in them – they could be "OO", "EE", "DD", "LL", etc.
- If all else fails, use trial and error!

Supplies

- ❑ a copy of the puzzle sheet for each girl
- ❑ a copy of the cryptograph wheel for each girl, printed on heavy cardstock
- ❑ scissors
- ❑ brass fasteners
- ❑ pencils
- ❑ paper to create more coded messages on

Block Cipher

We write the message in a square block, one row at a time, and then read off the columns.

Example: To encode a message, write it in a block like this:

```
THISI
SVERY
EASY!
```

The coded message is passed on by looking down the columns and writing them out like this: TSE HVA IES SRY IY!

The decoder then rewrites the code words in a block again and reads the message across the rows.

Cryptograph Wheel

The Caesar cipher, or shift cipher, can be solved with a cryptograph wheel. It is one of the simplest encryption techniques, where every letter of the alphabet is replaced by another letter, a fixed number of positions along the alphabet. For example, a shift of 2 (key=2), would be that A would be replaced by C, B would be replaced by D, C would be replaced by E, etc.

Make a cryptograph wheel with two circles, one smaller than the other, with the alphabet written along the outside of both circles. Attach the two circles together with a brass fastener in the centre, then rotate the wheels so the offset in letters is equal to the key. A template is included.

More Codes

Visit the Secret Codes for Cubs and Scouts website for more secret codes to try: https://sites.google.com/site/codesforscouts/

Solutions to the puzzles:

Cryptogram: It's a very cool thing to be a smart girl.

Block Cipher: Nothing great was ever achieved without enthusiasm.

Cryptograph: The purpose of life is a life of purpose.

Cryptogram

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
23			26													3			16						6

	T	’	
18	16		24

A								
23	7	17	4	13	8	5	5	1

T				
16	15	18	12	21

T	
16	5

11	17

A
23

		A		T
24	19	23	4	16

21	18	4	1

Block Cipher

NGSHINS OREITTM TEVEHH HAEVOU ITREUS NWADTI GACWEA.

Hint: use the grid below to figure it out!

Cryptograph

Make a Cryptograph Wheel and solve the following puzzle, then create your own secret messages for your friends.

Key = 21

o	c	z

k	p	m	k	j	n	z

j	a

g	d	a	z

s	n

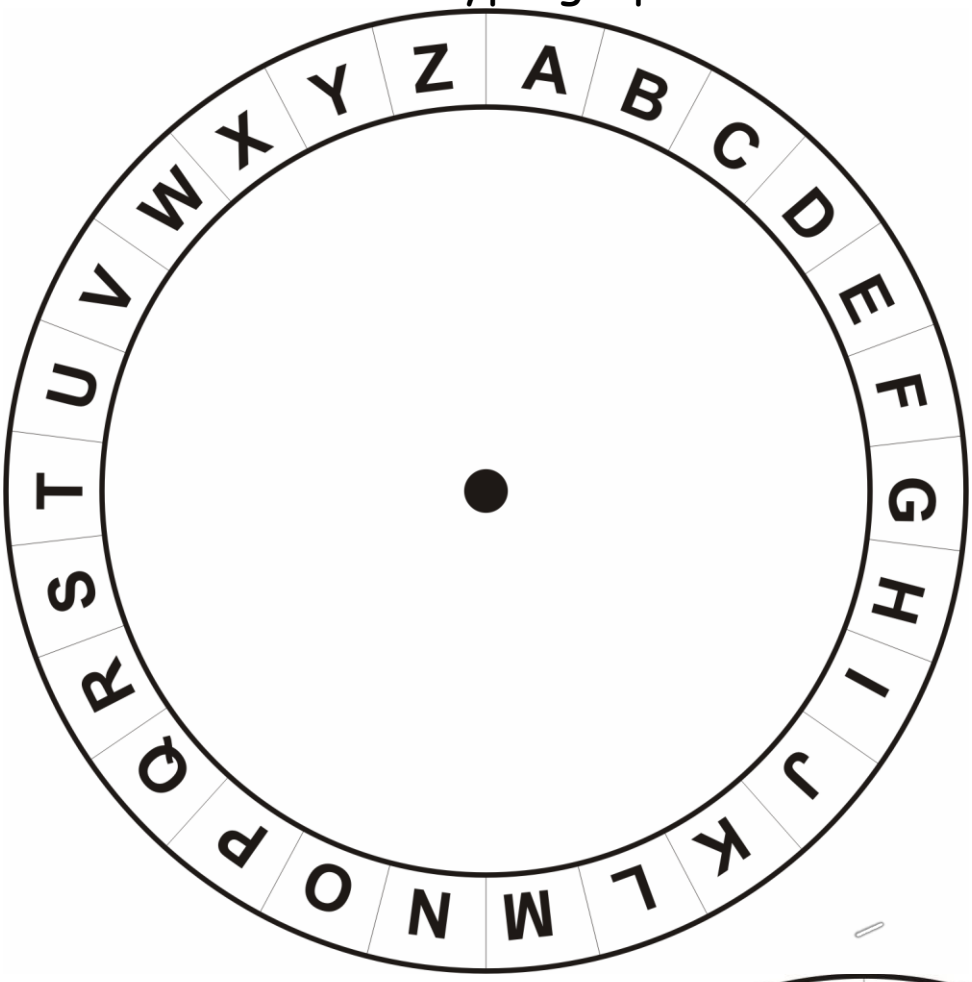
v

g	d	a	z

j	a

k	p	m	k	j	n	z

Cryptograph Wheel

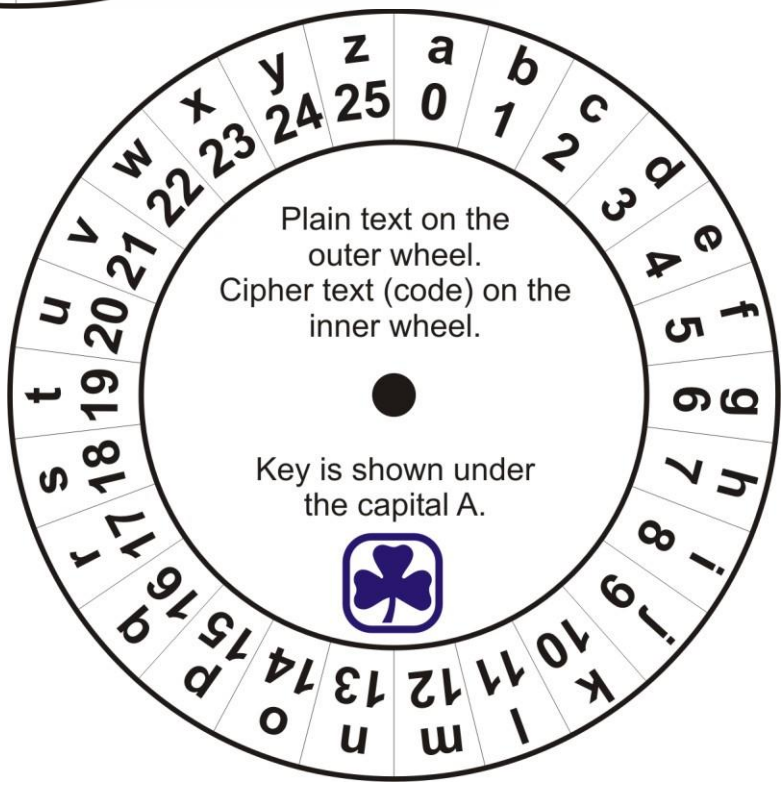


Print this sheet on heavy cardstock.

Cut out both circles.

Place the smaller circle over the larger circle, then attach them together with a brass fastener pushed through the black circles.

Spin the top circle so that the key number is shown under the capital A on the outer circle.



To make a cipher: convert from outer to inner circle. Example: key=4, plain text=”GUIDES”, cipher text=”kymhiw”

To decode a cipher: convert from inner to outer circle. Example: key=1, cipher text=”gvo” plain text =”FUN”

Odds and Evens Tag

This game reinforces the concept of odd and even numbers with younger girls. You will need a large playing area.

Directions

1. Divide the girls into two teams. Designate one team to be “odd” and one team to be “even”.
2. Start by having the girls on each team line up, side by side, at opposite ends of the playing area; the far ends of the playing area are the “home bases”.
3. Both teams walk, in their side by side line, to the middle of the playing area, facing the other team.
4. The Guider then calls out a number. If the number is odd, the odd team chases the even team, trying to tag girls before they reach their home base. If the number is even, the even team chases the odd team back to their home base.
5. If a girl is tagged before reaching home base, she becomes a member of the opposite team.
6. Continue playing for as long as you like, or until all girls are on the same team.

How to increase the Math Factor:

Call out math problems for the girls to solve, perhaps related to cookie sales – i.e. “You sold 3 boxes of cookies to Mrs. Smith and she gave you a twenty dollar bill. How much change do you need to give her?” (Answer: $5 = odd)

Norwegian Number Game

Play this singing game and practice counting! Hear the tune online at http://youtu.be/L3sJvSlKy7s.

Song

You can sing to 29 or 59 – your choice!

One, two, three, four, five, six, seven, eight, nine, ten
Eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty
One and twenty, two and twenty, three and four and five and six and twenty,
twenty seven, twenty eight, twenty nine ... Old Maid.

Directions

1. Girls each take a partner and link arms. The partners stand in one large circle, with one girl in the middle. See Figure 1.
2. The girls all start chanting in a sing-song tone:

   One, two, three, four, five, six, seven, eight, nine, ten
   Eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty
   One and twenty, two and twenty, three and four and five and six and twenty,
   twenty seven, twenty eight, twenty nine ... Old Maid.
3. The girl in center runs to find a new partner by linking arms with one girl in the circle. The girl she does NOT link arms (in the team) with must now find a new partner. See Figure 2.

Figure 1

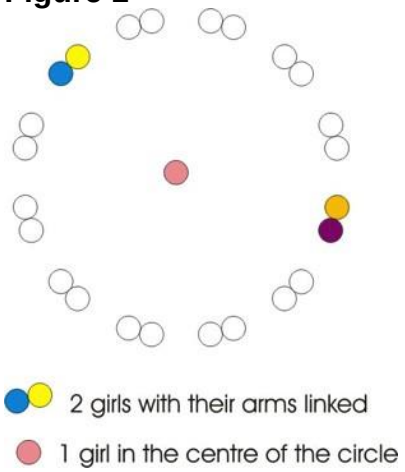
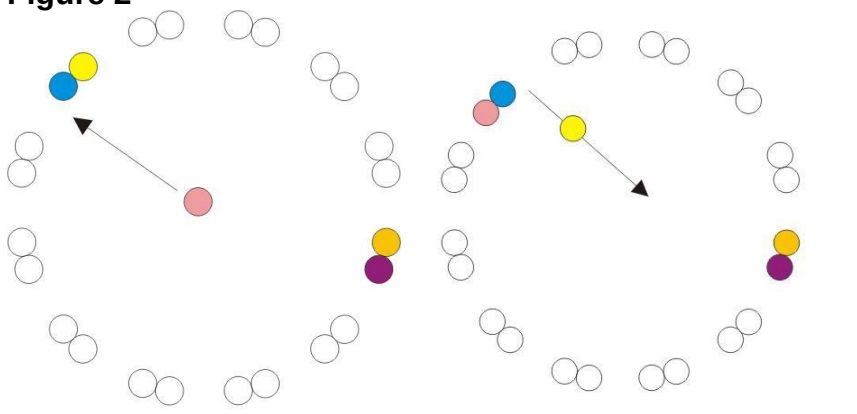
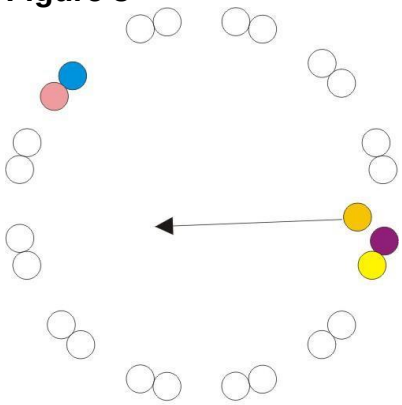


Figure 2



4. Note that the new girl in the centre must go somewhere across the circle to find a new partner. See Figure 3.
5. Try to make sure that the girls who have not been chosen each get a turn to either be in the middle, or to have someone new link up with them.
6. Continue until you get to "Old Maid" (instead of 30 or 60). The girl in the centre is the Old Maid.

Figure 3



play continues with a new girl entering the circle with each new linkage

Dice Games

Dice are fun to play with, and can be purchased inexpensively from a dollar store. These fast games would be good as gathering activities at a unit meeting.

Tic-Fact-Toe

Directions

Supplies

- ❑ a pair of dice
- ❑ tic-tac-toe board
- ❑ pencil

1. First decide if you are going to add, subtract or multiply (depends on age level).
2. Now write 9 numbers onto your game board, in any order: if you are adding using 2 to 12, if you are subtracting use 0 to 5, if you are multiplying use 1 to 36. Put a different number in each spot (except when subtracting, as you will need to put some duplicates in).
3. One player is “X”, the other is “O” Choose who goes first by each rolling the dice (highest or lowest goes first - your choice).
4. Take turns rolling the dice and doing the type of math you decided … for example, if you roll 3 and 4, for addition, you get 7, for subtraction you get 1, and for multiplication you get 12. If your number is on the game board, make your mark on top of the number.
5. The first person to get three in a row wins the round and earns one point.
6. Play nine rounds to decide the winner.

Snake Eyes

Directions

Supplies

- ❑ a pair of dice
- ❑ paper
- ❑ pencil

1. Make a scorecard with each player's name along the top of the paper.
2. Choose who goes first by each rolling the dice (highest or lowest goes first - your choice).
3. The first player rolls the dice and figures out the sum. The player can stop rolling and write down the total or choose to roll again. If she rolls again, she must keep the total in her head - but say the total out loud after each roll. When she is ready to stop rolling, she writes the total on the score sheet.
   - e.g. 1st roll 3 and 4 = 7. If she stops there, she records 7.
   - If she continues: 2nd roll = 2+7=9 plus 1st roll of 7 = 16. The player can add this to the paper or continue to a third roll in the same manner.
4. You can keep rolling for as long as you want, but... if you roll a "1" you lose all the points for that round (keeping the total that is already written under your name)...if you roll two "1"s (snake eyes) you lose all of your points and have to start again at zero.
5. The first player to get to 100 is the winner.

Beat That

Directions

1. Roll the dice and put them in order to make the largest number possible.
   - e.g. if you roll a 3 and a 4, then your choices are 34 and 43. 43 is your best choice, so you write that number down and pass to the next player to do the same.
2. The player with the largest number wins the round.
3. Play 5 rounds to decide the winner.

Supplies
- ❑ a pair of dice
- ❑ paper
- ❑ pencil

Crazy Faces

Note: this could be adapted for any picture - snowman, scarecrow, animal, etc. Use your imagination!

Directions

1. Each player takes turns rolling the die.
2. They cannot start drawing any parts of their face until they roll a 1 and draw the head.
3. After that you can draw each item on the face - but no more than 2 eyes, 2 ears, 1 nose, 1 mouth, 1 hair.
4. First to complete their face is the winner.

Supplies
- ❑ one die
- ❑ paper
- ❑ pencil
- ❑ a list of face parts:
  1 = head shape,
  2 = eye, 3 = nose,
  4 = ear, 5 = mouth,
  6 = hair

Mountain

Directions

1. For each player, write the numbers 1 2 3 4 5 6 5 4 3 2 1 in a mountain shape. See Figure 1.
2. The object is to roll the dice in numerical order, so you can cross the numbers off in order.
3. Roll the dice and hope for a 1... you must cross off the numbers in order.
   E.g., if you get a 1 and a 2, you can cross off both numbers, but if you get a 1 and a 3, you can only cross off the 1 before passing the dice to the next player.
4. The winner is the first to cross their mountain (up to 6 and back down to 1 again).

Figure 1:

```
      6
    5   5
  4       4
3           3
2           2
1           1
```

Supplies
- ❑ a pair of dice
- ❑ paper
- ❑ pencil

Matchstick Puzzles

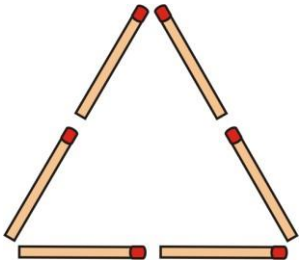
Matchstick puzzles help develop mathematical problem solving skills. Use toothpicks instead of matches, and challenge the girls to solve the puzzles on their own or in small groups. We've included one page of puzzles, but you can find many more online.

Supplies

- ❑ toothpicks
- ❑ puzzle sheet

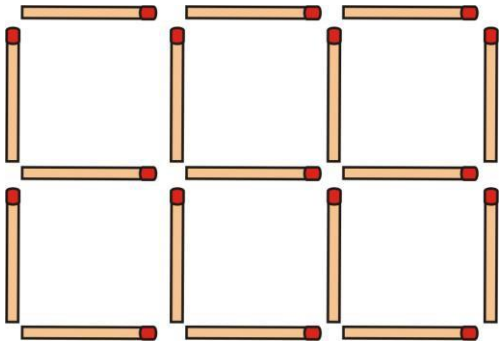
Matchstick Puzzles

Triangles



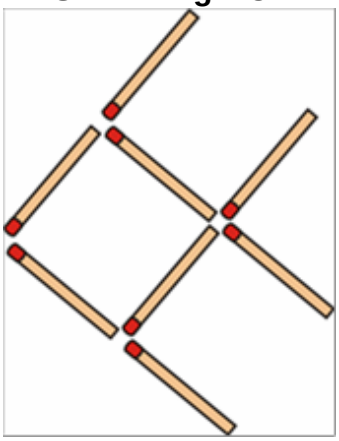
Move 2 sticks to make 2 equal triangles.

Squares



Remove 4 sticks to leave just 3 squares. The squares don't have to be the same size.

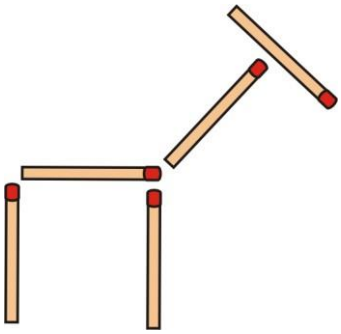
Swimming Fish



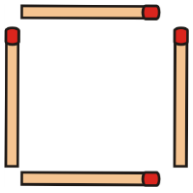
This fish is swimming to the left. Move 3 sticks to make it swim to the right. No overlapping sticks!

Turn the Donkey

Move just 1 stick to make the donkey face in another direction.

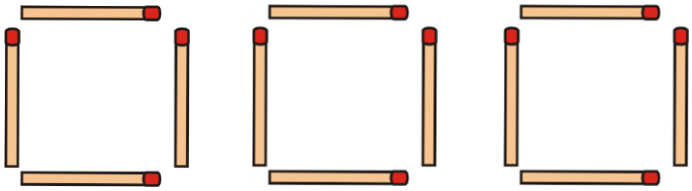


More Squares



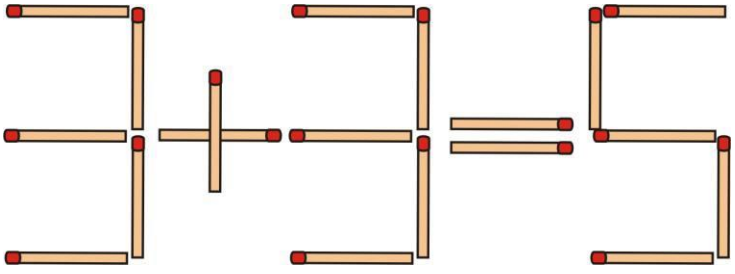
Starting with the square above, add 16 more sticks to create a total of 5 squares, all the same size.

The ONE Puzzle



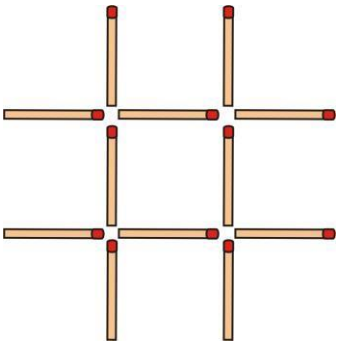
Move 2 sticks and remove 1 stick to make your answer 1.

Math Correction



Move 1 stick to fix this math equation.

Make 3 Squares



Move 3 sticks to make 3 squares.

Pi Day

Pi (represented by the Greek letter π) is a mathematical constant, equal to the ratio of a circle's circumference, C, to its diameter, d. ($\pi = C \div d$). No matter what the size of the circle is, the ratio is always the same: 3.14159…… This number is actually a rounded number, as pi is an "irrational" number, and has an infinite number of digits.

March 14th has been designated as "Pi Day" – the 3rd month and the 14th day, or 3.14. Celebrate Pi Day with some of the following activities – on March 14th, or on any other day of the year!

π Fiction

To introduce Brownies and Guides to pi, read "Sir Cumference and the Dragon of Pi (A Math Adventure)" by Cindy Neuschwander.

String π

Directions

Supplies

- ❑ a circular object, suck as a plate or a lid from a round container
- ❑ string
- ❑ scissors

1. Explain that you are going to figure out pi using the materials supplied.
2. Carefully wrap the string around the circumference of the circular object (this is around the outer edge of the circle) – cut the string where it meets itself around the circle, ensuring it does not overlap. It needs to be the exact size of the circumference of the circle.
3. Now, take the string and stretch it straight across the circle. From one side of the circle to the other side, going through the centre of the circle, is the diameter. Cut the string so that it is the same length as the diameter. Make as many "diameters" as you can.
4. Count how many diameters you have. You should have 3 diameters plus a little amount left over.
5. Can you estimate what faction the small piece is? Lie it against one of the diameters, then fold up the diameter to see how many "pieces" of one diameter match the small piece – it should be about 7, which means the small piece is 1/7th of a diameter, or about 0.14 of a diameter. Add this to the 3 diameters you cut, and you have just calculated pi!

   Note: No matter what size of circle is used (each girl, or pair of girls, can use a different circle), all will get the same result.

Throwing π

Amazingly, this crazy activity is one way to approximate pi, using geometric probability!

Directions

Supplies

- ❑ 30 or more toothpicks, all the same length
- ❑ paper & pencil
- ❑ ruler
- ❑ calculator

1. Start by measuring the length of your toothpicks.
2. Starting from the edge of the sheet, measure a length equal to the size of your toothpicks, then draw a line parallel to the edge of the paper. Draw a series of parallel lines on the rest of your page, making sure that the distance between each line is the same as the length of your toothpicks.
3. Now start tossing toothpicks at the page. Keep tossing them until you are out of toothpicks. Just throw randomly!
4. Remove any toothpicks that have gone over the paper's edge or did not land on the paper.
5. Without touching the toothpicks, count how many toothpicks are on the paper. Write this number down.
6. Carefully remove any toothpicks that have not crossed or touched any of the lines that you drew on the paper.
7. Count the toothpicks that remain on the paper – all of these toothpicks should be crossing a line. Write down this number.
8. Now it is time to use the calculator: π = 2 x (the total number of toothpicks – the number you wrote down in step 5) / (the number of toothpicks crossing a line – the number you wrote down in step 7).

Explanation

This activity is known as "Buffon's Needle Problem" and has quite a bit of complicated math to go with it. It is one of the oldest problems in geometric probability, and was first stated in 1777. If you are interested in the math behind this problem, you can search for a full explanation online.

What else you can do with this

You don't have to use toothpicks! You can use any stiff, straight object. Online we found examples of frozen hotdogs or celery sticks, but you could use unsharpened pencils, crayons, stir sticks, or anything that is straight and has a consistent length. Just make sure that your lines are all parallel and the distance between them equals the length of the objects (you could use masking tape on the ground for your lines).

π Music

Listen to pi music, or sing some pi songs. Find music and lyrics online. Following are some suggestions.

- "Mathematical Pi Song" by Ken Ferrier and Anton Chan: http://www.alltooflat.com/about/personal/ton/MathematicalPi.mp3 (lyrics at http://www.alltooflat.com/about/personal/ton/pi.html)
- "Loving Pi" by Pi Daddy: http://youtu.be/qAHPlrjSGQY
- "Pi 2 (Extended Pure Numbers)" by Hard 'n Phirm: (Short version): http://youtu.be/KgeKx6O2cLQ
- Pi Day Carols (lyrics): http://teachpi.org/music/pi-day-carols/
- Pi Day Songs (lyrics): http://mathforum.org/te/exchange/hosted/morehouse/songs.pi.html

Search π

Pi is an infinite, non-repeating number, and some people say that it contains every combination of numbers possible. We don't know if that is true or not, but there is a tool online that you can use to search the first 200 million digits of pi for a combination of numbers. Is your birthday in there? Search online at http://www.angio.net/pi/.

π Paper Chain

Make a paper chain with a different colour for each digit (0 to 9).

Supplies

- ❑ 10 colours of construction paper, plus black paper
- ❑ scissors
- ❑ tape or stapler
- ❑ marker

Directions

1. Cut each sheet of paper into strips, about 1 ½" wide and 11" long.
2. Assign a digit to each colour. For example:
   - red = 1
   - pink = 2
   - orange = 3
   - yellow = 4
   - dark green = 5
   - light green = 6
   - dark blue = 7
   - light blue = 8
   - purple = 9
   - brown = 0
   - black = decimal point (only one strip needed)
3. Mark the digits onto the strips of paper.
4. Now make a paper chain in the order of pi, by looping each strip into a circle (through the strip before) and taping or stapling it together. For the colours chosen

here, you would start with orange (3), then black (decimal point), then red (1), then yellow (4), then red (1), then dark green (5), etc. Here are the first 500 digits of pi, just in case you want to make a super long paper chain:

3.1415926535 8979323846 2643383279 5028841971 6939937510 5820974944 5923078164 0628620899 8628034825 3421170679 8214808651 3282306647 0938446095 5058223172 5359408128 4811174502 8410270193 8521105559 6446229489 5493038196 4428810975 6659334461 2847564823 3786783165 2712019091 4564856692 3460348610 4543266482 1339360726 0249141273 7245870066 0631558817 4881520920 9628292540 9171536436 7892590360 0113305305 4882046652 1384146951 9415116094 3305727036 5759591953 0921861173 8193261179 3105118548 0744623799 6274956735 1885752724 8912279381 8301194912

π Bracelet

Directions

1. Just like in the paperchain activity, choose a colour of bead to represent each digit.
2. String the beads onto a pipe cleaner in the order of pi.
3. Twist the ends of the pipe cleaner together to form a bracelet loop.

Supplies

- ❑ 10 colours of beads, plus one black bead (to represent the decimal)
- ❑ pipe cleaner

Dot-to-Dot Puzzles

Dot-to-dot puzzles are mathematical in that there is counting involved. You can purchase books of dot-to-dot puzzles, find some online, or create your own.

Make your own dot-to-dot puzzles: http://www.picturedots.com/

Dot-a-pix – advanced dot-to-dot puzzles, suitable for older girls: https://www.conceptispuzzles.com/index.aspx?uri=puzzle/dot-a-pix

Throwing Fists

This traditional Chinese game helps to develop quick thinking, addition and logic skills.

Directions

1. To start, play in groups of three girls. Each girl will take turns being the “caller”.
2. The girls face each other in a circle, and the caller counts to three, then calls out a number between 0 and 15. At the same time as she calls out the final number, all three girls throw their fists into the centre, extending between 0 (just a fist) and 5 fingers.
3. Add up the number of fingers that are extended. If the total number equals the number that the caller said, then she wins!
4. Keep playing, alternating callers, until someone wins, or until you don’t want to play anymore.

What else you can do with this

Sparks could play in pairs, with the maximum number to call out as 10.

If you want to increase the difficulty of the game, play with up to five girls, so that the total number of fingers would be up to 25 instead of 15.

To increase the complexity of the game, have the caller announce not just a number, but a phrase representing the number. This could be anything, for example, a dice term, such as “double fours”, meaning 8, or a card term, such as “Ace and Queen”, meaning 11, or any other phrase, such as “the month of September”, meaning 9. Another option, if the players agree beforehand, is the number of words in a phrase, such as “I promise to do my best!” which is 6.

Nim

Nim is a two-player mathematical game of logic and strategy. This game has been played since ancient times, and is said to have originated in China.

Directions

1. Lay the sticks out in 5 rows of 3 sticks (or 3 rows of 5 sticks).
2. Starting at any stick, on your turn you may pick up 1, 2, 3 or 4 sticks. However, after you pick up the first stick, the next stick must be above, below or beside the last stick you picked up. You cannot pick up a stick diagonal to another stick.
3. The object of the game is to NOT pick up the last stick.

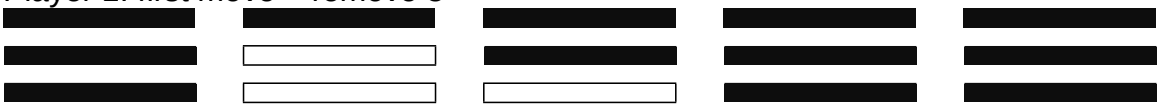
Supplies

- ❑ 15 sticks per game; could be toothpicks, skewers, stir sticks, etc.

Sample game

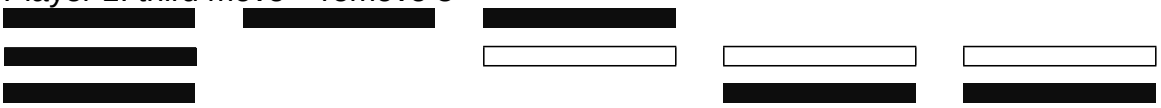
Setup:

Player 1: first move – remove 3



Player 2: second move – remove 2

Player 1: third move – remove 3



Player 2: fourth move – remove 1

Player 1: fifth move – remove 2

Player 2 now makes a crucial move – this next move decides whether she wins or loses! What should she do?

What else you can do with this

There are many variations of Nim online.

Adding to 100 and 1000

Brownies can use cards for a quick and fun game of adding numbers to 100. Guides, Pathfinders and Rangers can use cards for a quick and fun game of adding numbers to 1000.

Supplies

- ❑ deck of cards

Directions for Adding to 100

1. Remove all Kings, Queens, and Jacks from the deck of cards. Aces represent “1”.
2. Have the girls play in groups of 3 or 4.
3. Each girl is given 4 cards.
4. Each girl has to arrange the 4 cards so that a 2-digit-number is added to another 2-digit number. The goal is to try to make the sum of the two 2-digit numbers closest to 100, without going over.
5. The first girl to win 10 rounds wins the game.

What else you can do with this

The girls can take their 4 cards and try to create a subtraction problem with two 2-digit numbers so that the difference is closest to zero.

Directions for Adding to 1000

1. Remove all Kings, Queens, and Jacks from the deck of cards. Aces represent “1”.
2. Have the girls play in groups of 3 or 4.
3. Each girl is given 6 cards.
4. Each girl has to arrange the 6 cards so that a 3-digit-number is added to another 3-digit number. The goal is to try to make the sum of the two 3-digit numbers closest to 1000, without going over.
5. The first girl to win 10 rounds wins the game.

What else you can do with this

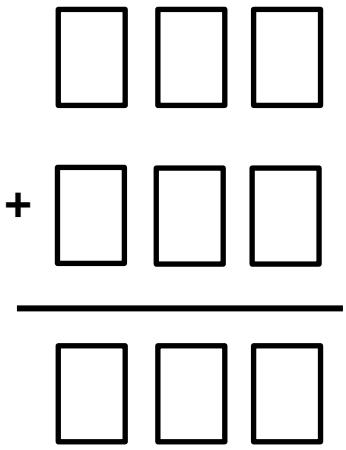
The girls can take their 6 cards and try to create a subtraction problem with two 3-digit numbers so that the difference is closest to zero.

One to Nine

Using playing cards to apply logic and math.

Directions

1. Divide the girls into pairs.
2. Give one girl 9 cards that go from 1 to 9 (e.g. A, 2, 3, 4, 5, 6, 7, 8, and 9). An Ace will represent the digit “1”. Arrange the nine cards so that the addition problem of two 3-digit numbers will use up all nine cards. Write down the addition problem on a pad of paper.



Supplies

- ❑ deck of cards (only need to use two sets of A, 2, 3, 4, 5, 6, 7, 8, 9 cards)
- ❑ pad of paper
- ❑ pencil

3. Give the second girl 9 cards that go from 1 to 9 (e.g. A, 2, 3, 4, 5, 6, 7, 8, and 9). An Ace will represent the digit “1”. Have her create an addition problem with the nine cards, but the sum must be different from the first girl. Write down the addition problem on a pad of paper.
4. Continue to do this until there are no more possible combinations.

Mancala

Mancala is a classic counting game that allows girls to use strategies to collect the most marbles.

Directions

Supplies

- ❑ empty egg carton
- ❑ 48 marbles
- ❑ 2 plastic bowls

1. Divide the girls into pairs.
2. Use an egg carton as the Mancala board. The board consists of 2 rows of 6 egg wells.
3. Each girl has one row of 6 egg wells.
4. Each girl has a plastic bowl, which is the mancala. The bowls are placed on either end of the egg carton. Each girl faces the egg carton, and the mancala on the right belongs to her. The mancala does not have any marbles in it at the beginning of the game. The objective is to collect as many marbles as possible into your mancala.
5. To begin the game, place 4 marbles into each of the egg wells.
6. During a player's turn, she picks up all the marbles in one of the egg wells on her side of the egg carton. She cannot pick up marbles from her mancala. The marbles are then dropped, one by one, into the adjacent egg wells in a counter-clockwise direction (i.e. to the right). Continue until she has no marbles left in her hand. The first marble will be dropped into the egg well to the right of the one she took the marbles from, then the next marble dropped to the right of that egg well, etc. At the end of the row, she drops a marble into her mancala as she continues around the board, then she continues around to her opponent's egg wells, as well. If she comes to her opponent's mancala, she skips this space and continues to her own side of the egg carton (i.e. do NOT place marbles into your opponent's mancala!)
7. If the last marble dropped on a turn ends up in her own mancala, she can take another turn.
8. If the last marble that she drops ends up in an empty egg well on her own side of the egg carton, then she "captures" all of the marbles from the egg well directly across on her opponent's side of the carton and places them in her mancala.
9. The game ends when a girl has no more marbles to pick up on her side of the carton.
10. The girl with the most marbles in her mancala wins the game.

Tic-Tac-Toe

The classic game of Tic-Tac-Toe challenges the girls to use strategy and mathematical logic. Have the girls make up their own Tic-Tac-Toe board and game pieces.

Directions

1. Have the girls make their own Tic-Tac-Toe board. It could be a portable one that they could take to and from their meetings or make a Tic-Tac-Toe hat craft so they could play it whenever there is extra time.
2. Once the girls have made their Tic-Tac-Toe boards, have them play the classic game, taking turns placing their game pieces until one girl has 3 pieces in a row.
3. Have the girls play in pairs. The first girl to win 5 rounds wins the game.

Supplies

- ❑ cardstock or scrap square wooden board
- ❑ suggestions for game pieces: found objects (e.g. different coloured pony beads, seashells, buttons, pebbles etc.)
- ❑ toothpick
- ❑ wooden dowel or sticks
- ❑ craft glue
- ❑ glue gun

Directions to Make a Tic-Tac-Toe Board

1. Measure the length of the Tic-Tac-Toe board.
2. Cut the wooden dowels or sticks so that they fit the length of the board.
3. Use a ruler to evenly space out the dowels/sticks on the board so that there is a 3 by 3 table (3 columns and 3 rows).
4. Use a toothpick to apply craft glue onto the dowels/sticks one at a time. Place the dowels on the wooden board. Leave for 30 minutes to allow the glue to dry.

5. Find items (e.g. buttons, pebbles, seashells) around the house that could be used as game pieces for the Tic-Tac-Toe board.
6. Place the board and the 12 pieces in a plastic bag to make a set.

Directions to Make a Tic-Tac-Toe Hat Craft

1. Use a computer to create labels for the mini Tic-Tac-Toe kit. Alternatively, use a permanent marker to label the outside surface of the container.
2. Print the labels and cut them apart.
3. Cut out a piece of string and thread it through the eye of the safety pin. Fold the string in half so that the two ends are together.
4. Use double-sided tape to attach the folded ends of the string to the canister, then attach the label onto the tape, as well.
5. On the cardstock, use a pen to draw two vertical lines and two horizontal lines to create a 3 x 3 table. There should be 3 columns and 3 rows.
6. Place 12 small buttons or beads (6 of one colour and 6 of another colour) into a plastic bag.
7. Place the Tic-Tac-Toe board and playing pieces into the container.
8. Attach the mini Tic-Tac-Toe kit to a camp hat. Use it to pass time while at camp.

Supplies

- ❑ small plastic container
- ❑ tic-tac-toe labels
- ❑ scissors
- ❑ double-sided tape
- ❑ string
- ❑ safety pin
- ❑ 4 cm x 4 cm piece of cardstock (size to fit the height of your container)
- ❑ pen
- ❑ buttons or beads
- ❑ small plastic baggie

PROGRAM CONNECTIONS

The Girls First program is girl-driven and designed to be highly flexible and agile. We encourage you to visit the Digital Platform to best determine how this challenge fits into the Program Areas and Themes.

You may want to start exploring the following Program Areas:

- Experiment and Create
- Build Skills
-

This is not a comprehensive list, and remember that you can apply your activities to the Girls First program as you see fit.