

**Math, Maps and More
Interest Project Patch Guide
For Cadette and Senior Girl Scouts**



BRIDGING
T H E
GAP

**A Collaboration
Between
Discovery Place, Inc.
and Girl Scouts, Hornets' Nest Council.**

BRIDGING THE GAP

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Math, Maps and More Interest Project Patch Guide

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These activities correspond to the activities found on pages 68-69 in Interest Projects for Cadette and Senior Girl Scouts. They are designed to be fun, easy and inexpensive. The layout of each activity contains simple instructions for preparation. All GSUSA guidelines should be followed when doing these activities.



Introduction

Who, What, Why, When, Where, and How?

Who?

You, of course! This Bridging the Gap Interest Project Patch Guide was written to give Cadette and Senior Girl Scouts extra resources to make it easier to investigate science, engineering, and mathematics Interest Project Patches.

What?

What is Bridging the Gap (BTG)? Bridging the Gap is a nationally recognized science education program developed specifically for Girl Scouting. BTG promotes the idea that girls can learn and have fun exploring science, engineering, and mathematics activities when given the opportunity to try them in a girl-friendly environment.

You may have already tried BTG activities as a Daisy Girl Scout, Brownie Girl Scout, or Junior Girl Scout and know how fun they can be. Fun is of special importance to Bridging the Gap. After all, **LEARNING IS DIRECTLY PROPORTIONAL TO THE AMOUNT OF FUN YOU HAVE!**

Why?

Why do Bridging the Gap activities? Understanding science and mathematics and being comfortable with engineering and technology can help you succeed in any career path you choose. If you dream of becoming an astronaut or a marine biologist, you know you need strong math and science skills. What many people do not realize is that in today's world, science, math, and technology play a major role in everything we do. So if instead, you dream of becoming an artist, an athlete, or businessperson, you will be better prepared if you have a strong background in science and mathematics. Here are the facts:

- Women with good math skills earn more than women without these skills;
- Engineering will be among the highest paying and fastest growing occupations over the next decade; and
- The fastest growing occupations all require strong backgrounds in science, technology, math and/or engineering.

When?

You can work on your Interest Project Patch whenever you want to do so. Use the Planner Page and Outline to decide which activities you want to do and plan when you want to complete them. One of the great things about being a Cadette or Senior Girl Scout is that you plan your own activities. Just remember to consult with your troop leader or an adult advisor and always follow Safety-Wise guidelines.



anywhere—at home, at troop meetings, at service you find Girl Scouts. You can even come activities require electricity or access to you need before you begin.

Interest Project Patch? Try the Get Started Activity
ments, you must choose at least 7 activities:

2 more activities from any category you choose

The Get Started Activity counts as one of the seven required activities, leaving only six to complete the Interest Project Patch. Each activity in this Interest Project Patch Guide will help you complete a different Skill Builder or Technology activity and will have more suggestions for possible Career Exploration activities and Service Projects. Additional links are provided to help you connect this Interest Project Patch to a future Gold or Silver project.



Math, Maps and More Activities at a Glance

Read the activity descriptions below and then try the Get Started With *The Mathematics of Doodles* to see if you would like to learn more about the subject of this Interest Project Patch. Then refer to pages 68-69 of *Interest Projects for Cadette and Senior Girl Scouts* and the corresponding activities in this guide to decide which activities you want to do to complete your Interest Project Patch.

In the Get Started activity, you will experiment with doodles and colors to learn about patterns and math skills necessary in map-making as you work on Skill Builder 5. Additional activities in this guide provide hands-on activities to:

- Discover a different approach to graphing with string art for Technology 1.
- Use statistics to crack a secret code for in Skill Builder 4,
- Learn about three different women who are also mathematicians for Technology 2, and
- Explore how doctors depend on mathematics to find out if you are healthy or not for Technology 4,

These activities are only suggestions. Some of the activities will go beyond the basic suggestions in the Interest Project Patch requirements listed in *Interest Projects For Cadette and Senior Girl Scouts*. If an activity in this book isn't interesting to you, change it or choose another activity. Remember, this is your Interest Project Patch!



Math, Maps and More Planner Page

Make a copy of this sheet to plan your Interest Project Patch activities.

My Interest Project Patch Plans

My two Skill Builders are:

1)

2)

My Technology activity is:

1)

My other activities are:

1)

2)

My Service Project is:

1)

My Career Exploration activity is:

1)

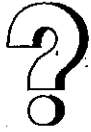
My Gold or Silver links could be:



Explanation of Icons



Pay close attention or else!



Here's a question for you



What's happening and why



Technical information



Extra tips and hints

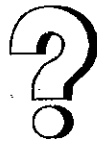
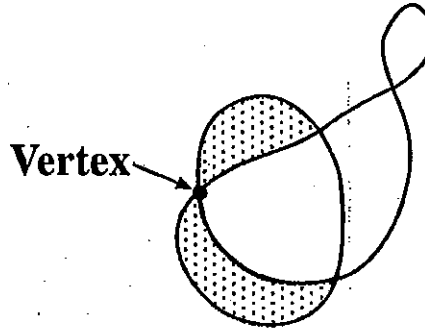


NOTES

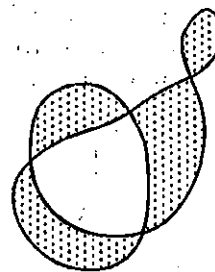
Lined area for taking notes, consisting of approximately 25 horizontal lines within a rounded rectangular border.



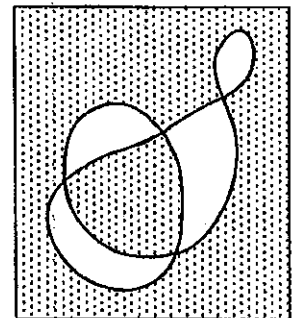
In math terms, a point is called a **vertex** and a side is called an **edge**. A mathematician would say Part C this way: It is okay for the same colors to meet at a **vertex** but it's not okay for the same colors to meet at an **edge**.



What did you discover? You only need, at minimum, two colors to color your doodle—the color of your paper and the color of your pen or pencil. Look at the picture below to see two ways of coloring the doodle. There is more than one right answer.



or

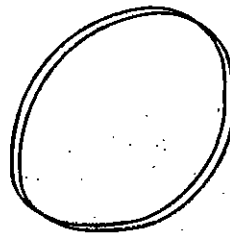




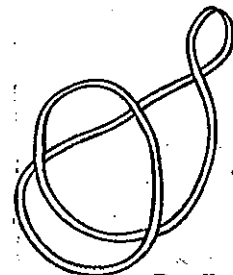
NOTES

**What's
Happening and
Why?**

1. To understand why you only need two colors to color the doodle shown in Step One of the **Do It!** section, imagine what shape you would get if you "untangled" the doodle. Using the circular piece of rope as a model, twist and overlap the circle of rope until it matches the doodle. Experiment with the rope to see that all doodles that start and end in the same place can be untangled to form a circle that has an inside and an outside.

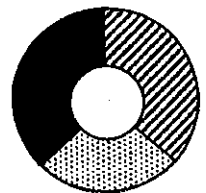
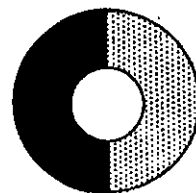
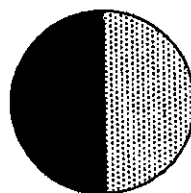


Circle



Doodle

2. How many colors does it take to color a circle so the inside and outside are different colors? Just two. It turns out that no matter how much the circle is overlapped or twisted, it will always have one inside area and one outside area. No twisting, turning, or stretching will change that fact. Any doodle that can be untangled to form a circle will only need two colors to color it.
3. Look at the doodle illustrations that need three and four colors to color. Can they be untangled to form a circle? No, they cannot and that is why they use more than two colors. No one has ever found a map or doodle that needs more than four colors.





NOTES

A vertical rectangular box with rounded corners, containing 20 horizontal lines for writing notes.



What's Next?

More to Explore

Career Links

one will come up with a simple proof for this problem that does not need a computer, but it could also be possible that a simple proof does not even exist.

The mathematics of coloring doodles and maps is a special type of geometry called **topology**. Topology examines the patterns created when shapes are twisted and stretched.

You have just completed Skill Builder 5 of the Math Maps and More Interest Project Patch by learning about one of the math skills people called geographers and cartographers use when they make maps. They need to use a lot of advanced mathematics to make accurate flat maps of our three dimensional world. You can learn about some of these advanced math techniques on pages 98-100 of *The Mathematical Tourist*.

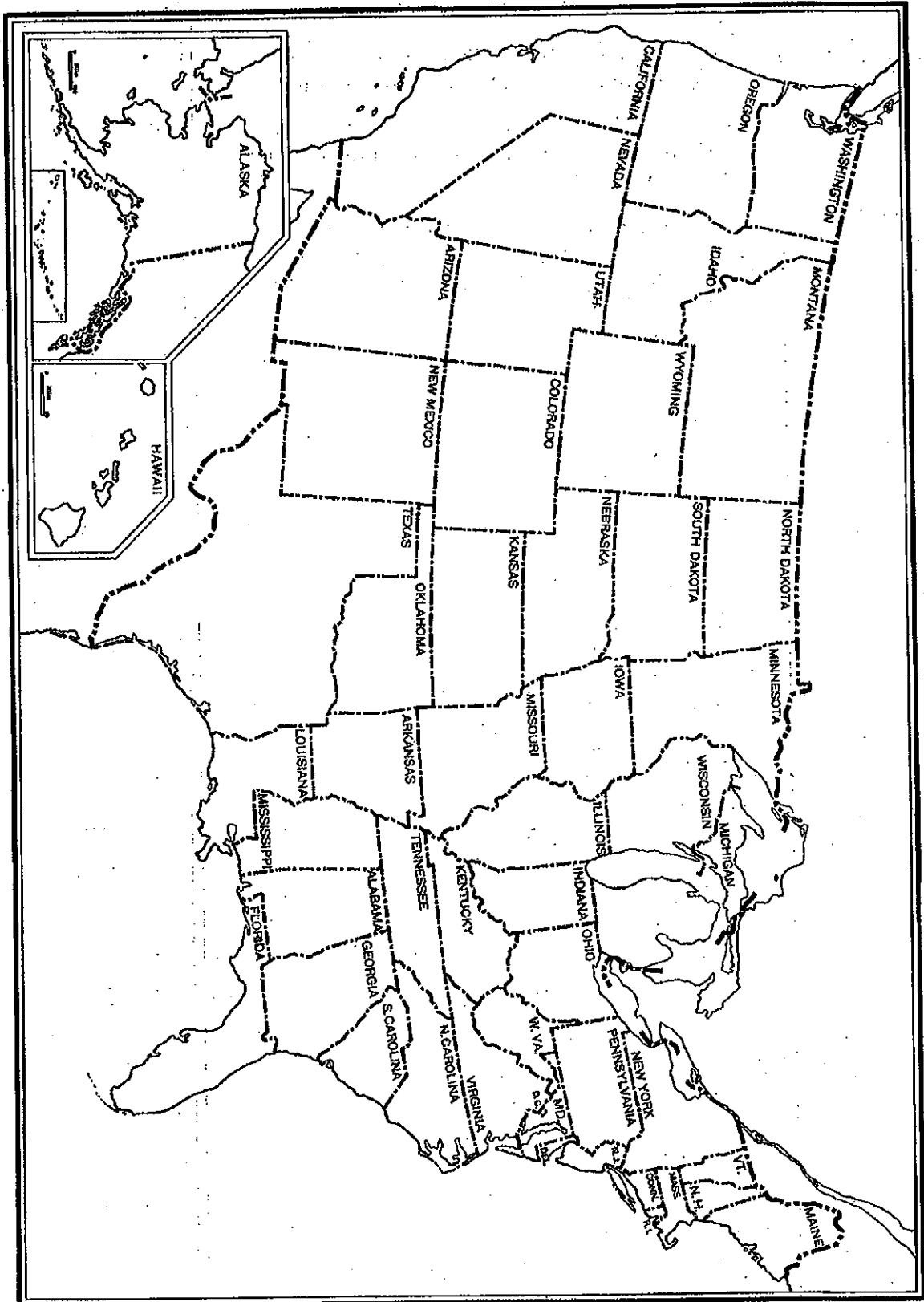
Did you know that mathematics is also used to create art? Look at "A Color Gallery Of Modern Mathematics" (the two sections of colored pictures) in *The Mathematical Tourist*. The descriptions for these pictures follow the Table of Contents on pages xi-xiii.

If you are interested in learning more about maps, check out the United States Geological Survey website at www.usgs.gov.

- Learn more about careers in cartography or geography. Check out information at careers.geocomm.com.
- Many colleges and universities have degree programs in geography. Talk with the guidance counselor at school or use the internet to see what programs are available at colleges near you.



BRIDGING GAP





NOTES

A vertical rectangular box with rounded corners, containing 20 horizontal lines for writing notes.

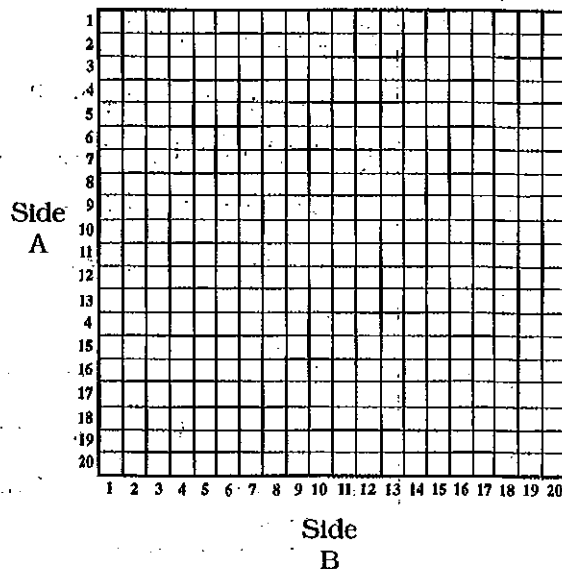
Do it!

1. Gather your starting materials.
 - A square of plastic needlepoint canvas
 - Yarn needle
 - 1 1/2 - 2 yards of embroidery floss or crocheted thread which will be your string
2. Thread your needle with 1 1/2 - 2 yards of string. Tie a knot in one end of the string, making sure the knot will not slip through the hole in the plastic canvas.
3. Look at the piece of plastic canvas. Count the number of holes on each side. If your square has twenty holes on each side, imagine that the holes on one side (Side A) are numbered from 1 to 20. Then, continue around the corner and start numbering the holes on the second side (Side B) from one to twenty again. Think of the holes on both Sides A and B as dots on a graph. Look at the picture below for an example.



The corner hole which is number 20 on Side A (Hole 20A) is also the first hole on Side B (Hole 1B).

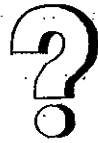
It is okay if your square has more than 20 holes. Any number of holes will work as long as the number is the same on both sides.





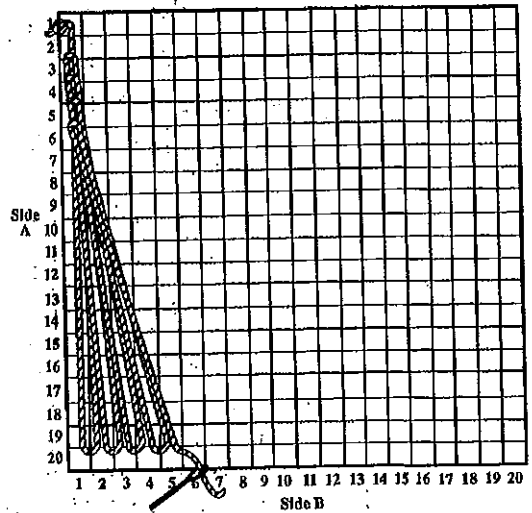
NOTES

A vertical rectangular box with rounded corners, containing 20 horizontal lines for writing notes.



**What's
Happening and
Why?**

6. Repeat the short backstitch and bring the needle and string up through Hole 3A, pull the string across, and put your needle back through Hole 3B.
7. Keep repeating the pattern of short backstitches and long top stitches until all the holes on Side A are connected with matching holes on Side B. **Do you see a pattern starting to form?** If not, look at the sample card to see the finished pattern. **What shape do you have when all the holes are connected? Does it look like anything you have seen before?**



Because the long straight stitches cross each other at a different angle each time, the final design is a curve made up entirely of bits of the straight lines. This is called **string geometry**. Mary Boole learned how to do this by accident. Read about how she discovered what she called curve stitching on page 52 of *Women and Numbers*.

As Mary Boole experimented with curve stitching, she discovered many different patterns, some of which were also found in ancient Celtic, Greek and Egyptian art. You can learn more about string geometry and see a copy of a Boole Curve-Sewing Card on pages 56 - 57 of *Women and Numbers*.



NOTES

What's Next?

More to Explore

Career Links

1. Learn more about Mary Boole and her accomplishments for Technology 2. Read the chapter about her in Women and Numbers or search the Internet for more information. Check www.agnesscott.edu/riddle/women/women.htm for information.

2. Experiment further with curve stitching using the triangle and diamond shaped pieces of plastic needlepoint canvas. Look at pictures in the book, Women and Numbers, on pages 56 - 57 for suggestions.

1. Use the hole punch, cardboard, yarn, and the other optional materials to make your own sewing cards.

a) Use the ruler and pencil to mark where you want your holes to be on the cardboard.

b) Use the hole punch or the yarn needle to punch the holes in the cardboard.

c) Use your own yarn or string to sew your own pattern.

2. You can also buy larger pieces or different shapes of plastic needlepoint canvas to experiment with different shapes.

3. You can use string geometry to make three-dimensional shapes. Ask your math teacher at school if you need help.

Mary Boole discovered that her education and knowledge of mathematics helped her to find a job to support herself and her five children after her husband died. Which careers interest you? Explore how strong mathematics skills can help you succeed in your career path.



One way to figure that out is to take a sample of something written in English, count the number of times each letter is used and list the results in a chart. A sample of writing, 1000 letters long, from the Cadette Girl Scout Handbook was counted to make the following chart.

| Cadette Girl Scout Handbook Sample | | | | | |
|------------------------------------|--------|--------------|---------------------|--------|--------------|
| Most to least order | letter | # times used | Most to least order | letter | # times used |
| 1 | E | 121 | 14 | D | 28 |
| 2 | T | 107 | 15 | P | 25 |
| 3 | O | 102 | 16 | M | 24 |
| 4 | R | 81 | 17 | W | 22 |
| 5 | L | 74 | 18 | G | 21 |
| 6 | I | 64 | 19 | B | 13 |
| 7 | S | 57 | 20 | F | 13 |
| 8 | A | 51 | 21 | V | 8 |
| 9 | C | 48 | 22 | J | 1 |
| 10 | H | 44 | 23 | X | 1 |
| 11 | N | 33 | 24 | Z | 1 |
| 12 | Y | 31 | 25 | K | 0 |
| 13 | U | 30 | 26 | Q | 0 |

1. Make a copy of the Code Worksheet found at the end of this activity or copy the information onto a piece of paper. Count the number of times each letter is used. You can do this by using a tally sheet and crossing through each letter after you count it.

The following example shows letters that have been tallied and recorded.

~~Baa-ee-dee~~ pif pkipx...

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | | |
| B | | | |
| C | | | |
| D | | | |
| E | | | |

2. When you have tallied all the letters in the message, count and record how many times each letter was used. Which letter was used the most? Was it "A"? Compare this to the Cadette Girl Scout Handbook sample. Could the letter that appeared most in the message possibly be the same letter "E" that appeared most often in the sample? Try it and see if it works in the message. Record "E" as the possible English letter for the code letter "A".

For example,

Baa oq dec pif pkipx ...
ee

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |

3. What letter appears the second most often in the code? Is it the letter "R"? The letter "T" appears second most often in sample. Check to see if the code "R" could really be "T". Record "T" as the possible English letter for the code letter "R".

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |

Baa oq dec pif pkipx rvob pesa.

ee _____ t _____ e

Kauaumak rvir awakd Jokt Bpecr taikfb rvob.

e e e t t e e _____ t e t

Rva Jokt Bpecr Gkeuoba.

T e _____ t _____ e.

Ef ud vefek, O lott rkd:

_____, _____ t _____:

Re bakwa Jes ifs ud pecfrkd,

T e e _____ t _____,

Re vatg gaegta ir itt rouab,

T e e e t t e _____,

Ifs re towa md rva Jokt Bpecr Til.

____ t _____ e _____ t e _____ t _____.



4. The third most common code letter is "E" and the third most common English letter in the sample is "O". Check to see if "O" is the English letter for "E".

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |
| E | | 15 | O |

Baa og dec pif pkipx rvob pesa.
e e o t e

Kauaumak rvir awakd Jokt Bpecr taikfb rvob.
e e e t t e e o t e t

Rva Jokt Bpecr Gkeuoba.
T e o t e

Ef ud vefek, O lott rkd:
O o o t

Re bakwa Jes ifs ud pecfrkd,
T o e e o o t

Re vatg gaegta ir itt rouab,
T o e o e t t e

Ifs re towa md rva Jokt Bpecr Til.
t o e t e o t



5. The fourth most frequent letter in the code is "K". See if it is really the fourth most frequent letter in the sample, which is "R".

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |
| E | | 15 | O |
| K | | 13 | R |

Baa oq dec pif pkipx rvob pesa
ee o r t o e

Kauaumak rvir awakd Jokt Bpecr taikfb rvob
Re e er t te e r o t e r t

Rva Jokt Bpecr Gkeuoba.
T e r o t r e

Ef ud vefek, O lott rkd:
O o or, tr:

Re bakwa Jes ifs ud pecfrkd,
To e r e o o tr,

Re vatg gaegta ir itt rouab,
To e eo e t t e,

ifs re towa md rva Jokt Bpecr Til.
to e t e r o t



6. What will the next letter be? The frequency order becomes less reliable as you move down the list. Look at your tally sheet. The fifth most common code letter is "T" which could be "L" and the sixth most common is "O" which could be "I", but does this make sense?

Look at the fourth line and you will find the letter "O" by itself. It makes sense that "O" would be "I" because "I" can be a word by itself. Next to this you will also find a word with a double "T". "L" could also be a double letter so this could also work. Try it and see.

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |
| E | | 15 | O |
| K | | 13 | R |
| T | | 12 | L |
| O | | 11 | I |

Baa og dec pif pkipx rvob pesa.
ee i o r t i o e

Kauaumak rvir awakd Jokt Bpecr taikfb rvob.
Re e er t te e irl o t le r t i

Rva Jokt Bpecr Gkeuoba.
T e irl o t ro i e

Ef ud vefek, O lott rkd:
O o or, I ill tr:

Re bakwa Jes ifs ud pecfrkd,
To ser e o o tr,

Re vatg gaegta ir itt rouab,
To el eo le t ll ti e,

Ifs re towa md rva Jokt Bpecr Til.
 to lie te irl o t L

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |
| E | | 15 | O |
| K | | 13 | R |
| T | | 12 | L |
| O | | 11 | I |
| B | | 10 | S |
| I | | 9 | A |
| P | | 8 | C |

Baa og dec pif pkipx rvob pesa.
See i o ca crac t i co e.

Kauaumak rvir awakd Jokt Bpecr taikfb rvob.
Re e er t ate e irl sco t lear t is.

Rva Jokt Bpecr Gkeuoba.
T e irl sco t ro ise.

Ef ud vefek, O lott rkd:
O o or, I ill tr.

Re bakwa Jes ifs ud pecfrkd,
To ser e o a co tr.

Re vatg gaegta ir itt rouab,
To el eo le at all ti es,

Ifs re towa md rva Jokt Bpecr Tila
A to lie t e irl co t La.



7. See if code letter "B" is really "S", code letter "T" is really "A" and code letter "P" is really C. Can you start to see some words forming?

| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| A | | 19 | E |
| R | | 16 | T |
| E | | 15 | O |
| K | | 13 | R |
| T | | 12 | L |
| O | | 11 | I |
| B | | 10 | S |
| I | | 9 | A |
| P | | 8 | C |
| V | | 7 | H |

Baa oq dec pif pkipx rvob pesa.
See i o ca crac thi co e

Kauumak rvir awakd Jokt Bpecr taikfb rvob.
Re e er t at e e irl Sco t lear this

Rva Jokt Bpecr Gkeuoba.
The irl Sco t ro ise

Ef ud vefek, O lott rkd:
O ho or, I ill tr

Re bakwa Jes ifs ud pecfrkd,
To ser e o a co tr

Re vatg gaegta ir itt rouab,
To hel eo le at all ti es

Ifs re towa md rva Jokt Bpecr Til.
A to lie the irl co t La



Secret Code Worksheet

Baa oq dec pif pkipx rvob pesa.

Kauaumak rvir awakd Jokt Bpecr taikfb rvol

Rva Jokt Bpecr Gkeuoba.

Ef ud vefek, O lott rkd:

-----, -----:

Re bakwa Jes ifs ud pecfrkd,

-----,

Re vatg gaegta ir itt rouab,

-----,

Ifs re towa md rva Jokt Bpecr Til.



| Code Letter | Tally | Count | English Letter? |
|-------------|-------|-------|-----------------|
| 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 | | | |

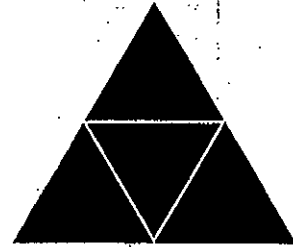
| Cadette Girl Scout Handbook Sample | | |
|------------------------------------|--------|--------------|
| Most to least order | letter | # times used |
| 1 | E | 121 |
| 2 | T | 107 |
| 3 | O | 102 |
| 4 | R | 81 |
| 5 | L | 74 |
| 6 | I | 64 |
| 7 | S | 57 |
| 8 | A | 51 |
| 9 | C | 48 |
| 10 | H | 44 |
| 11 | N | 33 |
| 12 | Y | 31 |
| 13 | U | 30 |
| 14 | D | 28 |
| 15 | P | 25 |
| 16 | M | 24 |
| 17 | W | 22 |
| 18 | G | 21 |
| 19 | B | 13 |
| 20 | F | 13 |
| 21 | V | 8 |
| 22 | J | 1 |
| 23 | X | 1 |
| 24 | Z | 1 |
| 25 | K | 0 |
| 26 | Q | 0 |



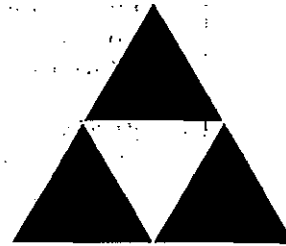
NOTES

A vertical rectangular box with rounded corners, containing 20 horizontal lines for writing notes.

4. Draw a line to connect the midpoints, which will break the large equilateral triangle into four smaller equilateral triangles.

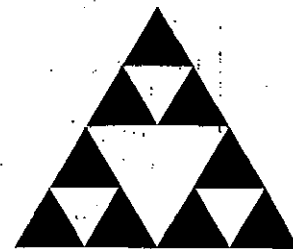


5. Remove the center triangle. Do this by using the white color-change end of the highlighter to remove the color. You should now have three triangles.



6. Repeat these steps for each of the three smaller triangles.
 - a) Find the mid-point of each side first.
 - b) Draw a line to connect the midpoints second.
 - c) Remove the center triangle.

You should now have nine triangles.





NOTES



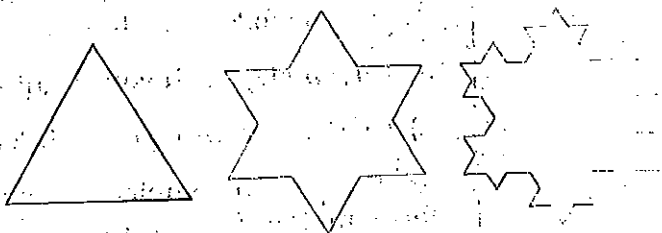
Make sure that each side of this triangle is 9 triangle grid units long.

1. Use the highlighter to color in the entire triangle. Here are the steps, or **iteration**, for making a Koch Snowflake.

a) Mark the middle third (middle three grid units) of each side of the shape with a pencil.

b) Add an equilateral triangle, pointing outwards, to each side using this middle third as the base of the added triangle.

2. Do at least two **iterations**. This pattern also can continue to infinity. You began with a triangle, but the shape changes after each **iteration**.



Start, 1st, and 2nd Iteration



These fractals may not look monstrous to you but they really baffled mathematicians when they were discovered. Maybe you can discover why. Can you find the exact area of just the colored part of a Sierpinski triangle? What is the exact perimeter of a Koch Snowflake?

A vertical rectangular box with rounded corners, containing horizontal lines for writing notes. The word 'NOTES' is printed at the top left of the box.





NOTES

and enjoyed teaching others to appreciate it. She used new ideas to make math fun and help others see it in a different light. She even named her cat Penrose after a type of math pattern called Penrose tiling. You can learn more about Theoni Pappas by reading pages 155-167 of *Women and Numbers* and discover how she started her own business and publishing company by designing math calendars and t-shirts and writing books and poetry about mathematics.

Women mathematicians can be everyday people, not just famous names from the past. Maybe you know some women mathematicians. There are several Internet sites with information about women in mathematics. For example, you can learn more about these women at

www.agnesscott.edu/riddle/women.htm.

Read other chapters in *Women and Numbers* and discover more about women mathematicians from the past to the present.

Check your local library to find books written by Theoni Pappas.

- Check out math career websites such as www.awm-math.org on the Internet.
- Be a math role model for younger girls.
- No matter what kind of topic you are interested in doing for you Gold or Silver project, research to find out about other women who worked in that area who can serve as role models for you or others.

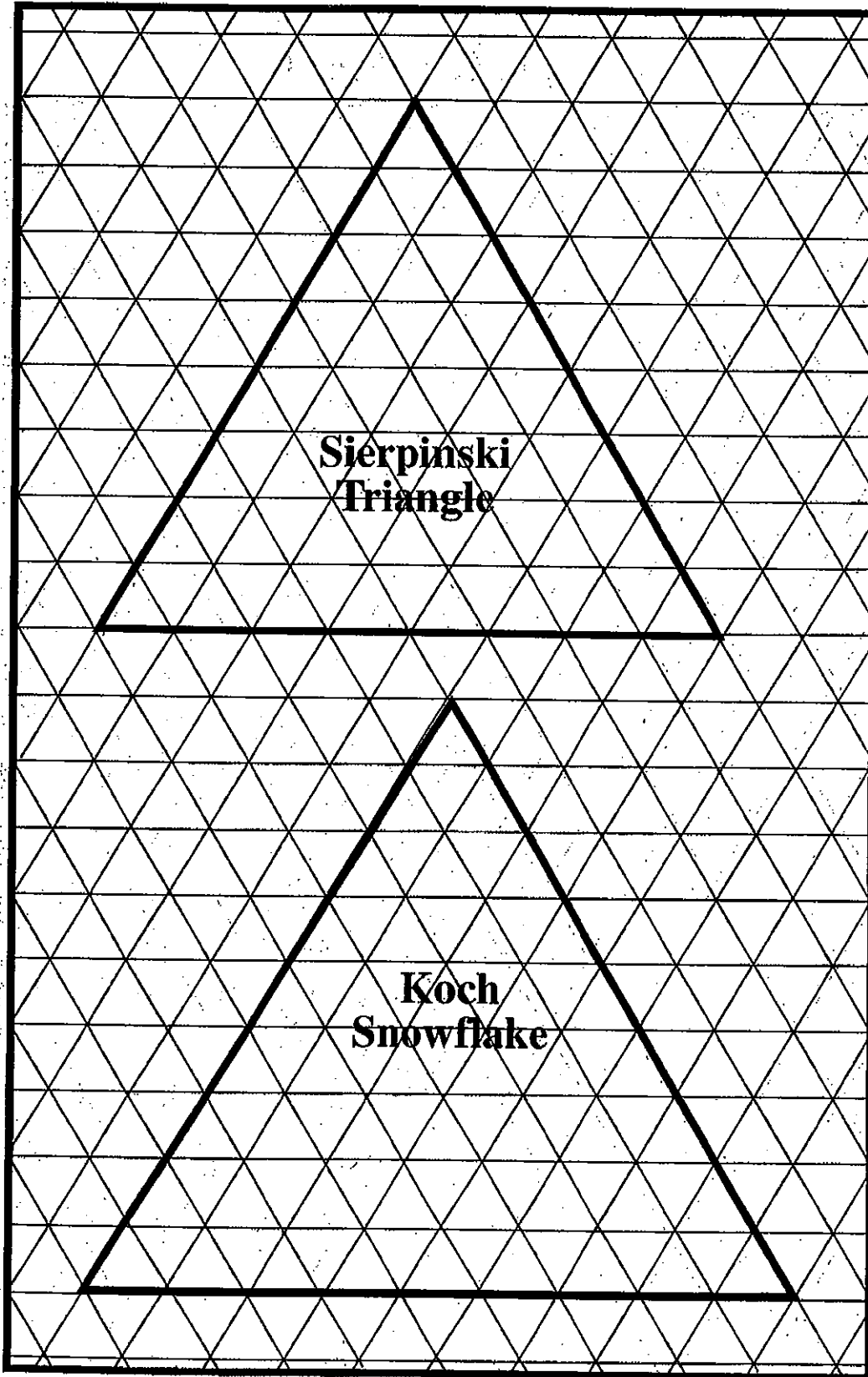
More to Explore

Career Links

Service Project Ideas

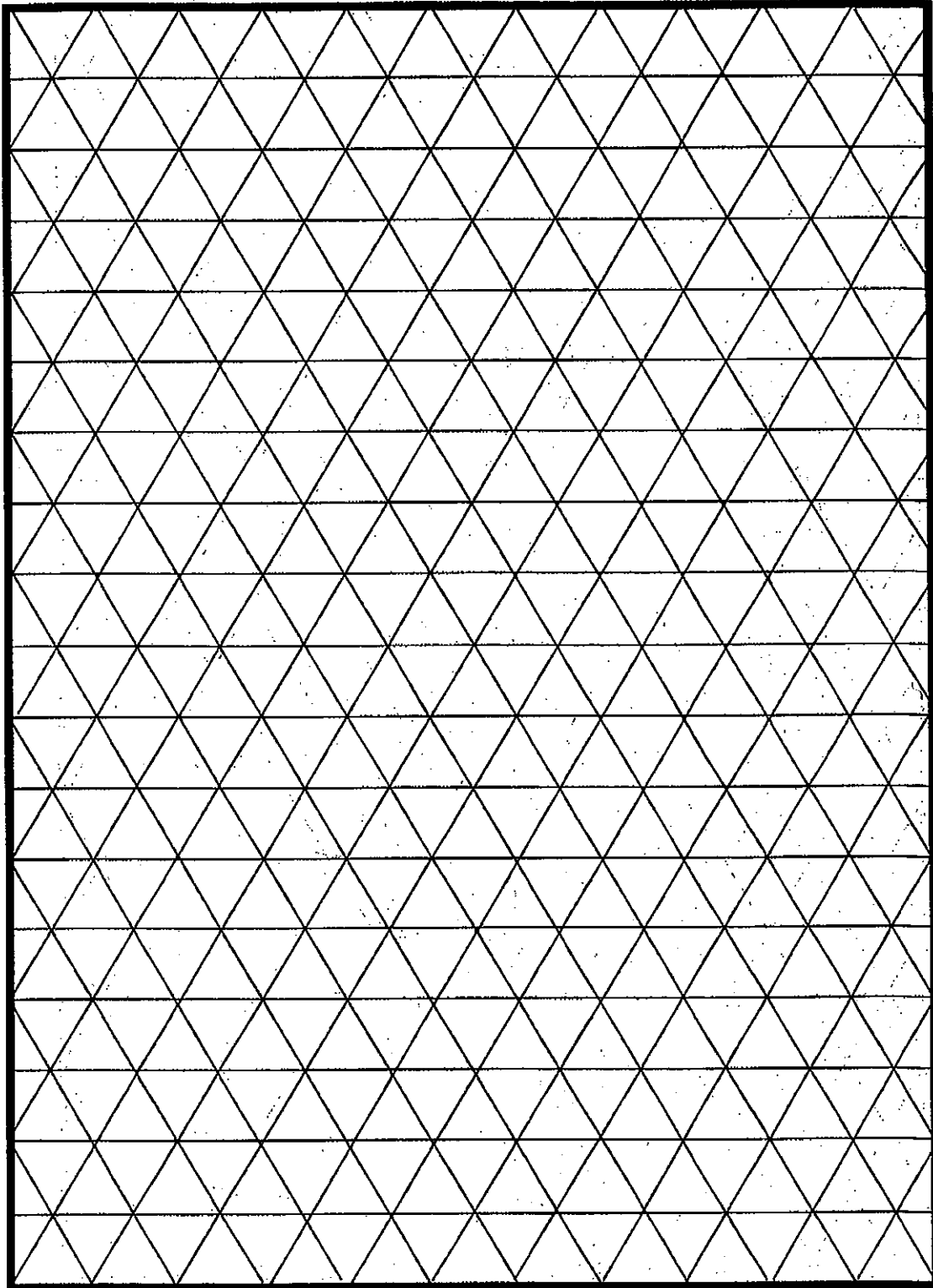
Gold and Silver Interest Project Patch Links

Fractals Sheet





Triangle Grid Sheet





NOTES

Lined area for taking notes.

Safety

Clean-Up

Do it!



No special precautions are necessary.

Dispose of used play dough and paper.

Both MRI and CAT scans measure the energy absorbed by narrow sections or "slices" of your body. The scans make a visual map of the inside of your body. This type of mapping is called **imaging** and it can show doctors what is happening inside your body without having to perform surgery.

CAT scans use multiple beams of x-ray energy, which are passed through a narrow section or "slice" of the part of the body being examined. A computer program uses mathematics to analyze how much of the x-rays were absorbed and then make a 2-D image of the "slice" which shows what is inside the body part.

MRI uses magnetism instead of x-rays to make 2-D and even 3-D images of what is inside the body. MRI also uses a computer program to do the complex mathematics needed to convert all the information collected to a picture that your doctor can use. MRI can show soft tissues such the brain, muscles, and tendons better than CAT scans.

To simulate doing an MRI or CAT scan, you are going to make a 3-D model of part of your head from play dough.

1. Make play dough. The following recipe should yield enough playdough for one face sculpture.

Homemade Playdough

7 1/2 cups of flour

1 1/2 cup of salt

3 tablespoons of alum

3 tablespoons of oil

4 1/2 cups of very hot water

Mix together all ingredients using a spoon.

Be careful—the mixture will be too hot to handle right away.

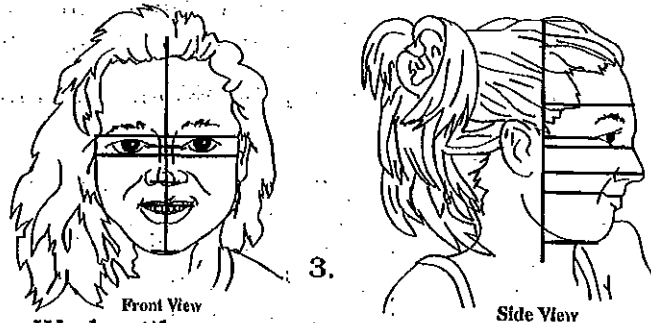


NOTES

2. To create the model, you will need to take specific measurements of your head. Ask a partner to help you because it will be hard to do this yourself. Make a copy of the Measurement sheet found at the end of this activity to record your data. You can:

- a) Make a photocopy, or
- b) Draw your own copy with paper and pencil

Look at the picture below to see what parts of your head need to be measured to create a 3-D model.



Work with your partner and use the ruler or measuring tape to make the following measurements. Begin measuring the front view of your face, then measure the side view.

Front view -

- 1) A vertical measurement through the center of the face, from the top of the head to the bottom of the chin.
- 2) A horizontal measurement from ear to ear (at the point where top of the ear meets the face).
- 3) A horizontal measurement from the inner corner of one eye to the inner corner of the other.
- 4) A horizontal measurement through the middle of the face.



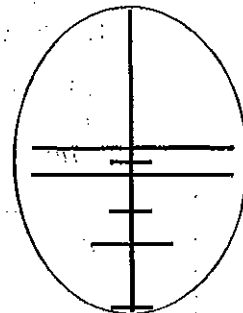
NOTES

- 5) A horizontal measurement across the bottom of the nose.
- 6) A horizontal measurement across the mouth (from one corner to another).
- 7) A horizontal measurement across the chin.

Side view -

- 1) A vertical measurement from the top of the head to the bottom of the chin. Take this measurement along a line about 1 inch in front of the ear (the point where the ear meets the face). Have your partner hold a ruler or other straight edge against her face along this line. This will serve as a guide for you, as you will take the remaining horizontal measurements using this line as a starting point.
- 2) A horizontal measurement across the forehead.
- 3) A horizontal measurement to the eye.
- 4) A horizontal measurement to the bridge of the nose.
- 5) A horizontal measurement to the tip of the nose.
- 6) A horizontal measurement to the corner of the mouth.
- 7) A horizontal measurement to the end of the chin.

4. To begin making your 3-D model, draw an outline of your face, using the front view vertical and horizontal measurements, on a piece of cardboard or a manila folder.



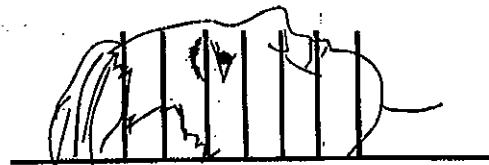
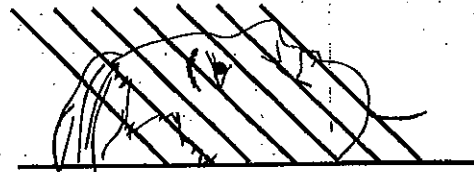


NOTES



MRI is an abbreviation for **Magnetic Resonance Imaging**. MRI uses a strong magnet and a smaller changing **magnetic field** to measure the natural magnetism, or **resonance**, of the tissues in your body to make an **image** instead of using x-rays. To fully understand what MRI means, you will need to know a lot of physics, chemistry, and mathematics.

8. Unlike a CAT scan, the slices for an MRI can be done in any direction, not just the **axial plane**. You can slice the 3-D model of your head any way you want to as long as all the slices are parallel. Choose a direction and use the fishing line to make the slices.



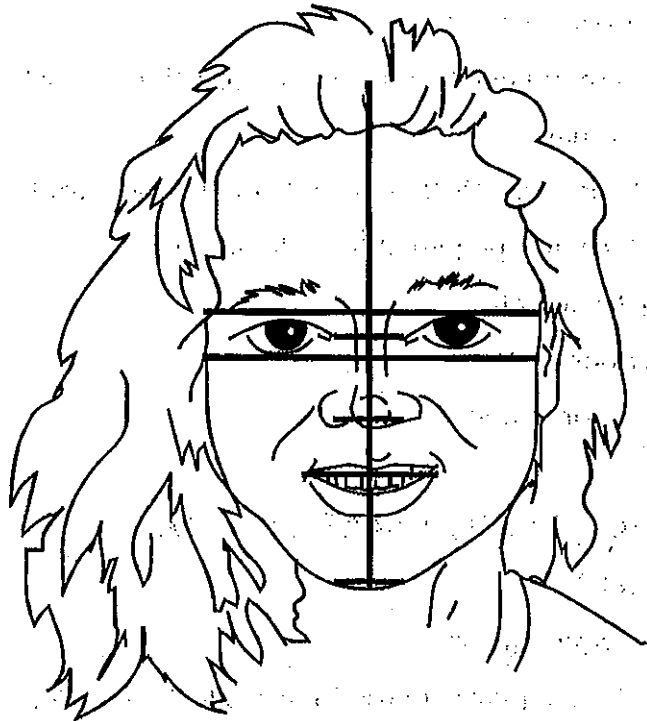
What's
Happening and
Why?

1. The x-ray beams used in CAT scans travel through a body in straight lines. This is why the slices can be made in only one direction. Bone and other body tissues absorb some of the x-ray energy, which makes the beams weaker.

CAT and MRI Measurement Sheet

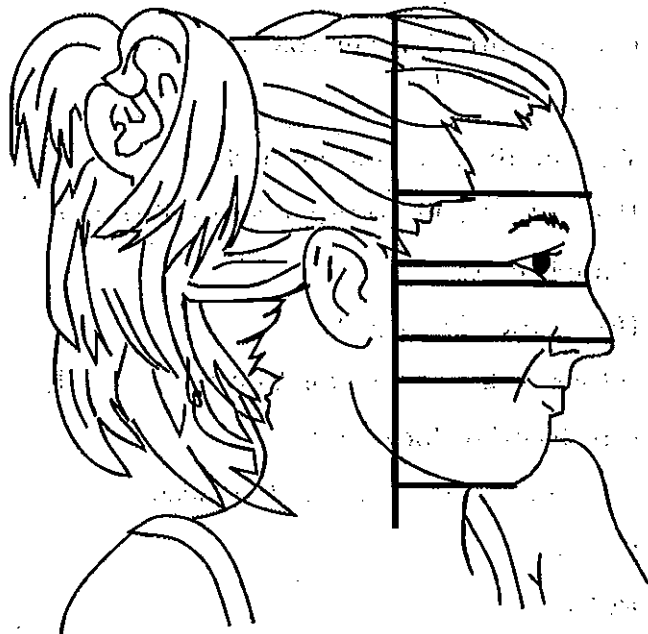
Front View

- _____ 1. vertical
- _____ 2. ear to ear
- _____ 3. between eyes
- _____ 4. middle of face
- _____ 5. bottom of nose
- _____ 6. mouth
- _____ 7. chin



Side View

- _____ 1. vertical
- _____ 2. across forehead
- _____ 3. to eye
- _____ 4. to bridge of nose
- _____ 5. to tip of nose
- _____ 6. to mouth
- _____ 7. to chin





Materials List for All Activities

The Mathematics of Doodles

Materials

From your leader:

- Colored pencils, crayons, or erasable markers
- US map
- Book—*The Mathematical Tourist* by Ivars Peterson
- Piece of rope joined to make a circle

To get yourself:

- Paper
- Pen or pencil

String, Math, and Mary Boole

Materials

From your leader:

- 3-inch square of size 7 mesh plastic needlepoint canvas
- Triangle shaped plastic needlepoint canvas
- Diamond shaped plastic needlepoint canvas
- Crochet thread or embroidery floss
- Scissors
- Yarn needle (metal or plastic)
- Book—*Women and Numbers* by Teri Perl

- Sample card

- Hole punch (optional)

To get yourself (optional for More to Explore):

- Cardboard or index card
- Your own yarn or embroidery floss
- Pencil
- Ruler



Secret Codes and Statistics

Materials

From your leader:

- Book—Women and Numbers by Teri Perl
- Calculator

To get yourself:

- Copy of code worksheet
- Paper
- Pencil

Taming Mathematical Monsters

Materials

From your leader:

- Erasable highlighter
- Book—Women and Numbers by Teri Perl
- Book—The Mathematical Tourist by Ivars Peterson

- Ruler (optional)

To get yourself:

- Copy of Fractals sheet
- Copy of Triangular Grid paper (optional)
- Pen or pencil



Math and Medicine

Materials

From your leader:

- Measuring tape
- Ruler
- Bamboo skewers
- Nylon fishing line
- Compass
- Ring magnet

To get yourself:

- Homemade play dough
- Measurement sheet
- Cardboard or manila file folder
- Newspaper to cover work area
- Pencil or pen
- Paper



Career Links List

Mathematics of Doodles

- Learn more about careers in cartography or geography. Check careers.geocomm.com for further details.
- Many colleges and universities have degree programs in geography. Talk with the guidance counselor at school or use the Internet to see what programs are available at colleges near you.

String, Math, and Mary Boole

- Mary Boole discovered that her education and knowledge of mathematics helped her to find a job to support herself and her five children after her husband died. What kinds of careers interest you? Explore how knowing mathematics can help you succeed in your career path.

Secret Codes and Statistics

- Check the Census Bureau's website at www.census.gov to learn about careers in statistics.

Taming Mathematical Monsters

- Use the career links on www.awm-math.org to check out math careers on the Internet.

Math and Medicine

- Talk with your school guidance counselor to find out what math classes you need to take in high school and college to become a medical professional.



List of Service Project Ideas

Mathematics of Doodles

- Make a map of the trails at a Girl Scout camp or of another site in your community.
- Do a doodle coloring activity with younger girls as a program activity at an overnight or service unit event.

String, Math, and Mary Boole

- Teach curve stitching as a craft activity with younger girls, just like Mary Boole.
- Use curve-stitching designs to make decorations or party favors for others.

Secret Codes and Statistics

- Develop a secret code activity to do with younger Girl Scouts.

Taming Mathematical Monsters

- Be a math role model for younger girls.

Math and Medicine

- Volunteer in the radiology department at a local hospital.

List of Gold and Silver Interest Project Patch Links

Mathematics of Doodles

- Even if you are doing a food drive or a non-math related project, see if you need to use mathematics or mapping skills when you do your project.

String, Math, and Mary Boole

- Use graphing techniques to help plan or share the results of your Gold or Silver project with others.

Secret Codes and Statistics

- Collect statistical data to help plan your Gold or Silver project.

Taming Mathematical Monsters

- No matter what kind of topic you are interested in doing for your Gold or Silver project, do some research to find out about other women who worked in that area who can be role models for you or others.

Math and Medicine

- Identify the mathematics involved in doing a Gold or Silver project. No matter what your project is, you'll need some kind of mathematics to do it!



Silver and Gold Projects in Science
Real Stories from Real Girl Scouts

Silver Awards

Nicole, age 15
Kennebec Girl Scout Council
Maine

"For my Silver Award project I put together a Mars Science Activity Kit and donated it to my council. The reason I chose to do this project was because I wanted younger girls to be able to know what was happening with Mars, some of the things that may happen in the future, and about Mars in general. I included a list of Web sites, science activities they could do, information about past, current and future missions to Mars, and general information about Mars."

Alicia, age 16
Hi-Low Girl Scout Council

"A friend and I got together to do our Silver Award. We planned and organized a Brownie Girl Scout Earth Day, encouraging Brownies to bring recycled products with them to use for crafts. There were four or five stations, a lunch break, opening and closing ceremonies, and song time (my favorite), where I led all of the girls in crazy songs. We involved several girls from our troop to run stations. Although things were rough at first, they eventually smoothed out and it convinced me to become a teacher because I love kids so much."

Linda, age 13
Mid-Continent Girl Scout Council
Missouri

"My friend and I did a Science weekend. We chose this project because her dad is a science teacher so we would have resources. We also liked this project because we both like kids. We did this for a Brownie troop. It helped them earn the "Science in Action" try-it and it got them a Junior badge, which is one of their bridging requirements. My friend and I learned that Brownies want and can do things for themselves. Third grade Brownies are able to do more than we thought. We also learned the hardships of planning an event. We did have fun making paper and crystals. The Brownies had lots of fun too, and that's the most important part."



Katty, age 15
Greater New York Girl Scout Council
New York

"I got involved with beach clean ups with my family at our local beach. I decided to make this my Silver Award project (1995) by getting others involved. Through the American Littoral Society, I was given a beach to clean for the National Beach Clean Up. I involved my whole troop as well as the community. We contacted the community through our local newspaper and by hanging flyers all over town. We then asked local merchants to donate drinks and snacks for the volunteers. Before the event, I held a workshop for Girl Scout troops in the area and had the parks department and other community workers talk about our role in cleaning up the beach, erosion, etc. We even made posters for store windows and held a poster contest. This was a lot of hard work for me but it paid off because that year we collected over 1200 pounds of trash and had some very unusual finds along the shore. The Annual Beach Clean Up is still being sponsored by my old troop at our local park, and I go to help out now as a Senior Girl Scout."

Meredith T., age 17
Mississippi Valley Girl Scout Council
Illinois

"I planned a science workshop for girls in third through sixth grade. I had women scientists present science through music, water, creative solutions, and Earth Matters! It allowed these girls to have a hands-on experience, while seeing professional women scientists in action!"



Gold Awards

Alicia

Pine to Prairie Girl Scout Council
North Dakota

"I started a recycling program in our community. I started the program because our community did not have a recycling program and there was a need for recycling. I learned that it takes a lot of work to get recycling going. We wrote a grant, met with city board members, and did a lot of paperwork. Most of all, I know I did something good for my community, and it will continue now that I have finished it. The whole community and our environment benefited from this project. It was worth all the work."

Serina, age 16

Girl Scout Council of Hawaii
Hawaii

"My Gold Project, entitled "Math = Fun + Logic," was a weekend workshop for 4th-7th grade girls. It is in this time period that girls may experience difficulty while learning math, and that they then give up on ever learning it. My project was to show the girls, through untraditional math problems, that they can be good at it, or at least be able to use math. I showed them that math is not only numbers and computations; it also is logic, sequence, pattern, connection, etc. Arithmetic is what most girls have trouble with, not the other math subjects; and arithmetic can only be improved through practice.

"At the workshop, I had the girls cook a meal with conversions and ratio, do string designs, learn magic tricks explained through math, and just become comfortable with their own individual math strengths and weaknesses. The favorite activities were a human checkers game (strategy and order) and a burning of our "math fears." I later presented each girl with a necklace containing the ashes of her fears to remind her that if she puts her mind to it, she can do anything—even math!"

Sarah, age 18

Morris Area Girl Scout Council
New Jersey

"For my Gold Award project, I created a science program for first through third graders to introduce them to the idea that anyone can have fun with science. I chose the project because I have been interested in science since I was a young girl. I learned a lot about my own skills with people, especially children."

Gold and Silver Project Ideas

Even if your Gold Award project is not related to science, you can still incorporate skills you develop through Interest Projects in the "Nature, Science and Health" category into your project. Take a look at some of these ideas gathered from different web sites for Girl Scout Cadette/Senior troops across the country:

- Create an interpretive map for a self-guided historical walking tour around your community, using math and mapping skills.
- Present a series of games and workshops utilizing sensory experiences to show girls first-hand what it's like to be disabled.
- Involve your community in an effort to clean up a polluted area, such as a lake or stream. You can also organize a community effort to clean up and improve facilities at a local park or nature center.
- Develop a web page for your school, troop or Council, or assist in maintaining an existing one.
- Plan and implement a recycling program in your school. Get people involved through an educational campaign, teaching people about environmentalism and the benefits of recycling. Arrange for the program to be continued after you graduate.
- Repair a troop house, making sure it complies with Safety Wise standards. Build a wheelchair ramp, if the house doesn't already have one, and make other improvements to ensure the house is accessible to all.
- Create a landscaping project for your school or Council. Consult with a landscape architect, if possible, to learn more about irrigation, maintenance, design and other aspects of the project.
- Conduct stargazing workshops for younger girls, teaching them about constellations and astronomy. Volunteer at a local observatory to learn more.
- If you are interested in the arts, you can write and produce a play that touches upon such themes as environmentalism, space exploration, modern technology or another topic related to science or nature.
- Develop and distribute science activity kits, with instructions and materials, for children who are hospitalized with extended care needs.
- Work with a local historical society and/or extension service to create a native plants education program. Develop a resource binder with reference information for the project.



Math, Maps and More Activity Survey

Approximately how long did you spend on each of the following activities?

Mathematics of Doodles _____ minutes

String, Math and Mary Boole _____ minutes

Secret Codes and Statistics _____ minutes

Taming Mathematical Monsters _____ minutes

Math and Medicine _____ minutes

What activity did you enjoy most, and why?

What activity did you like the least, and why?

Did you further explore any of the activities?

Which ones?

Give an example of what you did.

What can be done to make these activities more fun and/or successful?

Thank you for your help and your opinions!!!

Please return all forms to: