CSI: Alberta Challenge

Introduction - The goal of this challenge is to learn and have fun with science experiments and solving mysteries.

Challenge Requirements

Sparks and Embers

Do 3 of the following

1. Play a Kim's game
    a. Have several objects on a tray and have the girls look at them for one minute. Then cover the tray and have the girls try to remember as many objects as possible. This can resemble a crime scene that they have "witnessed" and now they are trying to remember what is there.

2. Finger Printing
    a. Learn about the different patterns in fingerprints (see supplement)
    b. Using an ink pad, create a fingerprint for each girl on a piece of paper or card stock, and put the girls name beside this. Have one fingerprint on a sheet and have the girls try to figure out who this belongs to by comparing to the named fingerprints.

3. "Who stole the cookie from the cookie jar?"
    a. Using cocoa powder, dust glasses for fingerprints (see supplement). If you have labelled the girls fingerprints from the activity above, these can be used to determine who the cookie culprit is.

4. DNA Extraction
    a. Using fruit and the recipe provided, extract DNA from the fruit (see supplement).
    b. Discuss how DNA is found in every cell, from bacteria to humans, and this is what makes us what we are. Each strand is so thin that we need a very strong microscope to see this, but when we combine this from many cells, it can be seen with the naked eye.

5. Decode a secret message (see supplement).
    a. Using one of the secret messaging systems or devising one as a group, decode two messages. The first should be the promise and the second can be one that is made by the girls and shared with each other.

6. Invisible Ink
    a. Create your very own invisible ink (see supplement)
    b. Using this, draw a picture or write a message to share

7. Create your own magnifying glass

a. Using locking bags, put in different amounts of water and see the different magnifications with each of these (from http://www.indianmoms.com/activities/science1.htm)

Guides, Pathfinders and Rangers **Do 4 of the following**

1. Play a Kim's game
    a. Have several objects on a tray and have the girls look at them for one minute. Then cover the tray and have the girls try to remember as many objects as possible. This can resemble a crime scene that they have "witnessed" and now they are trying to remember what is there.
    b. Try an elimination game. After covering the objects again, remove one object. The girls then have to remember which object is gone.

2. Decode a secret message
    a. See supplement for some ideas of possible codes and the girls can create messages to share with the other girls
    b. The girls can also create their own messages and codes and have other girls in the unit decode them
    c. Use a cipher wheel to create secret messages (see supplement)

3. Extract DNA
    a. Using fruit and the recipe provided (see supplement), the girls can extract DNA from fruit

4. Fingerprinting
    a. Learn about the different types of fingerprint patterns. Learn about the history of fingerprinting.
    b. Create fingerprint cards for each girl by using an ink pad and putting the fingerprint on a card with the girls name. Have someone as the "guilty party" and put their fingerprints on a glass. Dust the glass for fingerprints and try to solve the mystery of who they belong to (see supplement).

5. Identifying an Unknown Person
    a. Dental impressions (see supplement)
        1. Dental impressions are often used to determine identity. Create your own dental impressions. If each girl makes an impression, these can be compared to the "unknown impression" and used to determine identity.
    b. Determining the Height (see supplement)
        1. Using the length of a person's foot a height can be determined. Try to find the height of all the girls in the unit.

6. What is the white substance?
    a. One of the jobs of a CSI is to try to identify unknown substances at a crime scene. Using the attached instructions, try to figure out the unknown substance.

7. Mystery Ink
    a. By using chromatography, determine which pen wrote the mystery message left at the crime scene (see supplement).

Supplemental Information for CSI : ALBERTA Challenge

1. Different Patterns in Fingerprints

Loop

Central Pocket Loop

Double Pocket Loop

Double Loop

Plain Arch

Tented Arch

Plain Whorl

(Pictures from http://www.creativechemistry.org.uk/activities/fingerprinting.htm)

2. Dusting for fingerprints
    a. When fingers are oily or sticky you get better fingerprints. So press an oily or sticky finger on the side of a drinking glass.
    b. Coat the fingerprints with a dusting of cocoa powder.

c. Brush gently with either a camelhair or fiberglass brush. The fingerprints remain. 4. Place the sticky side of the tape on the dusted fingerprint. Lift on the tape and place on light colored construction paper.

Talcum powder should be used on dark surfaces.

(Instructions from http://homeschooling.gomilpitas.com/explore/crimescene.htm)

3. Extracting DNA from fruit or vegetables

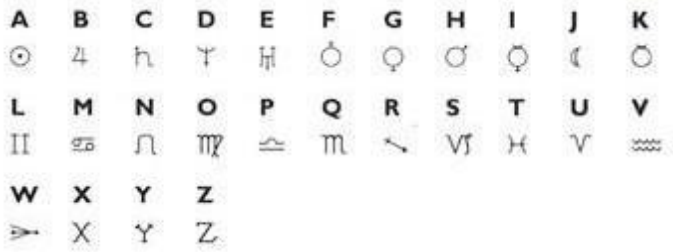
a. You will need

- ¼ (one-quarter) cup of rubbing alcohol
- 2 clear glasses
- A container of iced water (suitable for chilling one of the glasses)
- Just under ½ (one-half) cup of tap or distilled water
- A measuring cup
- 2 large pinches of salt (table salt will do)
- 2 tblsps of clear detergent, such as liquid soap or shampoo or dish washing detergent
- A spoon for stirring
- A fruit or vegetable (onions, split green peas, bananas, strawberries and kiwi fruits all work well)
- A sealable plastic bag
- Knife or blender for chopping and mashing (some fruit/veg can be mashed without these)
  - A paper coffee filter
  - A rubber band
- A glass rod, toothpick or popsicle stick
- Step 1 – Pour the alcohol into one of the glasses. Place the glass into the bowl of iced water to chill, then set aside.
- Step 2 – Pour the tap/distilled water into the measuring cup with the salt. Add the detergent and mix carefully until the salt is dissolved. This is the *extraction solution*.
- Step 3 – Remove the skins and stems from the chosen fruit/veg. Crush the fruit, either by mashing by hand in the sealed bag, or in a blender. When pulverised, add some of the extraction solution – about 5 teaspoons for a small banana. The consistency should be similar to a thick fruit smoothie.
- Step 4 – Stir the resulting bag (or blender) mixture for 30-60 seconds. Place the filter over the remaining glass and secure it with the rubber band. Pour the mixture into the filter. If the mixture is too thick, stir in more of the solution. Leave to filter for about 10 minutes.
- Step 5 – Some liquid should have filtered through (the *filtrate*). Remove the glass of alcohol from the iced water. Pour the filtrate into the alcohol. After about 5 minutes, a clumpy white *precipitate* – the DNA – should be visible in the alcohol. For a closer look, use the glass rod, popsicle stick or toothpick to hook it up.
- Step 6 – Pour the liquids down the sink and clean the rest of the equipment. (Instructions from http://www.suite101.com/content/how-to-extract-dna-from-fruit-andvegetablesa76806)

4. Secret messages

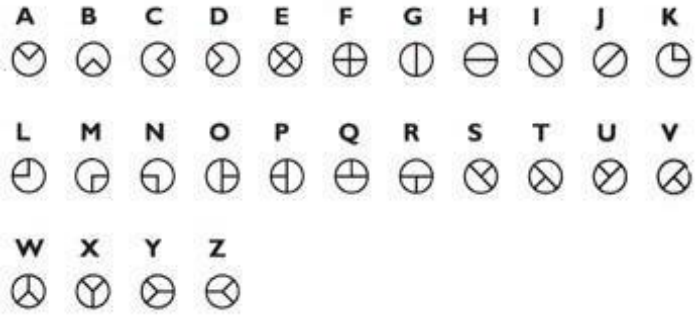
The first code comes to us from ancient alchemists.

This codes characters could be used in pictures to contain hidden messages.

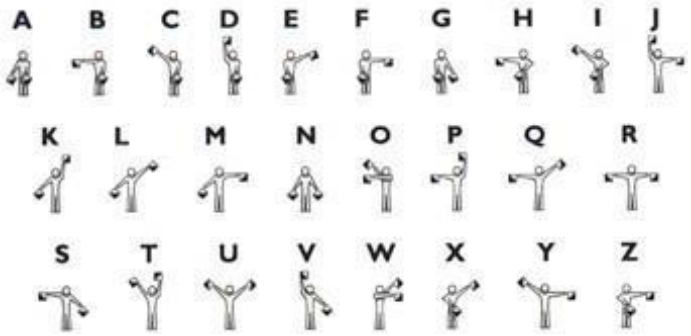


This system looks like different pills.

Try your own designs in the center and create your own code.



This code depends on the sender using flags held at various angles to represent letters Cut-and-paste the images into a message.



5. Invisible Ink **You will need:**

Half of a Lemon
Water
Spoon

Bowl
Cotton Swab
White Paper

Light Bulb

To make this:

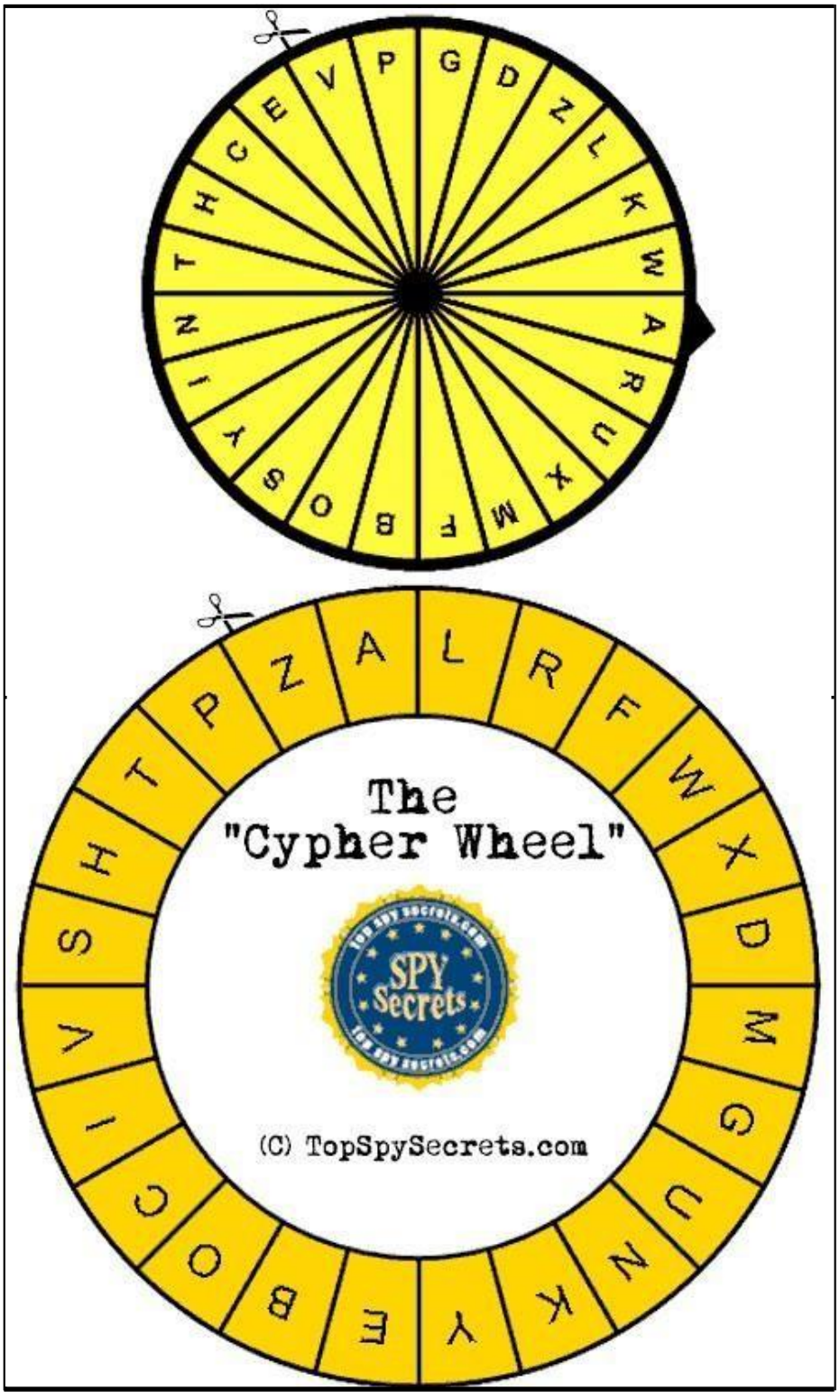
- Squeeze some lemon juice into a bowl and add a few drops of water. Mix the water and lemon juice
- Dip the cotton swap in the juice mixure and write a message on the white paper
- When your message dries, hold the white paper up to a light bulb that's on to reveal the message

(Instructions from: http://kidscraftzone.com/post/How-to-Make-Invisible-Ink.aspx)

6. Secret Cypher

If you want to exchange messages with others, create one cypher wheel for each:

- Print the two wheels you find below, on thick paper (or paste it on thin carton).
- Cut out both wheels. Make sure you don't cut off the black triangle on the smaller one!
- With a sharp point, make a small hole in the middle of both wheels.
- Join the two wheels together (small one on top of the big one) with a split pin or cotter pin.



Cipher Wheel Usage Instructions

Here's how you can use the cipher wheel to encrypt a message in such a way that only a friend with the same cipher (wheel) can read it:

- First, write down your message. Only use letters from the alphabet. No numbers (write them out), and no punctuations.

  ex. **JOHN IS IN LOVE WITH QUINTY**

  - The cipher wheel contains only 24 characters. For a "J" put in a "Y", and for a "Q" put in an "O". ex. **YOHN IS IN LOVE WITH OUINTY**
  - Select a single character from the alphabet (except "J" and "Q") and write down that character as the first letter of your encrypted message.

  ex. **YOHN IS IN LOVE WITH OUINTY**

  H (for this example, I've chosen "H").

  - Rotate the upper wheel until the black triangle points to the character you have just selected. This character is called the **"Key"**, you'll need both the cipher and the key to be able to decrypt the message.

  IMPORTANT: Make sure the triangle keeps pointing to the key character during the encryption of the message!

  - Now, for each letter of your message, find that character on the outer wheel, and write down the letter that is exactly beneath it on the inner wheel. When finished, you'll have your encrypted message!

  ex. **YOHN IS IN LOVE WITH OUINTY HVDAC LW LC FDKP SLRA DHLCRV**

  - Don't forget to destroy the original message!

Secret Codes for Kids: Message Decryption

Once your friend has received your (encrypted) message, she must follow this procedure to make it readable again:

- Look at the first character of the secret message. This is your key. Rotate the upper wheel of your cipher until the black triangle points to that character. Scratch that first character, as it's not part of the message.

IMPORTANT: Make sure the triangle keeps pointing to the key character during the decryption of the message!

- for each letter of your message, find that character on the inner wheel, and write down the letter that is exactly above it on the outer wheel. ex. **VDAC LW LC FDKP SLRA DHLCRV YOHN IS IN LOVE WITH OUINTY**
- Check the Y's and O's, if the message makes more sense with a J or a Q instead. ex. **JOHN IS IN LOVE WITH QUINTY**
- Don't forget to destroy the message after you've read it!

(Instructions from http://www.topspysecrets.com/secret-codes-for-kids.html)

7. Dental Impressions
   a. You will need:

i. Scissors ii. Styrofoam plate iii. Marking pen

b. To do this:

1. Divide the styrofoam plate into six equal wedges. Cut the wedges.
2. Take two of the wedges and stack them together. Cut off 1 inch from the pointed end of the wedges.
3. Place the two wedges into your mouth as far as possible.
4. Bite down on the wedges firmly and then remove them.
5. Label the top and bottom wedges Top Teeth and Bottom Teeth.
6. Study the teeth impressions. Count the number of teeth in the top and bottom impressions. What other characteristics of the impressions do you notice? Compare the top teeth impressions to the bottom. Are there teeth missing, spaces, chips, etc.?

8. Determining the height based on the foot size Create a spreadsheet. List the individuals name, height, and foot length.
   1. Have some adults remove their shoes and measure their height.
   2. Measure the length of the adult's left foot from the wall to the tip of the big toe.
   3. Examine the numbers. Do you see a pattern?

Divide the length of each person's left foot by his/her height. Multiply the quotient by 100. What do you get? You may also want to use the calculator on a computer for this. The results of your calculations should be about 15, illustrating that the length of a person's foot is approximately 15 percent of his or her height.

Find out the approximate height of each member by measuring their foot and charting it on a spreadsheet. Use this proportion for your calculations: 15/100 = Length of Foot/x (person's height) When a forensic scientist has the length of a foot, the forensic scientist will be able to approximate the height of the individual. This works best on a full grown individual for the ratio of body parts is slightly different in growing children.

9. What is the white substance?

a. Materials

- Pencil
- Sheet of white paper
- White chalk
- Magnifying glass
- Measuring spoons
- Eye dropper
- Vinegar
- Baking soda
- Water
- Sugar
- 4 small jars
- Salt
- Iodine solution
- Cornstarch
- Dish towel
- 4 Sheets of black construction paper

b. How to do this

1. Place one-fourth teaspoon (1 ml) of the four white powders on a sheet of black construction paper. Label the powders with the white chalk or white crayon.

2. Study the powders with the magnifying glass. Examine what each powder looks like. How would you describe the powder's shape. Does it have large or small grains? Your observations should be written in the appearance column of the chart.
3. Examine the powders further by rubbing each powder between your fingers. Describe how each powder feels in the Texture column of the chart.
4. Determine if there is a smell to any of the powders. Record your findings in the Smell column of the chart.
5. Take the eyedropper and place a drop of water on each individual powder. Examine what happens? Do the powders dissolve? Is there a reaction? Write your observations in the Reaction to Water column.
6. Place one-half teaspoon (2ml) of each powder in a separate jar. Add 2 drops of iodine to each jar using the eyedropper. Record what happens in the Reaction to Iodine column. Iodine should be handled with care.
7. Comparing test results of substances that are known help Forensic Scientists identify unknown substances.
8. After analyzing and recording results of each substance have your partner leave the area. Select and place one of the powders on construction paper and do not tell which substance it is. Invite your partner back to see if she/he can determine the powder by performing the same experiments and observations previously done.
   Change places so your partner can select one of the powders for you to identify. Can you correctly identify the mystery powder?

(Activity from: http://homeschooling.gomilpitas.com/explore/crimescene.htm)

Ink Chromatography a.

How to do this:

1. gather several black or blue pens
2. Obtain a sample of the evidence (have someone use one of the pens to write a note - your job is to figure out which pen they used)
3. Cut several coffee filters into 1/2" strips
4. Set up your chromatography apparatus. Place a skewer or other long object across two supports. Place a pan underneath the skewer and fill it about 1/2" deep with the solvent (water or alcohol).

Procedure

1. Use a long 1/2" wide strip of your evidence and hang it from the skewer so that the end just touches the solvent. Don't let the ink get wet.
2. use each of your suspect pens to place a dark spot of ink about 1/4" - 1/2" from the end of each coffee filter strip.
3. hang these strips from the skewer so that the tips of the strips just touch the solvent
4. allow the inks to separate for about 15 minutes
5. examine the banding patterns and determine which of your known suspect pens is the pen used to write the note.

(Activity from: http://www.shodor.org/workshops/forensic/labs/ink.html)

Program Tie-Ins – All Branches

Experiment and Create
Science Lab
Art Studio