

a WOW Lab

# BLUEPRINT

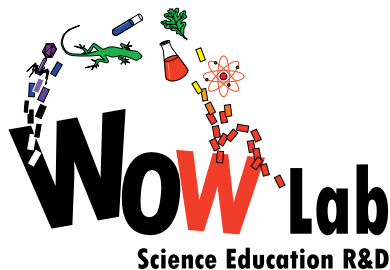
Classroom Science Investigation

## Activity Instructions

This document provides an explanation of the scenario (page 2), sample answers for the *Student Handout* (pages 3-10) and Ink Chromatography instructions (pages 11-12).

Sample answers can be used by the instructor to guide students to make the observations that will be necessary to solve the crime.

Pages 11-12 should be printed and placed at the Ink Chromatography Station for the students' use.



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## Classroom Science Investigation - Activity Instructions

### Scenario

Your teacher was having juice and cookies with three other teachers. Each teacher was eating a different kind of cookie, but they were all drinking the same kind of juice. When they were almost finished, your teacher had to leave behind his/her last cookie and a full glass of juice because he/she had been called to the main office. When your teacher returned to enjoy the leftover snack, the cookie was gone, there was no more juice and the three other teachers had disappeared.

You are Crime Scene Investigators that have just arrived at the scene of the crime. There are a couple of details that you should know before you begin the investigation:

- The three teachers that disappeared are now suspects labelled Suspect A, Suspect B and Suspect C.
- There were cookie crumbs left at each of the teachers' spots.
- A footprint was found near the table.
- Fingerprints were found on each of the teachers' cups.
- A bite mark was left on your teacher's cup.
- A fibre was found on your teacher's chair.
- There was a note found at the crime scene.

Each investigator should have a *Student Handout*, a pencil and a ruler. Your investigative team will analyze the evidence at different stations and use the results to answer the following question:

Who ate the teacher's cookie and drank the teacher's drink?

## Station I - Crime Scene

The following items will be needed for this station:

- yellow party streamer or danger tape
- Crime Scene sign (see *Prep Instructions*)
- cue cards labelled 1-4 (see *Prep Instructions*)
- crumbs of four different cookies (see *Prep Instructions*)
- paper towel with footprint (see *Prep Instructions*)
- styrofoam cups with fingerprints (see *Prep Instructions*)

Before you enter the crime scene, remember that investigation requires great attention to detail. Be prepared to sketch or take notes about everything that you encounter. Any object found at the scene of the crime needs to be analyzed and used as evidence, so write down what you see in the following tables.

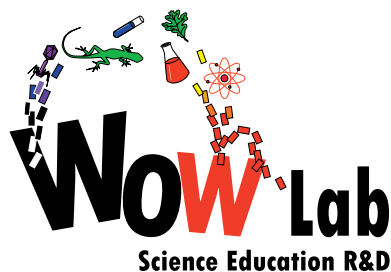
Position at table	Cookie observations	Fingerprint observations
1 (pink wafer & Oreo)	<ul style="list-style-type: none"> <li>• crumbs are pink, black and white -- more pink than black and white</li> <li>• large pieces have square pattern</li> <li>• white part looks squishy, black part looks solid</li> </ul>	<ul style="list-style-type: none"> <li>• this print has lines that look like upside-down U's</li> <li>• it is also a very large print</li> <li>• it looks like an arch fingerprint</li> </ul>
2 (dried fruit)	<ul style="list-style-type: none"> <li>• crumbs are dark golden brown</li> <li>• crumbs contain some coloured pieces (fruit?)</li> <li>• crumbs are larger than the other crumbs at the table</li> </ul>	<ul style="list-style-type: none"> <li>• this print looks like an upside-down swirly U that moves to the left with the tip pointing to the right</li> <li>• it looks like a reverse loop fingerprint</li> </ul>
3 (Oreo)	<ul style="list-style-type: none"> <li>• crumbs are black and white</li> <li>• crumbs have large chunks and small crumbs</li> <li>• white part looks squishy, black part looks solid</li> </ul>	<ul style="list-style-type: none"> <li>• this print looks like an upside-down swirly U that moves to the right with the tip pointing to the left</li> <li>• it looks like a loop fingerprint</li> </ul>
4 (sugar cookie)	<ul style="list-style-type: none"> <li>• crumbs are golden in colour</li> <li>• fine white powder (sugar?)</li> <li>• crumbs are small</li> </ul>	<ul style="list-style-type: none"> <li>• this print has a spiral pattern that goes counter-clockwise</li> <li>• it looks like a whorl fingerprint</li> </ul>

### Footprint Observations and Sketch

A footprint was found at the scene of the crime. Look at the footprint and write down your observations, perhaps including a sketch of the print. You might want to use a ruler to take measurements, but be careful not to touch or smudge the print. When investigating a crime scene, it is very important to keep the evidence exactly as you found it.

- footprint is made with black ink or paint
- footprint is 10 inches long and 4 inches wide
- footprint has a diamond or star pattern that covers the entire surface
- the diamonds and the stars are about 1 cm in diameter





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## Classroom Science Investigation - Activity Instructions

### Station II - Fibre Analysis

The following items will be needed for this station:

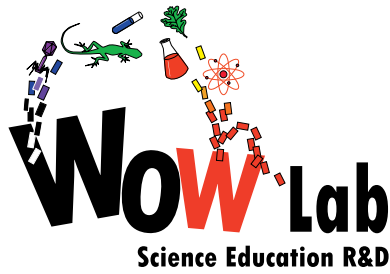
- 4 fabric swatches and unknown fibre (see *Prep Instructions*)
- 4 magnifying glasses
- Fibre Analysis sign (see *Prep Instructions*)

After carefully inspecting the crime scene, an unknown fibre was found on the teacher's chair. The unknown fibre was taped to an index card and taken to the laboratory for inspection. As highly qualified laboratory technicians, it is your job determine whose clothing the fibre came from. A piece of material from each of the teachers' clothes is provided on the cue cards for you to compare to the unknown fibre. Use the magnifying glass to analyze the evidence. You can use the tweezers to remove a fibre from the piece of fabric.

	Colour	Length	Thickness	Texture
Unknown fibre from crime scene	• blue	• 1 inch	• thin fibres that make up one large fibre	• scruffy
Teacher (denim cotton)	• blue on outside, white on inside	• 1 inch	• small	• soft
Suspect A (silk)	• blue	• 1 inch	• very small	• smooth
Suspect B (wool)	• blue	• 1 inch	• thin	• smooth
Suspect C (spandex)	• blue	• 1 inch	• thin fibres that make up one large fibre	• scruffy

Which suspect's clothes did the fibre come from? Explain your choice.

It appears that the fibre came from Suspect C's clothing because the unknown fibre has identical thickness, texture and strength to the fibres from Suspect C's fabric swatch. Even though the colour, length and flexibility are the same for all of the materials, the other three characteristics show that Suspect C is guilty of leaving a piece of fibre at the scene of the crime.



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## Classroom Science Investigation - Activity Instructions

### Station III - Fingerprint Analysis

The following items will be needed for this station:

- cue cards with fingerprints (see *Prep Instructions*)
- ink pad
- hand wipes
- Fingerprint Analysis sign (see *Prep Instructions*)

Before entering the fingerprint analysis laboratory, your fingerprint needs to be taken. Write your name on the solid line in the table. To take your fingerprint, roll your right thumb from left to right on the ink pad provided, then press your thumb lightly on the ink print square in the table. Wipe your hands on paper towel. You are now allowed to enter the laboratory.



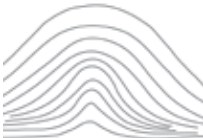

	Ink print	Description
<u>John Doe</u> (write name above)		• loop print points to the right so it is a reverse loop print

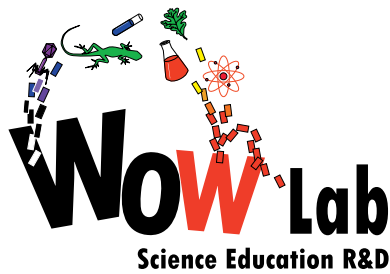
Carefully look at the index cards that have the suspects' fingerprints on them. Determine if the print is an arch, a loop, a whorl or a reverse loop. Write down any additional information that you think is important in the description column of the table on the next page.



## Classroom Science Investigation - Activity Instructions

Now look at the information collected at the crime scene and determine which fingerprints look similar. Write down the cup number that matches the fingerprint cue card in the right hand column. You now know the position of each person at the table.

Individual	Draw print	Description	Cup match
Suspect A		<ul style="list-style-type: none"> <li>• this print looks like an upside-down swirly "U" that moves to the left with the tip pointing to the right</li> <li>• it looks like a reverse loop fingerprint</li> </ul>	2
Suspect B		<ul style="list-style-type: none"> <li>• this print has a spiral pattern that goes counter-clockwise</li> <li>• it looks like a whorl fingerprint</li> </ul>	4
Suspect C		<ul style="list-style-type: none"> <li>• this print has lines that look like upside-down "U's"</li> <li>• it is also a very large print</li> <li>• it looks like an arch fingerprint</li> </ul>	1
Teacher		<ul style="list-style-type: none"> <li>• this print looks like an upside-down swirly "U" that moves to the right with the tip pointing to the left</li> <li>• it looks like a loop fingerprint</li> </ul>	3



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## Classroom Science Investigation - Activity Instructions

### Station IV - Footprint Analysis

The following items will be needed for this station:

- water, paint and soap mixture (see *Prep Instructions*)
- paper
- paper towel
- 4 pairs of shoes
- Footprint Analysis sign (see *Prep Instructions*)

The suspects' shoes have been collected and are available for analysis at the footprint lab station. Make prints of the bottoms of these shoes by placing them in the tray of paint and then onto a piece of paper. Compare the prints that you make at the lab station with your observations and sketch of the print left at the crime scene.

Suspect	Draw Pattern	Description
Suspect A	• students should sketch the pattern of each of the four footprints that they make at the Footprint Analysis Station.	• students should record the pattern, shape and measurements for each of the footprints that they make with the shoes at the footprint station.
Suspect B		• the description for Suspect B's footprint should match the crime scene sketch and description since the crime scene print was made with Suspect B's shoe.
Suspect C		
Teacher		

Who do you think left the footprint? Why?


Looking at the diagram of the footprint drawn at the crime scene and using the information gathered there (size, shape, pattern), it can be concluded that Suspect B left the footprint at the crime scene. Even though Suspect B left the footprint, this does not mean that Suspect B is guilty. This piece of evidence is a red herring (a misleading piece of information), and students can create a scenario to explain why Suspect B's footprint was present at the crime scene. For instance, Suspect B could have come back into the room to get his/her jacket and had nothing to do with the missing cookie and juice.

### Station V - Dental Analysis

The following items will be needed for this station:

- 4 plaster imprints (see *Prep Instructions*)
- piece of styrofoam cup with teeth imprint (see *Prep Instructions*)
- Dental Analysis sign (see *Prep Instructions*)

Someone drank the teacher's juice and a bite mark has been found on the cup. Carefully look at the marks left by the top teeth and write down your observations.

Draw bite mark	Number of teeth	Straight or crooked	Large or small	Spacing or no spacing	Curve of teeth	Additional details
	<b>6</b>	<b>straight</b>	<b>small</b>	<b>small spacing between second and third teeth from the left</b>	<b>U-shaped</b>	<b>no molars, only small teeth made an imprint</b>

Molds have been made of the four suspects' teeth. Use each mold to make bite marks on another styrofoam cup. Compare the bite marks made using the molds with the bite marks in the cup found at the crime scene.

Suspect	Number of teeth	Straight or crooked	Large or small	Spacing or no spacing	Curve of teeth	Additional details
<b>A</b>	<b>8</b>	<b>crooked</b>	<b>large</b>	<b>small space between front teeth</b>	<b>U-shaped</b>	<b>missing a tooth</b>
<b>B</b>	<b>6</b>	<b>crooked</b>	<b>large</b>	<b>no spacing between teeth</b>	<b>U-shaped</b>	<b>ridges on the front teeth</b>
<b>C</b>	<b>6</b>	<b>straight</b>	<b>small</b>	<b>small spacing between second and third teeth</b>	<b>U-shaped</b>	<b>no molars</b>
<b>Teacher</b>	<b>10</b>	<b>straight</b>	<b>large</b>	<b>no spacing between teeth</b>	<b>U-shaped</b>	<b>large front teeth</b>

Write down which suspect's teeth match the bite marks found on the cup.

**The bite mark corresponds to the dental molds from Suspect C.**



### Station VI - Cookie Analysis

The following items will be needed for this station:

- 4 cookies in sandwich bags (see *Prep Instructions*)
- Cookie Analysis sign (see *Prep Instructions*)

At this station, you will determine who ate what kind of cookie. Take a cookie and put it in a plastic bag. Crush the cookie and analyze the crumbs. Write down the cookie type in the left hand column and fill in the middle column with descriptive terms. Compare the results below with the descriptions from the crime scene and then match up the descriptions to determine the position of each cookie at the table. Once you have completed the fingerprint analysis and determined who was sitting where, write down who you think ate which cookie in the right hand column.

An example is provided below of how the table may be filled out. Students will be able to fill in the last column after completing the fingerprint analysis, where they determined who was sitting where. Note that the teacher's cookie is found not only at the teacher's position, but also at Suspect C's position since Suspect C is the guilty one.

Cookie type	Cookie crumb description	Position at table	Individual who ate the cookie
sugar cookie	<ul style="list-style-type: none"> <li>• crumbs are golden in colour</li> <li>• fine granules of white powder (sugar?)</li> </ul>	4	Suspect B
Oreo	<ul style="list-style-type: none"> <li>• crumbs are black and white</li> <li>• crumbs have large chunks and small crumbs</li> <li>• white part looks squishy, black part looks solid</li> </ul>	1	Suspect C
dried fruit	<ul style="list-style-type: none"> <li>• crumbs are golden brown</li> <li>• crumbs contain some coloured pieces (fruit?)</li> <li>• crumbs are larger than the other crumbs at the table</li> </ul>	2	Suspect A
pink wafer	<ul style="list-style-type: none"> <li>• crumbs are pink</li> <li>• large pieces have square pattern</li> </ul>	1, 3	Teacher, Suspect C

### Station VII - Ink Chromatography Analysis

The following items will be needed for this activity:

- note (see *Prep Instructions*)
- 2 skewers or straws
- 2 binder clips
- pencil
- 4 marker pens (see *Prep Instructions*)
- 2 cups or beakers
- glue
- 8 cm x 6 cm rectangles of filter paper (see *Prep Instructions*)
- Ink Chromatography Analysis sign (see *Prep Instructions*)

#### Step 1

Cut a 1 cm wide strip from the note left at the crime scene (**Figure 1**).



Figure 1



Figure 2

#### Step 2

Attach the strip, with ink at the bottom, to a skewer using a binder clip (**Figure 2**).

#### Step 3

Fill a cup with just enough water so that only the very bottom edge of the strip touches the water when the skewer is resting on the cup. Make sure the ink is not submerged in the water, but lies just above the water level.

#### Step 4

Allow the ink to separate into its components for five minutes. While waiting, follow Steps 6-11 to analyze the suspects' pens.

#### Step 5

Once the ink has separated, dry the strip by hanging it in an empty cup.

### Step 6

Draw a horizontal line in pencil 1 cm from the bottom of the blank piece of filter paper.

### Step 7

Make a dot with each of the suspects' pens along this line. Label them in pencil (**Figure 3**).

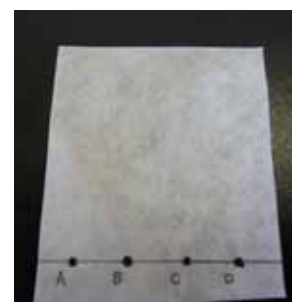


Figure 3

### Step 8

Attach the filter paper to a skewer using a binder clip.

### Step 9

Fill the cup with just enough water so that only the very bottom edge of the paper touches the water when the skewer is resting on the cup. Make sure the ink is not submerged in the water, but lies just above the water level.

### Step 10

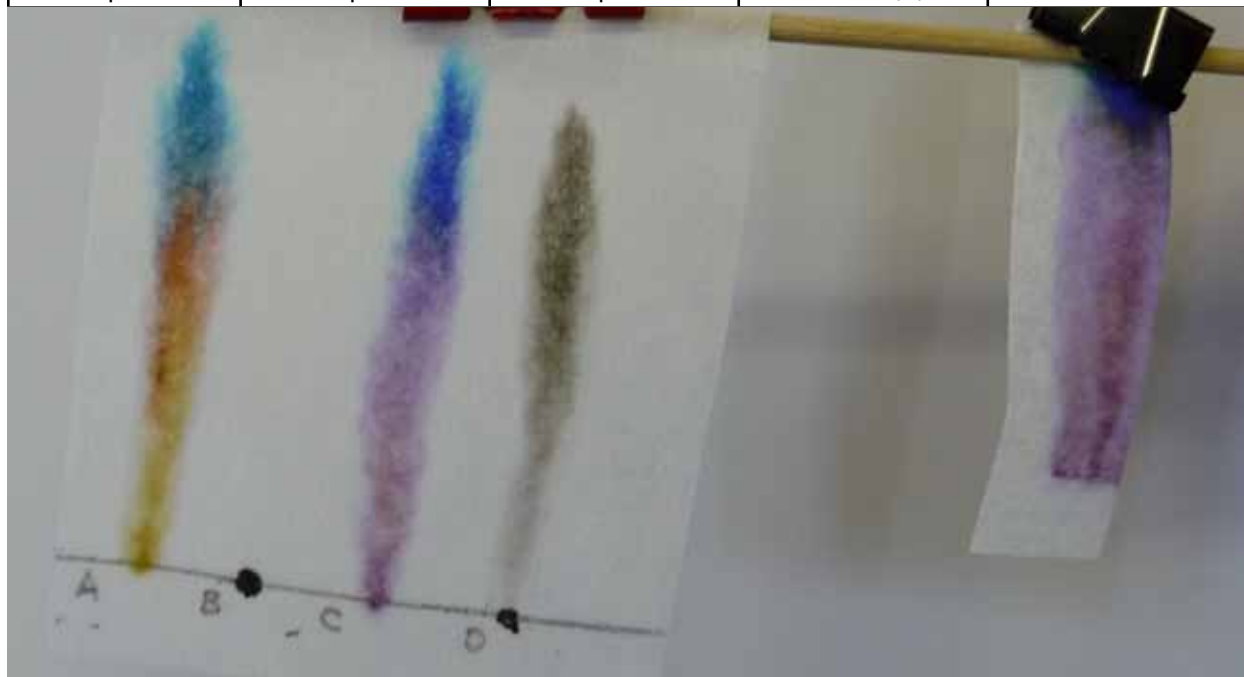
Allow the inks to separate into their component colours for five minutes.

### Step 11

Dry the paper by hanging it in an empty cup.

## Classroom Science Investigation - Activity Instructions

Glue both pieces of filter paper from the activity into the table below. Compare the patterns of the ink separation and answer the questions below.

Suspect A	Suspect B	Suspect C	Teacher (D)	Crime Scene Evidence
				

Who do you think left the note? Why?

The person who left the note can be identified by comparing the patterns of ink from all four marker pens to the pattern of the evidence. The pattern for A consists of yellow, orange and light blue. B is insoluble in water, therefore there is no pattern. C consists of purple and blue. D is dark green/black.

C matches the pattern of the evidence, therefore suspect C's pen was used to write the note.