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DETECTIVE SKILLS

ACTIVITY TYPE: Group discussion
AUDIENCE: 2nd-4th grade
TIME FRAME: 20 - 25 minutes

SUMMARY:
Children will discuss the skills detectives use to gather clues and solve mysteries.

MATERIALS:
- Book: *The Deductive Detective* by Brian Rock
- Whiteboard or chart paper and markers

ENGAGE:
Introduce the week’s theme:
*This week is all about learning to solve mysteries.*
- What kinds of jobs might involve solving mysteries?
- What kinds of mysteries might they solve?
- What skills do you think a person needs to help them solve a mystery?

We’ll be training our detective skills each day this week. Then on Friday, we’ll be on the job—we’ll put our skills to the test solving an actual case! Let’s start by thinking about the kinds of skills detectives need to investigate a crime.

PROCEDURE:
1. Invite the group to brainstorm things someone might do to help solve a mystery or a crime. Record the group’s ideas on the whiteboard or chart paper:
   - What different things do detectives do?
   - What might they do when a crime is first discovered?
   - What things might they do in the middle of an investigation?
   - What do you think they do at the very end of an investigation?
2. Encourage the group to think about the skills involved in the actions they listed. Make a list of skills detectives need:
   - What does a detective need to be good at in order to find clues?
   - What should a detective practice if they need to question witnesses?
What do detectives do with all the evidence to figure out who committed the crime?

3. Introduce the book. Invite the group to practice some detective skills by making observations and predictions based on the cover of the book.
   - What do you notice on the cover of this book?
   - What do you think the book will be about? What makes you think that?
   - What does “deductive” mean? If you “deduce” something, or “make a deduction,” what are you doing?

4. Encourage the group to listen for ways the detective makes deductions during the story and challenge them to look for other detective skills he uses as well.

5. As you read the book, stop periodically to ask questions and invite children to make observations and predictions:
   - What do you notice on this page? What clue do you think the detective has found?
   - What did the detective do to find that clue? What skills is he using?
   - Why do you think it can’t be the pig who did it?
   - Based on the clues so far, who do you think did it? What makes you think that?

6. Discuss the skills the detective used to solve the mystery and compare them with your brainstorm lists.
   - Which ones were already on our list?
   - Are there any new skills or actions we need to add?

7. Point out that real life crimes aren’t usually solved by just one person. Many people work together doing different parts of the job—one group of people collects the evidence, another group does tests in a lab to analyze the evidence, a different group of people talks to witnesses and questions suspects, and so on. Explain that they will be practicing parts of all these jobs during the week—and they will probably still need to work together to solve the final case.
   - Which of the skills we listed do you think are used in most or all of these different parts of the job?
   - Which skills or actions do you think would be best to practice this week? What makes you think so?

8. Keep the lists in a visible location and use this discussion to frame the rest of the week’s activities. Refer back to skills or actions on the lists when children use them in an activity, or add skills to the lists as the week goes on.
   - Which of our detective skills did we use in this activity?
   - How did we practice making observations or noticing details?
   - What part of detective work are we doing now—collecting evidence? Testing? Making deductions?
WHAT'S THE SCIENCE?
Solving mysteries or crimes is, at its root, about finding answers to questions. While detective is the career most people think of when it comes to solving mysteries, many different jobs involve a similar process of asking a question, looking for evidence, and using the evidence to find an answer to the question. Scientists try to find answers to questions about how the natural world works; engineers look for new solutions to practical problems; doctors diagnose illness and disease; historians and archaeologists gather information about past events and people; police detectives try to determine who committed a crime.

All of these people solve “mysteries” of different kinds, but they use many of the same skills:
- Making observations using different senses (hearing, sight, touch, etc.)
- Noticing details
- Gathering data or evidence
- Analyzing or testing the data/evidence
- Making deductions/inferences and drawing conclusions based on the evidence
- Communicating their conclusions and explaining how the evidence supports them

Unlike the way it is often portrayed in television and movies, the process of solving crimes is rarely done from start to finish by the same person or group. Different parts of the process are done by different groups who share information with each other but may not always work directly together.

- **Crime scene investigators** examine the scene of a crime to find and document evidence. This might include taking photographs or measurements and carefully collecting samples or other pieces of evidence.
- **Forensic scientists** work in labs to test and analyze the evidence that comes from crime scenes. Different scientists specialize in different types of evidence—one might focus on testing DNA or blood, another on finding out what chemicals something is made from, another on bullet or gunfire evidence, etc.
- **Police detectives** interview witnesses, question suspects, and use the evidence provided by crime scene investigators and forensic scientists to decide who (if anyone) should be charged with the crime.
DETECTIVE TRAINING: Asking questions

ACTIVITY TYPE: Game
AUDIENCE: Grades 2 and up
TIME FRAME: 20 minutes

SUMMARY:
Campers will play a questioning game to try to figure out who the most likely suspect is within a certain number of questions.

MATERIALS:
1. Suspect cards (1 per camper) (Harry Potter and LEGO superhero sheets printed in color from attached)
2. Suspect list (1 per 2 campers)
3. Tape

PREPARE AHEAD:
Cut out suspect cards from the lists.

ENGAGE:
When a detective is in pursuit of a culprit, they need to ask the right questions to narrow down their suspect list. We are going to practice our questioning skills by using as few questions as possible to figure out who the primary suspect in this case should be!

PROCEDURE:
1. Break the group up into partner pairs. Tape a suspect card on each campers’ back, so they cannot see who they are pursuing, but their partner can. Make sure each pair has a copy of the full suspect list with pictures, so they can refer to it if they need to.
2. Pairs should take turns asking each other questions about the primary suspect. Each question should be a yes or no question. In other words, “Does my suspect have red

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hair?” is good, but “What color is my suspect’s hair?” is not.

3. Keep track of how many questions it takes each pair to figure out who their respective suspects are.

TAKE IT FURTHER:

Try playing the game again (after mixing up the suspects and re-assigning them to campers) and limit the number of questions they can ask.

ADAPTATIONS:

For younger campers, allowing them to cross out the eliminated suspects may help with this game. Or you could limit it to a much smaller pool of suspects.

WHAT’S THE SCIENCE?

● Both scientists and detectives need to be very skilled at asking questions. Scientists need to be able to ask questions that are testable with an experiment, and detectives need to make sure that they are asking questions that give them information that they need to build a case.

● The answer to a good question gives you information that you didn’t have before, or confirms something you were unsure of. Asking good questions is also a key part of critical thinking skills.
CSI LOGBOOKS

ACTIVITY TYPE: Make-and-take

AUDIENCE: Grades 3 - 6

TIME FRAME: 15 - 30 minutes

SUMMARY:
Campers will create a logbook for recording their observations.

MATERIALS:
1. Copies of the CSI Logbook (one cover page, plus 5-10 activity pages per camper) (at end of this write up)
2. Blank white copy paper (several sheets per person)
3. Crayons and/or markers
4. Staplers

ENGAGE:
Scientists (and detectives) keep careful notes about the things they do and observe. Why do you think it might be important for scientists to record the details of their observations and experiments? What kinds of things do you think a plant biologist might write down? A chemist? A crime scene investigator?

PROCEDURE:
1. Distribute logbook pages, blank paper, and crayons/markers.
2. Invite students to personalize their logbooks by decorating the cover, designing their own pages to add to the book, etc.
3. Have students assemble and staple the pages together with three or four staples down the left hand side.
4. Create opportunities throughout the week (at least once per day) for students to record observations from different activities in their logbooks.

WHAT’S THE SCIENCE?
Observation means noticing things using one of the five senses—sight, sound, smell, touch, and taste. Scientists make careful observations to help them learn more about the world. Recording observations and details about experiments in a logbook helps scientists remember, compare, and share them.
CSI LOGBOOK
WHAT AM I?

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 2-6
TIME FRAME: 30 minutes

SUMMARY:
Campers will describe mystery objects to each other for drawing, like they are criminal sketch artists.

MATERIALS:
- Plain paper (1-3 sheets per camper)
- Writing utensils
- 1 Mystery Object card per camper (below)

PREPARE AHEAD:
Cut out Mystery Object cards.

ENGAGE:
Have you ever seen a police sketch of a suspect? How do the sketch artists create something so detailed based on eye-witness accounts? We’re going to stretch our observation and description skills today, as well as our drawing skills.

PROCEDURE:
1. Divide campers into pairs and distribute materials. Each camper should have a piece of paper, a writing utensil and a Mystery Object Card. An effort should be made to ensure that partners don’t have the same Mystery Object Cards.
2. For 3-5 minutes, 1 of the partners should describe their object while the other draws. They may not name the object or describe what it does. They must only describe what it looks like, and they should not look at what the other person is drawing (i.e. they can’t correct the drawing while it is being drawn).
3. Once the first sketch is complete, the campers should switch roles. Once both
sketches are complete, they should guess what they drew and reveal the answer to each other.

4. Debrief the activity: What was hard about this? Did anyone draw the correct object? How did their partner help them do that (without cheating)?

**TAKE IT FURTHER:**

Try faces of staff or cartoon characters that everyone is familiar with. For this challenge, only provide a name, so that the activity mimics what a real eye-witness would be trying to do.

**ADAPTATIONS:**

For younger groups (K-2): Have them describe the item to a counselor to draw for the whole group. They can take turns adding to the description, or the very youngest ones can just be the guessing team while you and your co-counselor act as the describer and sketch artist.

**WHAT’S THE SCIENCE?**

- **Observation** means noticing things using one of the five senses—sight, sound, smell, touch, and taste. Scientists make careful observations to help them learn more about the world. Being able to articulate those observations through words is a tough skill that is important for detectives and CSI agents.

- **Visual Memory** is a form of memory that preserves some characteristics of what we see for later recall. Except in certain cases of someone having ‘photographic memory’, or eidetic memory, it is not perfect. This makes eye witness testimony somewhat unreliable, even though it is given a lot of weight in court cases.
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WHAT’S MISSING?

ACTIVITY TYPE: Hands-on activity

AUDIENCE: Grades K - 6

TIME FRAME: 10 - 30 minutes

SUMMARY:
Campers will explore their sense of sight and how it relates to storing memories.

MATERIALS:
- Tray or plate
- 10 - 20 small items, such as: eraser, pencil, coin, marble, etc.
- Cloth or towel to cover the tray

PREPARE AHEAD:
Place the items on the tray and cover with the cloth. Keep items out of campers’ sight until the activity begins.

ENGAGE:
What do our five senses help us do? What about our sense of sight? How does it help you remember things?

PROCEDURE:
1. Gather the group in a circle or around a table and place the covered tray where everyone can see it.
2. Ask campers to get ready to make some observations about the things on the tray, using their sense of sight. Uncover the tray and let them observe it for 1 minute. Then cover the tray again.
3. Take the tray out of sight of the group and remove one item from the tray. Uncover the tray and ask them to guess what is missing. What helped them remember the missing object?
4. Take the tray away and remove a second item, but this time rearrange the other objects. Can they find the missing object? Is it easier or harder?
5. Repeat with different objects, and try other variations, such as: Try it with less time to look at the tray.
   - Try it with more objects on the tray.

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- Try it again, but this time remove 3-4 objects.
- Allow campers to discuss and describe the items to each other while looking at them.

**TAKE IT FURTHER:**

*Classroom Memory:* Tell everyone to take a good look around the classroom. Ask them to remember where objects are located in the room. While campers are at recess or lunch, move some of the objects in the room. When the campers return, ask them to figure out which things have changed. How detailed were their observations? You can also have your group divide into two teams and take turns changing the classroom for the other group to inspect.

*Who’s missing?:* Have one camper (or a counselor) leave the room. While they are out of the room, have another camper hide. Then bring the first person back into the room. Can they guess who is missing?

**ADAPTATIONS:**

For older groups, you might skip the basic version and start with the variations listed in Step 5.

**WHAT’S THE SCIENCE?**

When we store a memory, we are storing information. But some information is stored only temporarily, while other information is processed for more permanent storage.

*Working memory* is like a receptionist for the brain. It is responsible for storing information temporarily and helping determine if it will be dismissed or transferred on to long-term memory. For example, it is helping you right now by storing information from the beginning of this sentence, so that you can make sense of the end of it. *Working memory has a limited capacity*—it can only hold a few pieces of information at a time, so longer lists of things (like the things on the tray) are likely to be forgotten without some other cues or connections to make the memories “stickier.”

*Visual cues* (things we see) are one way to trigger memories -- you might first remember the shape or color of a missing object, or its location on the tray/in the room, which helps you remember what the object is. *Personal feelings or connections also make something easier to remember*—for example you might be more likely to remember a missing object if it was your favorite color, or the chair that you always sit in, or it reminded you of an event or person that is important to you.
POTATO POLICE

ACTIVITY TYPE: Hands-on exploration
AUDIENCE: Grades K - 6
TIME FRAME: 20-30 minutes

SUMMARY:
Campers will make observations using their senses of sight and touch in order to identify their potato in a line-up of other potatoes.

MATERIALS:
- Potatoes (one per camper, or one per group of 2-3 campers)

ENGAGE:
Discuss the different senses and types of observations campers have used throughout the week in order to solve various science mysteries. Pose these questions:

*Suppose you and a friend have the same toy or game. How could you tell them apart from one another? What about if you saw two animals or plants of the same species while exploring the outdoors?*

In a scenario like this, it would be very important to make precise observations about the individual objects in order to notice and remember the differences between them:

*What kinds of differences might you notice between two objects that are very similar?*

PROCEDURE:
1. Introduce the activity to campers by informing them that they are now potato police officers! Their mission will be to improve their skills as vegetable detectives by finding their potato in a lineup of potatoes of similar size and shape.
2. Distribute a potato to each camper (or group of campers) and encourage them to use their senses of touch and sight to become as familiar with their unique potato as possible.
3. After a few minutes of observation, have the campers line their potatoes up somewhere in the classroom. Reorder the potatoes outside of the sight of the
campers, making sure to **keep track of where each camper’s potato ended up.**
(You may want to make a diagram or a list.)

4. **Give each camper a chance to select their potato** from the line-up, making sure to have them take guesses in turns until all the potatoes have been successfully identified.

5. **Discuss the results** with campers. Was it easy or hard to identify their potatoes in the line-up? Why or why not? What could be done to make it easier to differentiate between the potatoes? How could making observations be useful to a scientist or detective in the field?

6. Repeat the activity but ask campers to be even more descriptive than they were the first round. Is it easier this time?

**TAKE IT FURTHER:**

Try playing the game of potato identification again with various modifications:

- Give campers a chance to record information they have gathered from their observations on a piece of paper. Did recording sketches or writing descriptions help in their investigation?
- Have campers pass their observations (either written or verbal) to another group and see if their descriptions are precise enough to allow someone else to select their potato correctly.
- Have campers use only their sense of sight (no touching the potatoes!) or only their sense of touch (use a blindfold or turn off the lights in the classroom) to observe a new potato. Make comparisons with previous activities. Was it easier or harder to find or describe the potato when using just one of our senses for observation?

**WHAT’S THE SCIENCE?**

- Scientific observations (especially those involving the natural sciences) often are dependent upon multiple senses working in tandem. For instance, in order to gather more information about a particular object or phenomenon, observations might involve both touch and sight, or both hearing and smell.
- Science (and forensics in particular) often involves noticing minute differences between similar objects or situations in order to isolate changes, answer questions, or solve mysteries. Observations may even prompt us to pose new questions or lead us to future investigations!
FBI LEADER

**ACTIVITY TYPE:** Active game

**AUDIENCE:** Grades K - 9

**TIME FRAME:** 15 - 30 minutes

**SUMMARY:**
Campers play a game that uses their observation and deduction skills to determine who is leading a group’s actions.

**PROCEDURE:**

1. Gather the group in a circle. Introduce the game by explaining that one person will be the FBI Leader, directing the rest of the group’s actions. Another person will be the Spy and try to figure out who the leader is.

2. Play a practice round with you acting as the FBI Leader. Begin a pattern by tapping hands on knees, clapping hands, etc. and ask the rest of the circle to follow whatever you do.

3. Explain that the goal of the group is not to let the Spy find out which person in the circle is the FBI Leader. Change your pattern or action a few times and point out that the group needs to change too, without giving away who is leading.
   - *What can the group do to make it harder to tell who is leading?*

4. Select one camper to be the Spy and send them somewhere that they can not easily see or hear the rest of the group. (Note: Ensure that the camper is safely supervised, as needed, when out of sight of the group.)

5. Identify someone in the circle to be the FBI Leader and have them begin a pattern. Remind them that they will need to change their pattern every minute or so once the Spy returns.

6. Ask the Spy to rejoin the group and stand in the middle of the circle. Challenge them to observe the movements of the group and figure out who the Leader is.

7. The Spy gets three chances to guess. If they are correct, they may choose the next Spy. If they are not correct, they rejoin the group.

*created by THE FRANKLIN INSTITUTE*
IDENTIFYING PEOPLE

ACTIVITY TYPE: Group discussion & movement activity
AUDIENCE: 2nd - 4th grade
TIME FRAME: 15 - 30 minutes

SUMMARY:
Children will explore different traits that make people alike and different.

MATERIALS:
● Whiteboard or chart paper and markers

ENGAGE:
Introduce the theme of the day:
Yesterday we practiced making careful observations and noticing details. One of the important things detectives have to make observations about is people.

● Why do you think detectives need to notice details and differences between people?
● What kinds of evidence might help to identify a person involved in the crime?

Today we’re going to find out more about the kinds of evidence that can identify people and practice our skills at noticing details about people. Let’s start by thinking about the factors that make people alike and different.

PROCEDURE:
1. Ask the group to think about the characteristics people use to describe themselves and others.
   ● If someone asked you to describe yourself, what would you say?
   ● What are some traits or characteristics we use to describe how people are alike or different?
2. Brainstorm together a list of traits and write them on the chart paper or board.
   Encourage campers to think of traits that are physical (hair color, height, eye color) and those that are not (favorite color, likes sports, plays an instrument).
3. Choose from the list one of the traits that has several distinct categories (such as eye color or favorite color) and challenge the group to sort themselves into “blobs” by that trait. In other words, they must figure out how to group themselves so that all the
brown-eyed people stand together in one cluster, the blue-eyed people in another, and so on.

4. Choose a different trait that falls across a spectrum rather than distinct categories (such as height, or how much you like sports). Challenge the group to arrange themselves in a line from one extreme to the other, for example, from the person who likes sports the most to the one who likes sports the least.

5. Repeat with two or three other traits. Invite the group to help you choose which traits to use and whether to organize into blobs or a line.
   - What do you notice about trying to sort ourselves by different traits?
   - Are some traits harder to sort than others?
   - Which traits do a lot of us have in common? Are there any traits where no one is the same as anyone else?

6. Next, challenge the group to sort themselves by two traits at the same time; for example, make blobs of people who have both the same eye color and the same favorite food, or make blobs by eye color and then each blob make a line by height.
   - How is it different when we sort by two traits at the same time?
   - What do you think would happen if we sorted by three traits?

7. Discuss how the group’s experience in the “blobs and lines” activity connects to the process of using evidence to identify an individual person (such as a victim or suspect).
   - Which traits make it easiest to pick out one person from the group? Which are harder?
   - If I only know a suspect’s eye color, does that tell me who the person is? What other traits might help me narrow it down to just one person?

EXTEND:

Classroom Guess Who?: Choose one camper from the group as your mystery person, but don’t identify who you have chosen. Invite the group to ask yes-or-no questions about the person’s characteristics, based on the traits you used in the blobs and lines activity, for example, “Does the person have brown eyes?” Challenge the group to figure out who your mystery person is, using as few questions as possible. Invite campers to take turns choosing a mystery person and answering the group’s questions.

WHAT’S THE SCIENCE?

The characteristics that we use to identify ourselves vary from physical features such as eye color or face shape to traits that are harder to see, such as food preferences or personality traits. Some of these characteristics, particularly physical ones like eye or
hair color, are determined by our DNA and are very difficult to change. Others, such as preferences for a particular color or hobby, are primarily shaped by our experience—what we were exposed to and the associations we have as a result.

Most of the characteristics we use to identify people are shared by many different people, such as height, hair color, or favorite food. Only a few characteristics are nearly or completely unique to an individual: the exact sequence of our DNA (except identical twins, who share the same sequence), the ridge patterns on our fingertips (as well as palms, feet, and toes), and the patterns in the iris (colored part) of the eye.

Evidence like fingerprints or DNA can be very helpful in identifying a single individual, because it is so unique to each person. Other types of evidence can be less helpful in narrowing down a group because many people share the same trait; for example, a brown hair doesn’t identify an individual because many people have brown hair. Combining multiple traits can make it easier to narrow the group of suspects down (for example: long, brown, curly hair, likes pizza, and has a size 8 foot)—but there is still the possibility that more than one person might have the same group of traits.
DETECTIVE TRAINING: Noticing Details

**ACTIVITY TYPE:** Hands-on activity

**AUDIENCE:** K - 4

**TIME FRAME:** 20 - 30 minutes

**SUMMARY:**
Campers will practice their observation skills by noticing changes in people’s appearances.

**MATERIALS:**
None

**SAFETY NOTES:**
Make sure that any campers acting as the “subject” are safely supervised if/when out of sight of the group.

**ENGAGE:**
Making careful observations is an important part of collecting evidence. When it comes to solving crimes, one of the important sources of evidence is the people involved!

- What kinds of details do you think detectives might notice about people?
- How could those details be important to help solve a case?

Let’s practice making observations and noticing details about the people around us.

**PROCEDURE:**
1. Identify yourself or another counselor as the first “subject.” Give campers 30 seconds to (silently) notice details about your appearance.
2. Go somewhere out of sight of the group—just outside the classroom door, behind a large piece of furniture—and make a small change to your appearance, such as removing a watch, untying a shoe, etc. **Note:** If there is no space available where a person can be safely out of view, the group could cover their eyes and/or put their heads down in their arms while you change your appearance.
3. Return to the group and ask campers to identify what you have changed.
4. Invite campers to take turns being the “subject.” Challenge them to think of details to change about themselves that are hard to spot (without being impossible!)
5. Increase the challenge by having the “subject” change multiple things, to see if the group can spot them all.

ADAPTATIONS:
For older groups, make the task more challenging by limiting the amount of time campers can study the subject to 5 or 10 seconds. Alternatively, give the group a minute or two before any subjects are chosen to study all of the other campers; once a subject is chosen they go immediately to change, and the other campers must rely on their initial observations.

TAKE IT FURTHER:
Continue practicing observation skills using the classroom as the subject. Invite campers to take turns making a small change to something in the classroom while the rest of the group’s heads are down. Or, make a change whenever the group leaves the room for lunch or activities, and challenge them to spot the difference when they return.

WHAT’S THE SCIENCE?
Scientists and detectives both rely on their senses to make observations about the world, whether it’s the subject of an experiment or the scene of a crime. To gather the most information they can, they need to:

- **Use as many senses as possible**: Different senses provide different kinds of information.
- **Make comparisons**: Seeing similarities and differences between objects or how one object changes over time helps identify patterns and relationships.
- **Notice details**: Small differences or seemingly unimportant elements can sometimes provide key information.
FINGERPRINT ANALYSIS

ACTIVITY TYPE: Hands-on exploration
AUDIENCE: Grades 2-6
TIME FRAME: 30 minutes

SUMMARY:
Campers will analyze their own thumbprint patterns, and identify another camper by their thumbprint only.

MATERIALS:
- Ink pad or pencil (1 per 3-4 campers)
- Clear tape
- White index card (1 per camper)
- Magnifying lenses (1 per camper)
- Wet wipes or baby wipes
- Examples of fingerprint types (below)

PREPARE AHEAD:
Cut each index card in half.

ENGAGE:
How are fingerprints useful? Does your fingerprint look the same as anyone else’s? How do detectives use fingerprints? Why do you think you have ridges on your fingers? Do you have ridges on your skin anywhere else?

PROCEDURE:
1. Use the wipes to clean everyone’s thumbs.
2. Give each camper two halves of an index card.
3. Have each camper cover their thumb with ink or graphite scribbled from a pencil.

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onto scrap paper. Then have them carefully roll their thumb from one side to the other onto both pieces of their index cards.

4. Once the prints have been made on the card, cover the prints with clear tape and wash thumbs again to minimize print contamination. Examine the print with a magnifying glass.

5. ALTERNATIVE to steps 3 & 4: Have campers pair up. Have camper #1 cover their thumb in scribbled graphite or ink, then have the camper #2 carefully stick a small piece of invisible tape to their thumbs. Remind #2 to be careful not to reposition the tape or let it slide, stick it once and done. Camper #2 should then carefully pull the tape off and stick it to one piece of the index card. Then campers should switch roles.

6. Compare the print to the example sheet and identify what distinguishing features the print has.

7. Each camper should write their name on one of the 2 cards, and hand the unlabeled card in to a counselor. The counselor should shuffle up the cards of one table (or no more than 8 campers in a smaller group) and hand them out to that table.

8. Campers at that table should display their labeled fingerprint cards for everyone to see.

9. Have campers identify whose thumbprint they have, by comparing them with the known samples. What distinguishing features helped them to identify who the print belonged to?

TAKE IT FURTHER:

Try to do the activity again without using ink or graphite, just finger oils on glass, plastic, or clear tape.

ADAPTATIONS:

For younger groups, skip the identification section, and just compare their prints to the example prints. Pattern matching is an important skill in that age group.
WHAT'S THE SCIENCE?

A fingerprint is an image of the whorls formed by the ridges on the palm side of the finger produced by it being pressed against a flat surface. Usually the fingerprint is made by the oils on the surface of the finger being deposited on the surface, but a fingerprint can intentionally be made with ink. Therefore both the oils deposited on glass or plastic by a finger, as well as the ink deposited on the paper are fingerprints.

Fingerprints are only made by the palm-side (the pads) of the fingers. If you look at your fingers, you will see the individual ridges that produce fingerprints, and you will also see that along the side of your finger they end. These ridges form on fetuses between the 10th and 16th weeks of pregnancy, and they are the same pattern that after birth that an individual has for the rest of his or her life. The reason these ridges (papillary ridges) are different in every individual is because they form randomly; they not determined by genetics. As such, even identical twins have different fingerprints, as different as any two people in the world. Although we are all constantly shedding dead skin cells from the top layer of our epidermis (the outer layer of human skin), we retain the same fingerprints throughout our life because the layers beneath the grow to replace the outer layer take on the form of the layer above them while they are developing.

Scientists are not totally sure why we have ridges on our fingertips. Many hypothesize that the ridges on our fingers give us better grip, allow us to have a better sense of touch, or allow our skin to stretch better. Maybe your campers will become the scientists who figure it out one day!
# Three Types of Fingerprint Patterns

<table>
<thead>
<tr>
<th>Arches</th>
<th>Plain Arch</th>
<th>Tented Arch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arches are least common with ridges that enter from one side and exit the other side of the finger</td>
<td><img src="image" alt="Plain Arch" /></td>
<td><img src="image" alt="Tented Arch" /></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Loops</th>
<th>Plain Loop</th>
<th>Double Loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loops are most common and can enter from either side of the finger</td>
<td><img src="image" alt="Plain Loop" /></td>
<td><img src="image" alt="Double Loop" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Whorls</th>
<th>Plain Whorl</th>
<th>Pocket Loop Whorl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whorls are the second most common with circles inside each other</td>
<td><img src="image" alt="Plain Whorl" /></td>
<td><img src="image" alt="Pocket Loop Whorl" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Whorls</th>
<th>Accidental Whorl</th>
<th>Accidental Whorl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any pattern that doesn’t fit into the above categories is called an accidental whorl</td>
<td><img src="image" alt="Accidental Whorl" /></td>
<td><img src="image" alt="Accidental Whorl" /></td>
</tr>
</tbody>
</table>
FOOT TO HEIGHT

ACTIVITY TYPE: Make & Take/Hands-on exploration
AUDIENCE: 3-9
TIME FRAME: 20 minutes

SUMMARY:
Campers will learn how an individual’s foot length correlates to her or his actual body height, and how this can be helpful when detectives and other officials are working to solve crime scenes.

MATERIALS:
- Large chart paper
- Pencils, markers
- Measuring tape (fabric, ~60”) (1 per 2-3 campers)
- Calculators (1 per 2-3 campers)
- Sheets of paper (colored or white)
- Other craft materials for decorating foot art (optional)

PREPARE AHEAD:
Create a table on the large chart paper that allows you to write the name, foot length, height, and percentage of foot length to height of each camper.

SAFETY NOTES:
Since shoes will be taken off, take care that campers are not slipping or could step on anything sharp.

ENGAGE:
How do detectives determine how tall a suspect might be? One way is through how big a footprint the perpetrator leaves. We’re going to explore how that works by measuring all of our feet.
PROCEDURE:

1. Have campers get into groups of 2-3, give them each a sheet of paper and a pencil/crayon/marker. Ask them to trace each other’s shoe-less foot onto paper. What do they notice about these tracings? Are they different sizes? Do they notice a pattern between the height of the owner and the size of their foot? Decorate, if time allows.

2. Using a measuring tape, have the campers measure their own (or another camper’s) foot in inches. Shoes should be off and it will work best by putting the back of the foot against a wall. Fill in the foot length on the table.

3. Using a measuring tape, measure the camper’s height in inches and record it on table.

4. Using a calculator, divide the camper’s foot length by body height (again, in inches) and the multiply by 100. Example: 11in/70in X 100=15.7%. In other words, an adult’s foot size should be relatively close to 15% of the person’s body height.

5. Note that this will probably not work correctly with the children’s feet/height sizes. Explain this to the campers and now try it on an adult counselor to show the difference. It should work pretty well with an adult and come out somewhere around 15%.

6. If scientists can generally assume that an adult’s foot size is about 15% of their height, how would they estimate a height from a found footprint?
   a. Allow campers time to show the calculation backwards: foot length divided by 0.15 (times 100 to make the percentage).

7. Discuss how they think scientists and legal officials use foot to height ratios to help solve crimes. What are the limitations to this piece of evidence?

TAKE IT FURTHER:

If you have a narrative or crime scene to investigate, the campers can use what they learned to figure out more about the perpetrator of the crime. Or you could create one for them, and have one of the counselors be the perpetrator.
**ADAPTATIONS:**

For younger groups, focus more on the measuring and less on the calculation. Also allow them more time for foot tracing and decorating.

For older groups, spend more time with making estimates based on the length of various footprints, and talk more about the anomalies (for instance, Melissa has a foot length of 8.75” and a height of 64.5” = 13.5%, which means she has relatively small feet).

**WHAT'S THE SCIENCE?**

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 fully grown individuals, seeing as the ratio of body parts is slightly different in growing children.
FOOTPRINT ANALYSIS

ACTIVITY TYPE: Hands-on exploration

AUDIENCE: Grades 3-9

TIME FRAME: 15 - 30 minutes

SUMMARY:

Campers will observe a set of footprints and propose a scenario about who left them and what happened.

MATERIALS: (one set per class)
- Long sheets of butcher or kraft paper (8’-12’ per scenario) (4-8 scenarios)
- 2-3 types of shoes (optional)
- Washable paint

PREPARE AHEAD:

Roll out the sheets of kraft paper. Cover the bottom of your shoes or feet with a thick layer of washable paint. Choose a walking style and travel down the length of the paper in that style. Possible walking styles:

- Walking
- Limping
- Running
- Tip-toes
- Walk backwards
- Hop on one foot
- Walk with a cane or crutch
- Walk like its slippery or icy

ENGAGE:

How do CSI agents and detectives use footprints to determine what happened at a crime scene? What kinds of things do you think they look for?
PROCEDURE:

1. Break campers into as many groups as you have different footprint sets.
2. Allow campers to examine a set of footprints. Have them observe with their eyes and also allow them to walk over the surface. (Remind them to be gentle and try not to rip the paper.)
3. Campers can begin to discuss these patterns as they are presented in the footprint set, and settle on a reasonable scenario.
4. Have each group present their findings, explaining how they reached their conclusion. Allow other groups to ask questions or propose other ideas.
5. Allow groups to switch scenarios, as time allows.

TAKE IT FURTHER:
Distribute rulers and have kids use their knowledge of foot to height ratios to gain more knowledge about who and how the footprints were made.

ADAPTATIONS:
For younger groups, work on the mystery together as a class. You may do more than one set of prints if you have time.

WHAT’S THE SCIENCE?
Aside from just analyzing an individual footprint, the entire pattern of footprints can be taken into consideration by a forensic investigator. This is known as gait analysis. When looking at a set of footprints, there are seven basic types of measurements referred to as gait patterns:

- Stride pattern: length of stride can indicate of someone was carrying something heavy (short stride) or running (long stride)
- Distance from toe of one foot to heel of other foot: can indicate a limp
- Distribution of weight on the foot: step first on toe or heel?
- Length or depth (of a plastic footprint): small people have short, shallow prints; large people have long, deeper prints
- Angle at which toe points away from direction of motion: feet turned out or in?
- Width between steps: the distance between inside of left foot and inside of right
- Overall pattern of prints: whether crime was random or planned, etc.

Many conclusions can be made by analyzing the gait displayed by footprints. It can be determined if an individual has a limp, if they are tall or short, or if they were running or walking based on the footprints they leave.
DISCOVERING DNA

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 2-9
TIME FRAME: 20-25 minutes

SUMMARY:
Students will isolate DNA from wheat germ and make DNA tube necklaces to take home.

MATERIALS:
- Safety goggles (1 per student)
- Ice pack, freezer, and/or small cooler with ice
- Raw wheat germ (not processed)
- Hot water
- Meat tenderizer
- Liquid dishwashing or hand soap
- Plastic spoon
- Isopropyl alcohol or ethyl alcohol (91%)
- Plastic cups (3-4)
- Dropper bottles (1 per 3-4 students)
- 1.5 ml microcentrifuge tubes
- 1 ml pipettes (1 per student)
- Yarn
- Scissors
- Water pitcher (for dispensing water)

PREPARE:
1. Several hours or the night before the activity, put the ice pack in the freezer and the alcohol in the refrigerator.
2. 30 minutes before the activity:
   Prepare the wheat germ liquid:
   In a clean plastic cup or container add 1 cup hot water, 2 spoonfuls of wheat germ, 1 spoonful of meat tenderizer, and a large squirt of soap (about 2 teaspoons). Stir well and distribute evenly into 3-4 plastic cups for student use. Let the mixture
in the cups settle for 15 minutes.

Prepare the dropper bottles of alcohol:

Fill the dropper bottles with chilled alcohol. Place the bottles on the ice pack until just before students use them to keep the alcohol chilled.

3. (Optional): Pre-cut 30-inch lengths of yarn for the necklaces.

ENGAGE:

Introduce the activity:

How do the different parts of your body know what to do and how to grow?

All living things have something inside called DNA, which is like their plan or instructions. People have it, animals have it, plants have it, even bacteria have it!

Today we’re going to try to find some DNA and take it home with us! We’re going to look for DNA in the wheat plant, to help us understand what our own DNA would look like.

Display some dry wheat germ. Explain that it is part of the wheat plant.

What do you think we might do to try to get the DNA out?

PROCEDURE:

1. Remind students of safety procedures and ask them to put on their safety goggles.

2. Distribute the cups of wheat germ liquid and ask students to observe the contents.
   
   What do you notice?
   
   What do you see in the bottom? What does the liquid look like?

3. Explain that the wheat germ is part of the seed of the wheat plant, and the soapy liquid is helping to break it up to get at the DNA inside it.

4. Demonstrate how to use a pipette to take a sample of the wheat germ liquid and add it to a microcentrifuge tube. Distribute the microcentrifuge tubes and pipettes and invite students to fill their tubes about halfway with the liquid. Note: Younger students may need to practice filling and slowly emptying the pipette into the cup a few times before adding the liquid to their tubes.

5. Distribute the alcohol bottles. Demonstrate for students how to carefully add alcohol to fill the tube almost all the way to the top, and then snap the lid shut.
   
   What does the liquid in your tube look like?

6. Demonstrate how to hold the tube between thumb and forefinger and gently rock the tube upside-down and then back up. Invite students to do this 4–5 times with their own tubes and observe them again.
   
   What does the liquid look like now?
   
   Can you see anything forming in the tube? What does it look like? What do you think created by THE FRANKLIN INSTITUTE
it is? What makes you think so?
7. Discuss students’ results: The whitish solid is wheat DNA, now all clumped together and separated from the rest of the wheat liquid to make it visible.
8. Distribute the lengths of yarn or assist students in cutting their own. Invite students to carefully reopen the cap, lay the yarn across the hinge of the cap, and snap it shut again. Encourage them to tie the ends of the string to make a necklace and wear their discovered DNA with pride!

TAKE IT FURTHER:

- If time and your group’s abilities allow, students could work in teams to prepare their own wheat germ liquid before the extraction activity. Divide the recipe amounts above by the number of teams and allow each team to prepare their own cup. Invite the group to think about what the different ingredients might be doing to help get the DNA out of the wheat germ. Leave the liquid to settle while doing another activity, then return to finish extracting the DNA and making the necklaces.

- For older students, include the following ideas in the discussion:
  - Living things are made up of cells. Each cell contains a copy of the living thing’s DNA “blueprint” which tells the body how to grow and develop.
  - DNA is like a long string made from four types of smaller building blocks. The pattern of those four blocks is the “code” that gives instructions to the cells.

WHAT'S THE SCIENCE?

- Genes are a set of instructions that give living things the information they need to grow and do their jobs. They are made of a chemical called DNA, which stands for deoxyribonucleic acid. DNA is a long chain made up of four smaller molecules called nucleotides. In the same way that the letters of our alphabet can be arranged in many different ways to create words and sentences, the pattern of these nucleotides in the DNA carries the genetic information that acts like the organism’s “blueprint.” This includes everything from the basic processes that keep cells running to traits like eye color or nose shape. A copy of the organism’s DNA is found in the nucleus of each of its cells. Segments of DNA form genes, which can be expressed (turned on) or not depending on stimuli in our environment. This explains why our environment and experience can shape how we grow and develop.
The extraction in this activity involved three different steps:

- Cell membranes are made of fatty substances which don’t dissolve in water. The **soap** helped break apart the fatty membranes of the cells (just as it breaks up grease on hands or dishes), releasing the DNA and other cell contents into the mixture.

- The **meat tenderizer** contains enzymes that help break up proteins to untangle the DNA from other parts of the cell. At this point, the DNA is floating freely but still dissolved in the water with everything else.

- **Isopropyl alcohol** is less dense than water, so it forms a layer floating on top of the water mixture. DNA is also less dense than water, so it floated to the top of the water and into the alcohol. However, DNA isn’t soluble in isopropyl alcohol, so it formed a solid in the bottom of the alcohol layer. (The DNA will re-dissolve in water, which is why it is important not to shake the test tube or transfer any of the water layer into the vial.)
DINNER PARTY

ACTIVITY TYPE: Active game
AUDIENCE: Grades K - 9
TIME FRAME: 10 - 30 minutes

SUMMARY:
Campers attempt to identify a “murderer” in their midst.

PROCEDURE:

1. Ask the group to close their eyes. Select one of the campers to be the “murderer” by tapping them on the shoulder so their identity remains a secret.

2. Have the group begin going around and shaking hands.

3. The murderer should try to tickle the inside of others’ hands during the handshake without being noticed by others.

4. Players who have their hands tickled should count for 10 seconds and then act out a dramatic death scene ending with themselves sitting on the ground.

5. The game is over when either: 1. A guest correctly guesses who the murderer is by whispering it to the instructor or 2. The murderer kills all the other guests.

6. If playing with more than 1 murderer it is possible for a third way to win. If the murderers kill each other thus making the party safe for everyone again.

ADAPTATIONS:
For younger campers, instead of a murderer, the suspect could be a magician who puts people to sleep.

For older campers, identify two or three “murderers” for each round to make the game more challenging.
LEFT BEHIND

ACTIVITY TYPE: Group discussion
AUDIENCE: 2nd - 4th grade
TIME FRAME: 15 - 30 minutes

SUMMARY:
Campers will explore how items and traces left behind at a scene can provide information about what happened.

MATERIALS:
- Book: *In the Woods: Who's Been Here?* by Lindsey Barrett George
- Printed copy of three scene photos (see below)

ENGAGE:
Introduce the theme of the day:
*Yesterday we learned about finding evidence that identifies people—but sometimes there are no fingerprints, or DNA, or witnesses to describe the suspect.*
- How else can we get information about what happened?
- What kinds of things might we find that could give us evidence?
*Objects, or even small things like threads, drops of liquid, or bits of dirt left behind at a crime scene can be important sources of evidence. Today we’re going to practice looking for this kind of evidence and figuring out what it can tell us about what happened.*

PROCEDURE:
Book Reading
1. Show the group the front cover of the book and invite them to make observations and predictions about the book based on what they see.
   - What do you notice about this book?
   - What do you think it is going to be about? What makes you think that?
   - What do you think this book might have to do with finding trace evidence—things that are left behind?
2. Read the book, pausing at each page to let campers make observations about the evidence they see and guess who/what left the evidence behind.
3. What evidence are the children looking at on this page?
4. Who or what do you think left the evidence? What makes you think that?
5. Do you see anything else in the picture that supports your idea?
6. Discuss the kinds of trace evidence shown in the book and make connections to the kinds of evidence humans might leave behind.
   - What kinds of evidence did the animals in the book leave behind?
   - Can humans leave similar kinds of evidence? What might they look like?

**Photo analysis**
1. Show the group the coffee photo and ask them what they think happened in the photo. Encourage them to look closely for evidence to support their ideas. Ask questions that invite them to challenge their assumptions and notice more details:
   - Where did this happen—in a house? At the park? How can you tell?
   - What makes you think the liquid is coffee?
   - If it is coffee, what kind is it—iced? Black? With cream? How can you tell?
   - Was the cup dropped from a height, or was it tipped over while sitting on the ground? What makes you think so? How would it look different otherwise?
   - Which direction do you think the cup was moving when the coffee spilled? What makes you think so?
   - Which direction is uphill in the picture, and which is downhill? How do you know?
   - What other details do you notice about how the liquid spilled? What information can you figure out from those details?
2. Point out that it can be easy to jump right to a guess about what happened, but it’s important to really look at the evidence and see what it tells you.
3. Show the group the room photo. Ask them not to try to make any guesses right away, but first just notice details. Invite campers to take turns pointing out details they notice in the scene.
4. Ask questions to encourage campers to start making inferences based on the details they noticed. Encourage them to justify their ideas using the evidence in the photo. Challenge them to think about the assumptions they make. (For example, dolls are often associated with girls, but boys might play with them too. The name “Megan” and the picture on the wall are stronger evidence that a girl lives there.)
   - Who uses this room? Just one person, or more than one? How can you tell?
   - Are they adults? Kids? Boys? Girls? What other details can you tell about them?
   - What things did they do in this room recently? What evidence makes you think that?
   - What time of year do you think this picture was taken? What evidence supports your idea?
   - What else can you conclude about what happened in this room or the people who used it?
5. (Optional) If time and the group’s interest allow, repeat the process using the bicycle picture. Encourage the group to think about what pieces of evidence are left behind, and what details in the photo provide information about what happened. You might also discuss the idea that not every detail or piece of evidence is necessarily important or part of what happened. (Is the woman in the picture related to the bicycle, or is she just a passer-by?)

6. Use this discussion to frame the rest of the day’s activities. Encourage campers to continue looking closely at details and drawing conclusions that are supported by the evidence.

WHAT’S THE SCIENCE?

Objects and traces left behind by people provide valuable information about the people themselves, or what they did at a particular place and time. This kind of information can be very important in determining who was at the scene of a crime, and what happened while they were there. Since the objects themselves can’t talk, detectives and forensic scientists have to perform tests and make deductions about what happened based on what they find.

Some types of evidence forensic scientists might look for and analyze include:

- Objects, such as food wrappers, receipts, items of clothing
- Damage to objects or buildings, such as dents in cars, knocked-over furniture, or broken windows
- Trace evidence, such as cloth fibers, soil, glitter, paint, hairs, pollen, etc., that is rubbed off or transferred from one person or object to another.
- Footprints, tire tracks, or other types of tracks
- Patterns of liquid spill or spatter—often blood but occasionally other liquids as well.
- Liquids, powders, or other substances that can be chemically analyzed to determine what they are made of
DETECTIVE TRAINING: Scent Identification

ACTIVITY TYPE: Nose-on Exploration

AUDIENCE: K-4

TIME FRAME: 30 minutes

SUMMARY:
Campers will discuss the importance of making observations using their sense of smell. They will learn about the sense of smell and put theirs to the test through matching and identifying scents.

MATERIALS:
1. Set of 6 ‘smell containers’ (2-3 sets per class)
   a. 6 different essential oils, extracts, or spices - peppermint, lavender, citrus, sandalwood, cinnamon, ginger
   b. 12 cotton balls
   c. 6 small containers with lids (plastic eggs, film canisters, etc) labelled 1-12.
   d. Optional: skunk spray smell, vinegar, or other “stinky” smells
2. Pencil & paper

PREPARE AHEAD:
Prepare smell sets with 2 cotton balls with one scent in each.

SAFETY NOTES:
Be aware of any allergies related to the scents used.

ENGAGE:
How good is your sense of smell? Do you think it is as good as a dog’s or pig’s sense of smell? What about an owl? Do humans rely on our sense of smell to survive?

PROCEDURE:
1. Divide your group into smaller groups of 6 or less campers, so that each group
gets 6 smell containers.
2. Challenge campers to match the 3 sets of smells that they have, and then identify each one. Have them record their guesses.
3. Once each group has identified their smells, have them trade with another group and complete the activity again.
4. Reveal the answers and have each group check if they guessed correctly.
5. Lead a discussion about how they feel their sense of smell stacks up to other animals, now that they have tested it. Were they surprised by any of the answers? Why would their sense of smell be better or worse than other animals?

TAKE IT FURTHER:

Add in stinky smells and see if they can identify those smells as well. Or change the essential oils list to make it harder (e.g. several types of mint, or lemon versus lime).

WHAT'S THE SCIENCE?

Most of what you taste is from your sense of smell. Without the sense of smell we vastly limit ourselves only to true taste sensations- sweet, salty, sour & bitter. But our very discriminating nose can differentiate between many thousands of different scents and flavors! Your nose can detect about 10,000 different odors.

Being able to identify different smells is also important for any animal or human survival. Imagine if you couldn't smell smoke! It could be very dangerous to not be able to tell that a fire is nearby. Compared to many animals, humans are not great scenters. Dogs and pigs can both catch scents that we cannot. This is why bloodhounds are often used to track people that the police can’t find, and pigs are used to find mushrooms in the forest that we can’t cultivate.

On the other side of things, many birds, and especially owls, are even worse at scenting things than humans. Instead they have a stronger sense of sight and hearing. Great horned owls are known to have a taste for skunks, but their sense of smell is not very strong, so they tend not to be bothered by the stinky spray from their prey.
SPATTER ANALYSIS

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 3 and up
TIME FRAME: Three 20 - 40-minute sessions (do one or all)

SUMMARY:

Students will investigate the effects of height, direction, and/or angle of impact on the spatter pattern of a liquid.

MATERIALS:

Part 1 (Height)
- Pipettes or eye-droppers– something that will accurately deliver one drop of fluid with a consistent volume (1 per group of 2 - 3 students)
- (Optional but recommended) Ring stand and clamp, or something to hold the pipette/dropper at a consistent height (1 per group)
- Meter sticks or measuring tapes w/ cm markings (1 per group)
- Rulers with mm markings (1 per group)
- Ingredients for blood substitute:
  - Red food coloring (1 small bottle per class)
  - Corn syrup (1 bottle per 2 groups)
  - Water (~100 mL per group is enough for all 3 parts)
- 5-6 oz bottle or cup to hold blood substitute (1 per group)
- Mixing bowl or pitcher (1 per class)
- Mixing spoon (1 per class)
- White paper (4 - 5 sheets per group)
- (Optional) Graph paper for graphing results

Part 2 (Direction)
- Blood substitute (see part 1)
- Sheets of large chart paper, ~24 x 36”, or similar lengths of butcher paper (4 - 5 per group)
- Toothbrushes or small paint brushes (1 per group)
- Protractors (1 per group)
- Safety glasses (1 per person)
- (Optional) Table and/or floor coverings, or towels for wiping up spills

**Part 3 (Angle)**
- Stand and clamp (see part 1)
- Pipettes/eye droppers (see part 1)
- Meter sticks and rulers (see part 1)
- Colored water (see part 1)
- Lunch trays (1 per group)
- White paper to fit the lunch tray (at least 4 sheets per group)
- Blocks, L-brackets, or other way to prop the tray at different angles
- Protractors (1 per group)
- Masking tape (several rolls per class)

**PREPARE AHEAD:**

- Prepare a large batch of blood substitute, enough for each group to have ~100 mL. Mix about 1 part corn syrup to 4-5 parts water to about 10 drops food coloring in a mixing bowl (for example, to make 100 mL of blood substitute - use 80 mL of water, 20 mL of corn syrup, 10 drops of red food coloring.) Use plenty of food coloring—more intense color will make the drops easier to see. Separate the blood substitute into cups for each group.

- For Part 1, cut paper into half-sheets. Each group will need at least 7 half-sheets.

- (Optional) Prepare some “unknown” spatter patterns with different heights, angles, directions for students to analyze. If you like, think of scenarios or challenges to go with them, e.g.: “This was made from a dripping paintbrush. Was the person crouching, standing, or reaching up?” (Alternatively, have groups make patterns during the activity and exchange them with another group.)

**SAFETY NOTES:**

Although colored water is not generally harmful, students should wear eye protection for safety in Part 2 and any other experiments where liquid might swing or spatter into eyes.

**ENGAGE:**

How could a spilled liquid, or a trail of bloodstains, be evidence in a crime? What kinds of information might this evidence tell us? What kinds of things do you think forensic
scientists look for in liquid spatter patterns? How could they use what they find to get information about what happened?

**PROCEDURE:**

**Part 1: Height**

1. How could a liquid drop tell us what height it fell from? How could we find that out? Take student ideas; if time allows, help them think through the variables involved and develop a procedure, or else suggest the steps below.

2. Divide the class into groups of 2 - 3. Distribute materials and containers of colored water.

3. Decide on a set of heights to test, e.g. 10 cm, 20 cm, 40 cm, 60 cm, 80 cm, 100 cm, 150 cm.

4. Label a half-sheet of paper with the first chosen height (e.g. 10 cm). Fill the pipette or dropper with liquid.

5. If using a stand and clamp, attach the dropper on the stand so the tip is 10 cm (or chosen height) above the sheet of paper. Otherwise, one group member should hold the meter stick or measuring tape perpendicular to the paper while another student holds the dropper beside it, with the tip at the proper height (see photo above).

6. Drop one droplet onto the paper. Carefully (without smudging the drop!) label it Trial 1.

7. Shift the paper so the next drop will fall in a clean area of the page. Drop a droplet and label it Trial 2.

8. Repeat for Trial 3.

9. Remove the paper and allow it to dry.

10. Move the dropper on the stand so the tip is at the next height (e.g. 20 cm).

11. Label a new sheet of paper with the new height and do three drop trials at that height.

12. Repeat the process for each of the other chosen heights.

13. Measure the diameter of the drops (in mm) and average the three trials to find the average diameter for each height.

14. (Optional) Use graph paper to graph average droplet diameter vs. height.

15. Discussion:
   - *Based on your results, is there a relationship between height and the diameter of the droplet?*
   - *What is the effect of the different heights on the diameter of the droplet?*
   - *Are there any sources of error? What are they?*
• How could these errors affect your results?
• Did you note anything else of interest about the patterns?
• As the height increased did the droplet pattern change consistently?
• Was there a height that resulted in no further change?

16. Challenge groups to use their data to gather information about an unknown drop pattern. Distribute pre-made unknowns (if you have them) or have each group make one and trade with another group.

17. Discussion:
• What did you figure out about the unknown drops? How did you do it?
• What are some real-life situations where evidence like this could be useful?
• What kinds of information could we determine about a crime scene based on the height from which drops fell?

Part 2: Direction

Note: This part can get messy! Consider table and/or floor coverings, or have cleaning materials handy to wipe up spills. If this is not practical, you could do one set of examples as a teacher demonstration, and have the group examine the results together.

18. What else might liquid drops be able to tell us besides the height they fell from? What about whether the dripping object was moving? How could we determine which direction it was going?

19. Take student ideas; if time allows, help them think through the variables involved and develop a procedure, or else suggest the steps below.

20. Place a large sheet of paper on the table or floor.

21. Dip the toothbrush or paintbrush in the colored water.

22. Have one student place their elbow on the table (or floor) and, using a protractor, position their arm at a pre-determined angle, e.g. 45°.

23. Keeping the arm at the same angle, move it quickly (but not too forcefully!) across the paper, e.g. Right → Left, allowing drops to fall from the brush. Write the angle and the direction of travel on the paper.
24. Do two more trials at the same angle and direction. (You may need to do each on a separate piece of paper.)

25. Repeat the process, doing three trials of each of the following:
26. Same angle (45°) but opposite direction, e.g. Left → Right
27. Consistent 20° angle (choose one direction)
28. Consistent 75° angle (same direction as 20°)
29. Start at shoulder height and move downward to table height while moving across the page (choose one direction)
30. Start at table height and move upward to shoulder height across the page (same direction as previous)
31. Note: if time is limited, assign some groups to do the two consistent angle tests (20° and 70°) and the other groups to do the two changing angle tests (shoulder to table, etc.). Have the groups report their findings to each other.

32. Discussion:
   - How do drops from a moving object look different from stationary ones?
   - What features of the liquid drops are important when working out the direction the blood droplet came from?
   - Does changing the angle affect those features?
   - Did you note anything else of interest about the patterns?
   - Are there any sources of error? What are they?
   - How could these errors affect your results?
   - What else might affect how drops fall from a moving object?

33. As in Part 1, invite groups to use their data to analyze unknown spatter patterns (provided by you or made by another group) for information about how the dripping object was moving. (If they’ve completed Part 1, challenge them to look for information about height as well as movement!)

34. Discussion:
   - What did you figure out about the unknown patterns? How did you do it?
   - What are some real-life situations where evidence like this could be useful?
   - What kinds of information could we determine about a crime scene based on the direction a dripping object was moving?

Part 3: Angle of Impact

35. If students have completed Part 2, refer to the tests they performed at different angles. How did the spatter patterns differ? Do they think the differences due to the angle, the movement, or a combination of both? How could we find out? Take student ideas; if time allows, help them think through the variables involved and develop a procedure, or else suggest the steps below.
36. Choose a standard height to test the drops from. (This could be determined from Part 1). As in Part 1, attach the pipette or dropper to a stand and clamp set at the appropriate height, or have one group member hold a meter stick while another positions the dropper at the right height.

37. Place a piece of paper on a lunch tray, securing it with a few pieces of tape. Place the tray and paper beneath the dropper.

38. Allow one drop of blood to fall from the agreed height. This will measure impact at an angle of 90°. Label the paper 90°.

39. As in Part 1, repeat twice more to give 3 trials at 90°. Be careful to adjust the paper so the trials are clearly separate.

40. Remove the paper to dry taking care that the droplet patterns do not “run”.

41. Choose 2 - 3 additional angles to test, e.g. 60, 45, and 20.

42. Do NOT adjust the height of the dropper.

43. Tape a different piece of paper labelled with the next chosen angle on the board.

44. Using a protractor, adjust the board so it is at an angle of 60°. Reminder: This should be the angle between the tray and the stand/dropper—NOT between the tray and the table.

45. Allow a drop to fall from the same height. Repeat so there are 3 trials at the new angle.

46. Repeat this process for the other chosen angles (e.g. 45 and 20°).

47. When the sheets with the 3 trials are dry, measure the length and width of each stain in mm. Note: when measuring the length and width of the bloodstain do not include spines or satellite stains. Calculate the average width and length for each angle.

48. Discussion:

- How does the angle of impact of a droplet influence its shape?
- As the angle decreases what happens to the relationship between length and width of the drop?
- How could you determine the angle a droplet came from based on the mark it left?
What are the potential sources of error?

How does the angle of impact affect the number of spines or satellite stains? Why do you think this is?

What are some real-life situations where evidence like this could be useful?

What information could we determine about a crime scene based on a drop’s angle of impact?

49. As in Parts 1 and 2, provide unknown spatter patterns and ask groups to use their data to gather information about the angle of impact. If they have completed Parts 1 and 2, challenge them to look for height and direction information as well. How much can they figure out about how the pattern was made?

**TAKE IT FURTHER:**

- Explore surface type—drop on plastic wrap, fabric, ceramic tile, carpet, wood, metal, etc. How does the surface influence the shape and/or size of a droplet? Is there a correlation between surface and the number of spines and satellite stains? Do you think that any of the surfaces tested would be unable to be used for spatter analysis? What are the potential sources of error?

- Explore the effect of different movements – walking, running – on spatter patterns. This could be completed with a student performing the action along a paper pathway with some liquid dripping. This is an example of low velocity spatter.

- Explore the effect of objects in the spatter path. Place different objects (hammer, pencil, cloth) on the paper before creating spatter patterns; then remove the objects. How does the object affect the spatter pattern? What situations might create a spatter pattern like this? What might you be able to learn from this kind of pattern?

- Explore the effect of velocity: low (dripping from a brush, etc.), medium (flung with a mousetrap, or a baseball bat striking wood), and high (spray from a bottle with a misting nozzle). Do these tests inside a large box or cover surfaces! Why does the velocity at which the blood droplets are travelling have an effect on the size of the bloodstains? What sort of objects or activities could create the three different blood spatter patterns?

  - Low velocity (e.g. cutting a finger while peeling a potato)
  - Medium velocity (e.g. beating with hand or club, stabbing with a knife)
High velocity (e.g. gunshot wounds, chainsaw injury)

**ADAPTATIONS:**

To simplify or shorten the activity:

- Choose just one of the variables (height, direction, or angle); or do them as separate activities in multiple sessions.
- Omit the measurements of drop diameter, etc. and look for general relationships rather than quantitative-- as the dropper gets higher, does the drop get bigger or smaller? Spikier or less spiky?
- Test fewer data points, e.g. only 2 - 3 different heights, and/or only 1 - 2 trials at each height. (This makes the data less rigorous, but will be enough to illustrate relationships.)

**WHAT'S THE SCIENCE?**

- Spatter patterns are evidence created when drops of a liquid fall through the air and land on a surface. The shape of the resulting mark is determined by the physical forces acting on the drop (gravity, surface tension, speed and direction of motion, angle of impact, etc.)
- Forensic scientists analyze the shape and pattern of spatter droplets to gather information about the acts or events that caused them. Spatter can provide information such as the height at which a dripping object was held (which could indicate the height of the person holding it), how fast it moved and in what direction(s), or where a crime or spill occurred (the origin of the spatter).
- Spatter analysis is often used on bloodstains, but it can also be used for other liquids, such as paint or soda.
- **Volume**: The size of the drop affects the mark it makes. The more liquid is in the drop, the bigger the mark it makes.
- **Viscosity**: The thickness of the liquid changes the size and shape of the drop created. Because liquids like blood and water demonstrate surface tension, cohesive forces that act like an outer skin, falling drops form a near-perfect spherical shape.
- **Spines** or **satellite** drops may form as smaller bits of liquid are thrown out of the drop by the force of impact.
- **Release height:** In general, the farther a drop falls, the more force it has on impact (due to the acceleration of gravity), and the larger the resulting stain will be. Greater height also usually produces more visible spines and satellites.

- **Angle of impact:** Drops landing on a surface at 90° (perpendicular) will be very round, with spines or satellites evenly distributed around the edges. As the angle gets smaller, the drop becomes more elongated. Below 75°, the spines tend to be longer on the side opposite the angle of impact. At very low angles, a single satellite may break off to form a separate stain, like an exclamation point.

- **Surface:** A smooth surface, such as tile or linoleum, will not change the shape of the drop, whereas a rougher surface, such as carpet or concrete, disrupts the surface tension and causes the drops to break apart.

- **Movement:** Spatter caused by a moving object forms arcs or trails of drops. The shape and number of arcs/trails can determine how (or how many times) the object was moved; the tails of each drop point in the direction of motion.

- **Void patterns:** A void occurs when a person or object blocks the path of the falling droplets, leaving a blank area on the surface. Voids can tell investigators if an object is missing from the scene, or where people were standing when the spatter occurred. The missing object (or person’s clothing) would also have a matching spatter pattern on it, which could be used to place it at the scene.
POWDER ANALYSIS

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 2 - 8
TIME FRAME: 20 - 30 minutes

SUMMARY:
Campers will perform chemical tests to identify an unknown powder.

MATERIALS:
- Powder scoops--wooden craft sticks, or straws cut at an angle (4 per pair)
- Eyedroppers or pipettes (3 per person)
- Medicine/condiment/art cups for sample testing (15 per person)
- Larger cups or containers for holding powders and liquids (8 per 4-6 people)
- Toothpicks for stirring (15 per person)
- Dilute iodine solution
  - Iodine solution is readily available as a disinfectant at drug stores as a 10% solution. This can be further diluted by adding 2-4 parts water for one part iodine solution.
- Vinegar
- Water
- Baking soda
- Corn starch
- Baking powder
- Powdered sugar
- Disposable gloves
- Paper or lab books and pencils
- Optional: flour, salt, other white powders

PREPARE AHEAD
Prepare labeled containers of the four known powders and the three test solutions with scoops or pipettes for each (1 set for every 4-6 people).
Prepare “unknown” samples of the four powders in small cups, labeled as A, B, C, or D respectively. Each camper should get a cup with one of the four unknowns.
ENGAGE:
A white powder is found at a crime scene. It could be a vital clue—but what is it? You, the forensic scientists, are charged with trying to identify what the powder is. What could you do? What are some ways to tell different substances apart?

We’ll be using some common household substances to help us model one of the techniques that forensic scientists use to identify unknown substances.

SAFETY NOTES:
Iodine can stain hands and clothing. Campers should wear gloves.

PROCEDURE:
1. Ask campers to make observations about the four known powders. Are there any differences they notice between them by sight or touch?
2. Introduce the three test reagents. How do campers think the different powders might react with each of them? Ask campers to make predictions.
3. Encourage campers to work in pairs.
4. Challenge campers to figure out a process for comparing the reactions between each of the four powders and each of the test reagents and record their results. Remind them to think about what is needed for a fair test: what things should change, and which should stay the same? One possible methodology is listed below:
   - Draw a grid with the names of the powders down the left side and the identifying reagents (liquids) across the top.

<table>
<thead>
<tr>
<th></th>
<th>Water (60 drops)</th>
<th>Vinegar (20 drops)</th>
<th>Iodine (10 drops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking powder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baking soda</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornstarch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdered sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Place a scoop of each powder in three separate medicine cups, using the end of a wooden coffee stirrer or straw. Be sure to label them, either by writing on the cup or putting them on a piece of paper and writing on that.

Using a pipette, add 60 drops of water to the first cup of each powder and stir each with a separate stirrer. Observe carefully and record any reactions in the grid.

Add 20 drops of vinegar to the second cup of each substance and stir. Record any reactions or changes.

Add 10 drops of iodine solution to third set of cups and stir, recording any reactions.

5. Discuss the group’s results. Do they agree on the results of each reaction? If there are differences, what might explain them? How could they use this information to identify an unknown powder?

6. Distribute an unknown sample to each student. Challenge them to determine the identity of the substance, using the test method they developed.

7. Reflection:
   - What does their test say about the identity of their unknown sample? Do the results agree with others who had the same unknown?
   - What are the limitations of this test? Does this test definitely identify the unknown substance? Why or why not? (Hint: What about substances other than the four they tested?)

**TAKE IT FURTHER:**

Try testing other white powders: flour, salt, etc. What reactions do they have with the test reagents?

**ADAPTATIONS:**

- Have campers work in pairs or small groups rather than individually.
- For younger groups:
  - Break the testing down into steps by introducing the reagents one at a time. Help students develop a process for testing the powders with water; then have them repeat the process with the vinegar and iodine.
  - Simplify the unknown testing by using a single unknown for the whole group, rather than four different ones.
WHAT’S THE SCIENCE?

Chemical compounds that look very similar can have very different chemical properties. Chemists and forensic scientists can take advantage of this by using chemical tests to identify unknown substances that might otherwise look similar. In this experiment, the four powders are reacted with three separate liquids. None of the liquids will distinguish between the substances by itself; using all three produces a different pattern of reaction from each powder, which makes it possible to tell them apart.

- **Baking soda** (sodium bicarbonate) reacts with acids (such as vinegar) to release carbon dioxide gas.
- **Baking powder** contains both baking soda and a powdered acid (usually tartaric acid). They will react as soon as they are dissolved in water to produce bubbles of carbon dioxide.
- **Iodine reacts with starches** (long chains of sugar molecules found in plant materials) to produce a dark blue or black compound. This reaction is frequently used to test for the presence of starch.
- **Expected results:**

<table>
<thead>
<tr>
<th></th>
<th>Water (60 drops)</th>
<th>Vinegar (20 drops)</th>
<th>Iodine (10 drops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking powder</td>
<td>Bubbling</td>
<td>Bubbling</td>
<td>NR</td>
</tr>
<tr>
<td>Baking soda</td>
<td>NR</td>
<td>Bubbling</td>
<td>NR</td>
</tr>
<tr>
<td>Cornstarch</td>
<td>NR</td>
<td>NR</td>
<td>Turns dark</td>
</tr>
<tr>
<td>Powdered sugar</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

- One limitation of chemical tests like these is that they are not necessarily specific--more than one substance, or whole groups of related substances, might react in the same way. If we know that the unknown substance is one of the four we tested, these tests help to distinguish between them, but if the sample were completely unknown, these tests would not be enough to identify it.
- Chemical tests are still used to quickly test for (or rule out) the presence of certain types of substances such as lead, starch, or blood; to identify more complex compounds, or mixtures of different substances, modern forensic scientists use...
other techniques such as mass spectroscopy, which provide a more specific “fingerprint” for individual substances.
GLITTER FORENSICS

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 3 - 8
TIME FRAME: 30 minutes

SUMMARY: Campers will make observations about different kinds of glitter to explore characteristics such as color, size, shape, and light reflection.

MATERIALS:

- 3 - 4 different brands and/or sizes of glitter of the same color (if needed, search for ultra fine, extra fine, large, body, etc)
- Sticky notes, light colored (4 - 5 per group of 2 people)
- Magnifying glasses (1 per 2 people)
- Index cards (4 per 2 people)
- Hole punch (1 per 2 people)
- Transparent tape
- Pocket microscopes (1 per 2 people)

PREPARE AHEAD:

Set aside a portion of one of the types of glitter in a bag or container labeled “evidence.” Do not let the class know which type it is.

ENGAGE:

Just like chemicals and substances have different properties; simple glitter can have a surprisingly different number of properties like color, size, shape, and how it reflects light. This can be helpful if something like glitter is left behind at the scene of a crime.
Glitter is an example of trace evidence. **Trace evidence** includes a large number of things like hair, fibers, soils, paint chips, glass or plastic fragments. Trace evidence can eliminate possible suspects or point to a group of people as suspects, but cannot conclusively link one suspect to a location.

**PROCEDURE:**

**Visual analysis**

1. Give each pair of campers one sticky note for each of the known samples and the evidence sample. Have them label each first **on the side with the sticky strip**. (Use any labels you like: A, B, C or 1, 2, 3 or by brand names, etc.)

2. Then have them use the sticky strip on the to collect a small sample of each type of glitter from the known samples and from the evidence sample.

3. Using their magnifying glasses, ask the campers to make some observations about each type of glitter. How large are the individual pieces compared to the others? What shapes are they (square, hexagon, triangle, diamond, etc)? How shiny or not shiny are they? Do they look like a slightly different color when you look at one piece compared to a pile of it together?

4. Ask the campers if they can match which of the known samples the evidence sample came from.

**Microscope analysis**

5. After the campers have used the sticky notes to collect a small amount of glitter from the samples, have them punch a hole in the middle of an index card for each sample. Label the index cards in the same manner you used for the sticky notes.

6. Then have them use a small piece of clear tape to pick up just a few pieces of glitter from the post-it note and stick it over the hole in the index card.

7. Have them add one more small piece of clear tape over the hole on the other side of the index card to seal the pieces of glitter in between the pieces of tape. They should now have a “window” in the card with a few pieces of glitter sealed in it for closer investigation.

8. Have students take turns looking at the samples under a pocket microscope.

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WHAT’S THE SCIENCE?

- Glitter starts out as a roll of foil or plastic which is cut into tiny pieces. To minimize waste, it is usually cut into shapes which can completely fill a 2D plane (squares, hexagons, etc., as opposed to circles).

- Different brands of glitter may vary by:
  - **Shape**: Hexagonal is most common, followed by square, and then rectangular. Anomalies in how a particular machine cuts on a particular day can even sometimes distinguish between batches from the same manufacturer (e.g., if one corner is rounded rather than square.)
  - **Size**: Glitter particles can range in size from 0.05 mm to 6.25 mm
  - **Color**: The color may be caused by all the particles being the same color, or by blending particles of different colors together so they “read” as a single color from a distance.
  - **Thickness**: Glitter particles usually have at least three distinct layers (e.g. an aluminum layer sandwiched between two plastic layers), but the thickness of individual layers may vary.

- Glitter has been used as forensic evidence in real-life cases. (See: [http://projects.nfstc.org/trace/docs/final/Blackledge_Glitter.pdf](http://projects.nfstc.org/trace/docs/final/Blackledge_Glitter.pdf))

- Because the glitter from the same batch can be found in multiple places, it can’t be used to definitively identify a suspect or place them at a crime scene, but it can provide supporting evidence.
NIGHT AT THE MUSEUM

ACTIVITY TYPE: Active game
AUDIENCE: Grades K - 9
TIME FRAME: 10 - 30 minutes

SUMMARY:
Campers practice close observation of sight and sound through a movement activity.

SAFETY NOTES:
Remind campers that they must walk to play.

PROCEDURE:

1. Explain the game: One person is a night security guard whose job it is to make sure the museum stays safe all night. All the other individuals are statues/dinosaurs/dioramas/etc. Their job is to try and move around the museum without getting caught.
   - *What kinds of observations could the guard make to notice if something is moving?*

2. Select a night guard and have them turn around so they can’t see the group.

3. The other campers all find a space in the room, freezing into a position that resembles a statue, animal, dinosaur, or other museum exhibit. The night guard then turns around and begins to walk around trying to “catch” the exhibits moving. If someone is caught moving they sit down until the next round.

4. Campers may not touch each other or talk. This game should take place silently.

5. When the guard has their back to someone or part of the group, they should switch positions or try to move around without getting caught. Campers must make some movement every minute or two, or they may be ruled “out”.

6. The last camper who is not caught moving gets to be the night guard in the next round.
**PAPER CLUES**

**ACTIVITY TYPE:** Group discussion  
**AUDIENCE:** 2nd - 4th grade  
**TIME FRAME:** 15 - 30 minutes

**SUMMARY:**  
Campers will explore the kinds of evidence written or printed documents can provide.

**MATERIALS:**  
- Book: *Bad Day at Riverbend* by Chris Van Allsburg  
- An assortment of writing utensils (pencils, pens, crayons, markers)  
- Pieces of scrap paper (approx. half- or quarter-sheet size)

**ENGAGE:**  
Introduce the theme of the day:  
*Yesterday we investigated the different kinds of physical evidence detectives might use to solve a case. Today we’re going to focus our skills on one particular kind of physical evidence... but first we’re going to have to solve the mystery in this book to figure out what the kind of evidence is!*

**PROCEDURE:**  
**Book Reading**  
1. Show the front cover of the book and invite campers to practice their detective skills by making observations and predictions about the book.  
   - What do you notice on the cover of the book?  
   - What do you think the mystery in this book might be?  
2. Pause occasionally as you read to ask the group to notice details and make more predictions. If campers solve the “mystery” early on, encourage them to continue checking whether each new piece of evidence still supports their idea.  
   - What do you think the mysterious substance could be? What makes you think so?  
   - What do you notice about the driver’s back compared to his front? What do you think is the reason for the difference?  
   - How does the flash of light fit with your idea of what is happening?  
3. Discuss the book’s mystery and invite campers to predict what it has to do with the day’s theme:
• What did this book turn out to really be about?
• What kind of evidence do you think we’ll be studying today? Why do you think that?

4. Explain that today’s detective training is all about **documents**—things that are written or printed on paper.
• What kinds of evidence do you think detective could get from a document?

**Document Evidence**

1. Pass out a writing utensil and a piece of paper to each camper, making sure there is a variety of different writing utensils among the group (different colors, types, etc.)

2. Ask campers to listen to the sentence you say and write it on the paper. Choose a simple, 4 - 5 word sentence, such as “The cat is my friend.” (If needed, reassure them that it’s not for a grade and spelling doesn’t matter!)

3. Collect all the papers and spread them out on a table or in the center of your circle where the whole group can see them. Point out that all the papers say the same thing—but are they the same?

4. Explain that besides the actual words in the document, forensic scientists look for details and differences between documents to give them even more information.

5. Invite campers to examine the group’s documents and look for similarities and differences. Encourage them to think about different features of the writing as well as the paper itself.
• What are some differences you notice between the documents?
• How can you tell which ones were written with pen or with marker? How do they look different?
• Look at all the ones written in pencil. What is different between them?
• What details can you notice about the paper besides the writing?

6. Explain that the rest of the day’s activities will help them practice different parts of analyzing documents, from identifying handwriting and types of ink to gathering clues from the paper itself.

**WHAT’S THE SCIENCE?**

Letters, notes, journals, grocery lists, and other written documents can provide key information for solving a case, not only through their contents, but also through the physical documents themselves. Some areas that detectives might investigate to find out how or by whom a document was written include:

• **Language and spelling**—particular word choices or misspellings
• **Handwriting**—letter shapes, how they are connected, pressure against the page
• **Ink type**—for both handwritten and computer-printed inks
• **Paper type**—thickness, color, type of fiber
• **Paper details**—tears, folds, evidence of tape, staples, or paper clip, etc.
DETECTIVE TRAINING: Evidence and Inference

ACTIVITY TYPE: Hands-on activity

AUDIENCE: Grades K - 4

TIME FRAME: 20 - 30 minutes

SUMMARY:
Campers will make observations about unknown objects to explore the difference between facts and inferences drawn from those facts.

MATERIALS:
- Opaque fabric drawstring bags, approx. 3” x 5” or 4” x 6” (1 per camper)
- Plastic eggs (1 per camper)
- Small “mystery” items to put in the bags and eggs, such as:
  - Buttons
  - Plastic/toy coins
  - Seashells
  - Spiral pasta
  - Jumbo paper clips
  - Pompoms
  - Packing peanuts
  - Plastic animals or other figures
- Masking tape

PREPARE AHEAD:
Place one “mystery” item in each bag and each plastic egg. Make sure a variety of different types of object are represented, including some objects with similar shapes or textures, such as buttons and coins, or different four-legged animals. Pull the drawstring bags closed. Close the eggs and seal them more permanently by taping over the seam with a piece of masking tape.
ENGAGE:
What is evidence? What kinds of things are evidence in a science experiment? In a crime?

Have you ever heard the word inference? What do you think it means to infer, or make an inference? Inferences are conclusions, ideas, or opinions that come from the evidence. For example, if I see a person wearing an Eagles jersey, that is a piece of evidence—a fact. I could infer from that evidence that the person likes the Eagles...but do I know that for sure?... Not unless I gather some more evidence!

Gathering evidence and making inferences are both important skills for a detective—but it’s important to be able to tell them apart. Why do you think that is? Let’s practice making some observations and sorting out what is evidence, and what is inference.

PROCEDURE:
1. Hand out a mystery bag to each camper. Encourage campers to explore the item in the bag without opening or looking inside it. Encourage them to describe their mystery item to a partner.
2. Use an example to remind campers how to tell the difference between evidence and inference. For example, by feeling an object, you can determine if it is hard. However, saying what is it made of (metal, for example) is an inference—possibly correct, possibly not. There is no way to be sure that the item is made of metal just by feeling it in the bag.
3. After a few moments, encourage the children to switch bags with their partners and repeat the description process in order to add more data to the investigation.
4. Invite campers to share their observations about their mystery items. Encourage them to begin by stating the evidence they gathered by touching it—shape, texture, weight, etc., and then their inferences about what the item could be.
   - Is that an evidence, or an inference? How can you tell?
   - What evidence supports your inference? What did you touch or notice that makes you think that?
5. Finally, have campers open their bags and confirm the contents. Then have the campers return the items to the bags, and re-tie them.
   - Were your inferences right or wrong?
   - If you were wrong, what evidence misled you? What parts were you correct about?
6. Hand out a mystery egg to each camper.
   - How are the mystery eggs different from the bags?
What kinds of observations can you make about what is inside?

7. Invite children to make and share observations of their eggs. Again, have them identify their comment as evidence or inference.
8. This time, however, explain that you will not be opening the eggs to confirm their opinions.
   - Why do you think I would not let you open them?
   - How is this like a detective working on an actual case?

TAKE IT FURTHER:

- Challenge campers to think of ways to gather more information about what’s inside the mystery eggs without opening them. Encourage them to try their ideas if possible and see what else they can learn.
- Invite campers to mix up or add to the contents of the mystery bags and challenge each other with new “mysteries.” How is it different with more than one item? How is it different with items you’ve seen before vs. new ones?
- Provide additional supplies for campers to make their own mystery bags or eggs to take home.

WHAT’S THE SCIENCE?

Evidence is data or factual information that can be directly observed as part of an experiment or investigation. This might be a physical object or substance, or the result of a measurement or test. Inference is the conclusion drawn as a result of the evidence. An inference isn’t directly observed and therefore may or may not be true. For example, a person’s fingerprint found on a glass at a crime scene is evidence. Saying that the person was involved in the crime is an inference. There is no direct evidence that the person was holding the glass when the crime happened—they might have touched it before or afterwards.

Detectives and scientists rely on both evidence and inference to solve cases and make discoveries. Inferences often lead to looking for more evidence to support or disprove them. In real-life situations, however, there is often no way to get direct evidence of the “right answer,” so detectives and scientists must gather as much evidence as they can, and make their best guess based on that information.
WHO WROTE IT?

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grade 2 and up
TIME FRAME: 15 - 30 minutes

SUMMARY:

Students analyze characteristics of handwriting samples to identify the author of a piece of handwritten evidence.

MATERIALS:

- Copies of “Guest Book” page (1 per 2 people) (below)
- Copies of “evidence” note (1 per 2 people) (below)
- Blank paper (½-sheet per person)
- Pens or pencils
- Whiteboard or chart paper
- (Optional) magnifying glasses

PREPARE AHEAD:

Cut paper into half-sheets.

ENGAGE:

There’s been a mysterious disappearance from a weekend party at an estate. The victim’s car and belongings are untouched, and security cameras show no sign that they left the estate. None of the other guests report seeing or hearing anything unusual between when they all went to bed and when they met for breakfast the next morning. The only clue so far is a handwritten note found in the victim’s room, saying “I can solve your problem. Come to the terrace fountain at midnight.”

How can this help us? How can we figure out who wrote it?

PROCEDURE:

1. Pass out paper and writing utensils. Write the sentence “The quick brown fox jumps over the lazy dog” on the board or chart paper and ask students to each
write it themselves on their own paper. Why do they think we chose that particular sentence to write?

2. Have students compare their sentences with each other, and with the version you wrote. What differences can they find?

3. While students compare their samples, write the 12 basic characteristics of handwriting (see “What’s the Science?”) on the board or chart paper.

4. Ask students to share what differences they found in each other’s handwriting. Refer to the characteristics list and discuss them as a group. Which ones did they notice in each other’s samples?

5. Have students compare each other’s samples again and analyze some of the characteristics they didn’t look at before.

6. Now for the mystery note! Explain that the detectives are trying to keep the investigation quiet for now, so they can’t ask for complete handwriting samples from the other guests. However, they do have the guest book that everyone signed when they arrived.

7. Distribute copies of the “Guest Book” and “note.” Invite students to use as many of the 12 characteristics as they can to compare the note with the names in the guest book.

   - Which characteristics can’t they use with these samples?
   - Which characteristics seem the most helpful for distinguishing these samples?

8. Discuss as a group. Encourage them to support their answers with evidence— which specific characteristics of the handwriting matched or didn’t match?

   - Which guests can they definitely rule out? Why?
   - Which guests had similar handwriting to the note?
   - Who do they think is the most likely author of the note? Why?
   - Is this enough to close the case? Based on this evidence, what steps do they think the detectives should take next?

ADAPTATIONS:

For more advanced groups, consider making a mystery note written by a person not on the guest book list. Can students discover enough differences to suspect that the author is not one of the listed guests? Can they completely rule out all of the listed guests?
WHAT’S THE SCIENCE?

Forensic handwriting analysis can be used to detect forgery or whether or not two samples of handwriting were written by the same individual. This type of evidence can be used to support other evidence, but cannot be the sole piece of evidence that closes a case, as there is no way to prove that no two people have identical handwriting.

There are 12 basic characteristics of handwriting that are used for comparison. They are:

- **Slant**: which way to the letters slant on the page: left, right, or neither?
- **Baseline**: Does the writing stay on a line, or does it go above or below?
- **Line quality**: Do the letters flow smoothly, or is the writing more deliberate, shaky, or sloppy?
- **Spacing of words and letters**: Is there even or uneven spacing, or gaps between letters and words? Are the margins straight or slanted?
- **Unusual letters**: Are there any letters written in an unusual way – with unusual slants? Are some letters printed and others in cursive?
- **Pen pressure**: How hard did the writer press the pen/pencil onto the paper? Are the words bold or light?
- **Fancy writing habits**: Are there unusual curls or loops?
- **Diacritic placement**: How are the I’s dotted and the t’s crossed?
- **Size and proportion of writing**: Do the letters get larger or smaller as they writing continues? How big are various letters in comparison to others (ie CAPS vs lower case)?
- **Lifting**: Did the writer lift the pen during writing, or does the writing seem to be a continuous line all the way through?
- **Connecting strokes**: Are the capital letters connected to the lower case letters?
- **Page use**: Does the text start at the top of the page and fill it? Does the text start somewhere in the middle of the page?

The sentence “The quick brown fox jumps over the lazy dog” is frequently used for handwriting samples because it uses all 26 letters of the alphabet, so it provides an example of each letter for comparison.
PAPER EXAMINATION

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 2 - 6
TIME FRAME: 30 - 40 minutes

SUMMARY:
Campers will practice procedures for the non-destructive examination of paper that may be evidence.

MATERIALS:
- Paper
  - Spiral-bound notebook
  - Glued notepad
  - White cover stock
  - White construction paper
- Hand-held UV lights
- Flashlights
- Mirrors
- Invisible tape
- Paper clips
- Stapler
- White chalk
- cup/glass/bottle
- Disposable gloves
- Observation table (below)

PREPARE AHEAD
Prepare 5 sets of 4 sample evidence papers to be examined. You don't have to follow these instructions exactly, but here are four options of paper samples to make:
- **Option #A:** Use notebook paper torn out of a notebook, fold it up multiple times, then smooth it out. Put a piece of newspaper or a magazine page on top of it.
Write a word, phrase, or message so that a slight indent is left on the notebook paper.

- **Option #B:** Use tablet paper torn off of a glued tablet. Tear off 8-10 pieces and paper clip them together for at least a few hours. Sit a slightly wet glass or bottle down on the paper for a second. Let it dry.

- **Option #C:** Use a piece of white construction paper, draw or write something on it with white chalk. Brush or smear it up to further obscure (depending on your campers level). Then tear it into a smaller pieces through the image, so some is on both pieces.

- **Option #D:** Use a piece of white cardstock. Dog-ear one small corner, crease gently, then unfold it. Using an empty stapler, make a staple mark in that same corner. Stick a piece of invisible tape on it, anywhere, then pull it back off.

**ENGAGE:**

What are some types of evidence that might be left at a crime scene that are made of paper? List all the answers campers can name. What's on the paper is important, but so is the paper itself. What kinds of paper can you think of? What other things are made of paper that aren't writing paper? How can you change a piece of paper? (rip it, cut it, color on it, get it wet, burn it, etc) After you have made that change, can you make it go back the way it was? How could you tell if someone else had tried to repair a piece of paper they changed? Let's try some ways!

**PROCEDURE:**

1. Demonstrate a few of the techniques for careful, but non-destructive, examination of paper.
   a. Wear gloves. Why is that helpful for preserving the evidence? Why might that be safer for the examiner?
b. In overhead light, look at all areas of the paper. Hold it up to the light and look through the paper. Hold it at eye level so you can look across the surface. Do this again on the other side. Have campers record what they observe in the table below.
c. Have campers do all the parts of Step b with a flashlight, a UV light, and in sunlight, if possible.
d. If campers do notice something but can’t make out the image, have them hold it up to a mirror to see if reversing the image helps.
e. Feel all the surfaces, edges, and corners of the paper to see if there is something there you couldn’t see. (With or without gloves depending on the situation.)

2. Have campers work in pairs to fill out the observation table below. They should make notes on any observations they make for each procedure, including if they don’t observe something.

WHAT’S THE SCIENCE?

**Document evidence** is a very common type of evidence found at many crime scenes. Paper evidence can be direct like a ransom note or a counterfeit check or can be indirect like a receipt or a signed legal document. Document analysis contains many types of examinations from characterizing paper, inks, pigments to restoring obliterated writing to handwriting verification.

Paper today is made primarily of **wood pulp** from trees. Wood is comprised mostly of two types of compounds called lignin and cellulose. Both of these chemicals are polymers, which mean that they are made of repeating molecular pieces in either a long chain or set of chains linked to one another. Cellulose fibers (group of molecules) are so long and so thick that they can be seen with the human eye. If you tear a piece of paper, you will see them along the “fuzzy” torn edge.

When paper was first beginning to be made from wood pulp, the wood was simply ground up and mixed with water. The resulting paper was brown, and browned further with age, becoming thin and brittle. Scientists learned later that this was caused by degradation of the lignins, which released acid that further degraded the cellulose. Higher quality bleached paper is now made of mostly long chain cellulose to form stronger white paper and to combat this browning and degradation.
To make pulp from wood today, two methods can be employed. The chemical pulping process separates lignin from cellulose fibers, then washes it away resulting in higher quality paper. The pulp can also be bleached to produce white paper. Or optical brighteners, chemical additives, can be coated onto the paper to make them look even brighter white. Optical brightening agents can take invisible ultraviolet light and cause it to re-emit in the blue spectrum - or fluoresce - at a point that is just barely visible to our eyes. Our eyes will see a bright blue-ish white, but when viewed under UV flashlight it will glow. The 2nd method, is known as mechanical pulping, where wood chips or pieces are either ground up or squeezed into pulp. Mechanical pulping does not remove the lignin, so the resulting paper is lower quality, but it costs less to manufacture than chemical pulping.

Paper engineers (usually a type of chemical engineer) help develop paper products for all kinds of purposes, from writing paper to paper plates to cardboard boxes to toilet paper. Paper engineers may help develop new products, develop better techniques to conserve resources, work with teams to run a paper mill, or even create art like pop-up books.
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<th>Sample B</th>
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<td>Holes/Tears - yes or no, where</td>
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CHROMATOGRAPHY

ACTIVITY TYPE: Hands-on activity
AUDIENCE: Grades 2 - 8
TIME FRAME: 20 - 45 minutes

SUMMARY:
Campers will explore the process of chromatography and determine the pigments present in different markers.

MATERIALS: (per camper)
- Coffee filter or filter paper
- Variety of washable or wet erase markers
- Clear plastic cup
- Pencil or chopstick
- Large binder clip
- Water
- Ruler
- Scissors
- [Optional] Isopropyl alcohol and permanent or dry erase markers

PREPARE AHEAD
Cut coffee filters/filter paper into strips about 1” wide and as tall as your cups.

ENGAGE:
Have you ever mixed paints to make different colors? What colors did you end up with? What colors did you mix to make black or brown or purple? How do you think black and brown paints get made in the factory? Is it similar to how you’ve done it?

Many colored paints and markers are made by mixing other colors together. We can use a technique called chromatography to separate those colors and identify them.

PROCEDURE:
1. Give each camper at least one strip of filter paper. They will need one strip for
each marker they test.

2. Instruct them to draw a pencil line across the width of each paper strip, about 1 inch from the bottom end.

3. Give campers markers to test. For each marker, have them draw a short line, dot, or blob (about 1 cm) on the middle section of the pencil line, not reaching the edges of the strip. Have them use a pencil to write the color of the marker used on the top end of the strip.

4. Encourage campers to make predictions about each of the markers they chose. Will it contain one color or more than one? How many, and what colors?

5. Instruct campers to fasten the top of each strip (the side farthest from the marker line) to a pencil with a binder clip.

6. Pour about ½ inch of water into each cup.

7. Hang one strip in one cup by letting the pencil rest on the top rim. The bottom end of the strip should just touch the water level. If needed, add water to the cup until it is just touching the paper. **Note: It is important that the water level stays below the marker line on the strip.**

8. Encourage campers to watch as the water rises up the strip and record their observations. What happens to the water on the strips? Does the color run up as well? Do you see any color separation?

9. Tell campers to remove each strip from its cup when the water level reaches about 1 cm from the top (this may take up to 10 minutes). **Note: remove the strip from the cup before the color reaches the top.**

10. Discuss and compare groups’ observations. Which colors contained more than one color? What colors made up each one? Which colors ran to the top of the strips (meaning they moved quickly) and which stayed closer to the bottom (moved more slowly)? Did any of the markers not run at all? Why could that be?

11. Have groups hang their strips to dry in empty cups or by taping them to a table edge and check on them when fully dry. Do they notice any changes?
12. As time permits, have campers repeat with different markers.

**TAKE IT FURTHER:**
Test a mixture of washable, permanent, and/or dry-erase markers using isopropyl alcohol as a solvent instead of water. Do you think similar combinations of pigments are used to color different types of markers?

**WHAT'S THE SCIENCE?**

*Chromatography* is a method used by chemists to separate the components of a solution by dividing them between a *stationary phase* (something that stays in one place) and a *mobile phase* (something which moves across the stationary phase). There are several different types of chromatography; some are used to simply identify which substances are present in a mixture, while others are used to physically separate components from the entire mixture.

In *paper chromatography* the components of the solution start out in one place on a strip of special paper (the stationary phase). A solvent, such as water, oil or isopropyl alcohol, is allowed to absorb up the paper strip (the mobile phase). As it does so, it takes part of the mixture with it. The components of the solution will travel different distances up the paper depending on how soluble they are in the liquid solvent, and how large their molecules are. Substances that are very soluble in the liquid will travel the furthest, substances that are less soluble will travel less far, and substances that don’t dissolve in the solvent will not move at all. Changing the solvent changes how fast or far different substances will move. Similarly, smaller molecules are less likely to get trapped in the paper’s fibers, so they travel furthest, while larger molecules spend more time caught on the paper and travel less far up the paper.

Other common types of chromatography include thin-layer chromatography, column chromatography, and gas chromatography. Thin-layer chromatography is similar to paper chromatography, but it uses a thin layer of silica (SiO$_2$) on a glass plate instead of paper. Column chromatography involves passing a mixture through a column packed with a solid (usually silica), and collecting the separated components as they exit the column. Gas chromatography involves using a specialized machine which vaporizes a small sample of the mixture, injects it into a stream of an inert gas such as helium, and passes the gas through a tube lined with a stationary phase (various substances). Components are detected and recorded as they exit the tube.
TRASH LIFE RECONSTRUCTION

**ACTIVITY TYPE:** Hands-on activity

**AUDIENCE:** Grades K - 6

**TIME FRAME:** 15 - 30 minutes

**SUMMARY:**
Students practice making inferences about an unknown person’s life and movements based on observation of their discarded items.

**MATERIALS:**
Bags of 6 - 8 “trash” objects (1 per group of 2 - 4 people) that tell a story. Include random other trash items that do not fit the story (scraps of paper, receipts, wrappers, etc).

**Scenario #1: Party**
- Wrapping paper
- Party hat, plate, or napkin
- Plastic spoons
- Ribbon
- Birthday candles
- Empty juice box or water bottle

**Scenario #2: School**
- Broken pencil or pencil shavings
- Notebook paper
- Chalk and/or Expo marker
- Highlighter
- Scrap of construction paper
- Empty glue stick or bottle
- Novelty eraser
- Something that looks like a test

**Scenario #3: Restaurant**
- Empty food containers
- Condiment packets

**Scenario #4: Sports game**
- Napkins
- Plastic utensils
- Crumbs or loose flour
- A slotted spoon
- A rag

**Scenario #5: Sports game**
- Grass
- Paper hot dog boat
- Ticket stub
- Water or sports drink bottle
- Empty sunscreen tube or bottle
- Hat/visor/sunglasses

**Scenario #5: Preschool classroom**
- Broken crayons
- Bits of clay or play dough
- Broken toy or puzzle piece
- Bits of yarn
- Snack wrapper
- Glitter

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PREPARE AHEAD:

Prepare bags of “trash” with items and clues appropriate to the age of the group:

- Younger groups’ bags may have fewer items and a very simple concept (party hats, wrapping paper, and a birthday card = an 8-year-old had a birthday party).
- Older groups’ bags may include evidence indicating multiple people, as well as items that aren’t helpful or don’t fit.

ENGAGE:

What does your trash say about you? What kinds of things do you throw away? What kinds of things do other members of your family throw away? If someone looked through your trash can right now, what would they find?

Both crime scene investigators and archaeologists use the things that people leave behind to make **inferences** about what those people did and how they lived. What is an inference? How is it different from an **observation**? What are some examples of inferences you could make from a piece of someone’s trash?

PROCEDURE:

1. Divide the class into groups of 2 - 4 students and give one bag of “trash” to each group.
2. Encourage groups to start by making careful **observations of the items** in the bag.
   - *What things are there? How many of each?*
   - *What details can they notice about each one?*
3. Next invite the groups to begin making **inferences about the items**:
   - *Where might the item have come from?*
   - *How could it have been used?*
   - *Could there be more than one answer to these questions?*
4. Ask groups to start **drawing connections between the items to make inferences about the people** who created the trash:
   - *How many people live in this house? How can you tell?*
   - *What kind of job might they have?*
   - *What do they like to eat?*
   - *What do they do in their free time?*
   - *What can you tell about when this trash was created, or specific times when events or activities took place?*
5. **Discussion:** Invite groups to give a profile of the people whose trash they analyzed:
   - *How does the evidence support their inferences?*
   - *Were there any pieces of evidence that were hard to explain or didn’t fit?*
   - *Are there any alternative ways to explain the same evidence? Which one do they think is most likely? Why?*

**TAKE IT FURTHER:**
Ask groups to imagine they are the people who made the “trash” in their bag. Have them make up and act out a story that explains the evidence— it can include things not indicated by the trash, and can be as silly or wacky as they'd like! Have the rest of the class play the role of investigators and discuss:
   - *How much of the story do they think is true? Why?*
   - *What part(s) of the story are supported by the evidence?*
   - *Are there any alternative explanations that fit the evidence?*
   - *What other evidence should they look for to prove or disprove the group’s story?*

**ADAPTATIONS:**
- As noted in the “Prepare Ahead” section, scale the activity by increasing or decreasing the complexity of the items in the bags.
- **For youngest groups:** This could also be done as a large-group/circle time activity instead of individually. You may also want to simplify the definitions of observation and inference: **observation is what we notice about something (using our senses), and inference is what we decide about it.** (E.g., we notice a party hat in the trash; we decide that means the person had a birthday party.) Encourage them to first notice the things in their bags and then decide what they say about the mystery person who made the trash.
- **For older groups:** Challenge students to think carefully about when they are making inferences. (Is that thing actually a party hat? Could it have been used for something else?) **Encourage them to think of alternative explanations—even crazy ones!—and evaluate how the evidence might support one more than another.** (Does an empty candy wrapper mean the person ate the candy? How many other ways could it have gotten there? What other evidence might you need to support each explanation?)
WHAT’S THE SCIENCE?

- An **observation** is something detected directly by using one of the five senses—things like color, shape, texture, temperature, sound, movement, etc.
- An **inference** is an explanation or conclusion about the observation based on previous experience or other information. For example, you might observe that an object is cone-shaped, has brightly colored circles on it, and has a piece of stretchy material attached at the wide end; you infer that it is a party hat, based on your previous experience that things with those particular characteristics are worn on people’s heads at parties.
- It is important to recognize what things are observations and what are inferences, because **inferences can be incorrect**, or there may be more than one possible inference drawn from the same observations. Further observations or evidence might be needed to support a particular conclusion.
- **Inferences are still very important in science** because many things cannot be observed directly. Archaeologists and forensic scientists rely on inference because they are studying things that happened in the past, so they can’t observe them directly. They have to carefully examine clues and things left behind and use them to draw conclusions about what happened.
- **Many artifacts that archaeologists study are, in fact, trash.** People in ancient times threw away the things they didn’t need anymore, just like we do, and those things were protected by being piled up or buried. Sometimes the best archaeological finds come from ancient toilets! People would toss their trash into the latrine, and those remains provide us with lots of clues to what they ate, made, and did.
SECRET MESSENGER

ACTIVITY TYPE: Active game
AUDIENCE: Grades K - 6
TIME FRAME: 10 - 30 minutes

SUMMARY:
Campers practice using their senses of hearing and touch as they pass a message around the group.

PROCEDURE:

1. Ask the group to either stand or sit in a line or a circle.

2. Invite the first camper in line to think of a message and whisper it in the ear of the second person in the line. The second player repeats the message to the third player, and so on. Remind the group to practice listening closely and try to pass on exactly what they heard.

3. When the last player is reached, they announce the message they heard to the entire group.
   - *How does it compare to the original message?*
   - *What parts, if any, got confused or were hard to hear?*

4. Repeat several times, choosing a different camper to think of the message each time. Encourage them to try making the message longer or shorter, or have it be nonsense instead of something familiar. Does that change how well the message gets through?

5. Next, send messages with touch instead of sound. Instead of whispering, have campers trace a simple picture or word with their finger onto the back of the person in front of them. The last person then draws the image they felt onto a piece of paper. Then compare it to the starting image the first person was used.
   - *How were the touch messages different? Were they easier or harder to pass on correctly?*

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PUTTING IT TOGETHER

ACTIVITY TYPE: Group discussion
AUDIENCE: 2nd - 4th grade
TIME FRAME: 15 - 30 minutes

SUMMARY:
Campers will discuss how detectives put together evidence from multiple different sources to draw conclusions about a case.

MATERIALS:
- Book: *Black and White* by David Macaulay
- Pieces of a 24-piece jigsaw puzzle, removed from box

ENGAGE:
Introduce the theme of the day:  
*We've been training our detective skills all week, and later today we'll finally be putting them to the test solving an actual case. Let's think about what it's like to put together lots of different pieces of evidence to find a solution.*

PROCEDURE:

**Puzzle Pieces**
1. Give each camper one piece of the puzzle. Invite them to look at their own piece, make observations about what is on the piece, and predict what the picture on the puzzle is.
2. Who knows exactly what the picture on the puzzle is, just from their piece?
3. What can you tell, or what do you think you know about the picture so far?
4. Invite 2 - 3 campers to put their pieces in the center of the circle so everyone can see them.
   - *What can we tell about the picture from these pieces together?*
   - *Does anyone have a piece that they think is related to one of these pieces?*
5. Invite the campers to add their related pieces to the center.
   - *How do these pieces fit together?*
   - *What do we know about the picture now?*
6. Have the group continue adding pieces a few at a time, pausing to notice how their ideas of the picture change as more pieces are added.

7. When the puzzle is completed, discuss the experience and connect it to the process of solving a case.
   - What was it like when we only had a few pieces of the puzzle?
   - How did your idea of the picture change as we added more pieces?
   - Did you have an idea about your piece or the whole puzzle at first that later turned out to be wrong? What helped you change your mind?
   - How do you think this is like what detectives do when they’re solving a case?

**Note:** If you have more puzzle pieces than campers, consider keeping one or two of the extras aside, so the group can’t completely finish the puzzle. This is a good opportunity to discuss that in real life cases, detectives often don’t have every single piece of information they need, and they have to make a best guess about the solution based on what they have!

**Book Reading**

1. Show the group the cover of the book and introduce the title and the author. Invite the group to make observations and predictions about the cover and the story.
   - What do you think this book might be about? What makes you think that?
   - What do you think this book might have to do with putting pieces together, or solving mysteries?

2. Read the book, pausing occasionally to ask questions and encourage observations and predictions about the story.
   - Why do you think there are four separate parts to each page?
   - What do you think the boy on the train is seeing out the window?
   - Do any of these people or stories have anything in common? How do you think they might be related?
   - What do you think will happen next?

3. Discuss the group’s ideas about the story and the process of figuring it out.
   - What actually happened in this story? What is the order of events?
   - What were the clues that first told you the stories were connected?
   - Did you have any ideas about the stories that turned out to be wrong? What helped you figure it out?
   - How was reading this book like putting the jigsaw puzzle together?
   - How do you think this book is like what detectives do when they’re solving a case?
SENSE EXTENDING TOOLS

ACTIVITY TYPE: Hands-on activity; Circle Time demonstration

AUDIENCE: K - 2

TIME FRAME: 20 - 30 minutes

SUMMARY:

Campers will practice using tools to extend their senses to make observations about things they can’t see or touch.

MATERIALS:

1. Pre-made Mystery Boxes (1 per 2-4 students), OR shoeboxes, each with a recognizable object (bar of soap, army man, apple, rock, sock, etc.) inside, and prepared as follows:
   - One (or more) completely sealed and no hole
   - One (or more) sealed, with a small hole in the top, large enough for a chopstick to fit through (but not a finger)
   - One (or more) sealed, with a 2” hole covered by a magnifying lens (and a small hole (<1”) on one side to allow light in)
2. Chopstick or small dowel (to fit through small hole in box)
3. Paper and writing utensils for drawing/writing observations

PREPARE AHEAD

If necessary, make the boxes according to the material list directions.

ENGAGE:

Start by asking what the students know about their senses. (How many are there? What are they? Which parts of their bodies do they use for each?) Each of those body parts can help with only one (or maybe two) senses, so the brain works together with all of them to help you understand everything around you.

Sometimes scientists and detectives come across things that they can’t directly sense. The object may be too far away or too small or hard to predict the movement of - this is when

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tools come into play! What kinds of tools do detectives and scientists use to extend their senses?

**PROCEDURE:**

1. **Introduce the boxes.** Explain that campers are going to **challenge their brains by observing things without using their senses directly.** Each has a mystery object inside – their job is to see what they can figure out about what’s inside without opening the box.

2. **Put one box on each table** and pass out paper and writing utensils. Encourage campers to share and work together to find out what they can about what’s inside. **Have them make notes or draw pictures about what they observe.** As they work, ask guiding questions like:
   a. What other tools or techniques could you use to find out more?
   b. What tells you that it is a ____? (Is it the sound? The weight? The smell?)

3. **Don’t initially hand out the chopstick for the small-hole box.** Let the group work on the problem first; if they don’t come up with the idea after a few minutes, you might ask questions like:
   a. If it’s too small for your finger and too dark to see into, is there anything else you could try?
   b. Are there any tools you can think of that might help you?

4. **After students have had time to make their observations,** **rotate the boxes to new tables and repeat with the new boxes.** Ideally each group would have a chance to observe all of the boxes, but if time is short, you could stop after 2 or 3. (However, you may want to make the boxes available for the students during free time, so they can try the ones they missed.)

5. **Discussion:** What characteristics were they able to figure out about the object in each box? What senses did they use, and what senses couldn’t they use? (You may want to list their observations for each box on a separate piece of chart paper). Which objects were the hardest to figure out? Which senses make it easiest to figure out what something is? Did they use any other tools (like the chopstick, the table, other things) to get more information? Optionally, have everyone make a final guess about what they think is in each box.

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NOTE: The students will, of course, want to open the boxes and find out what the objects are. If at all possible, **don't do this right away!** Leave the boxes accessible, and challenge them to think of other creative ways to get more information about what’s inside. Reveal what’s inside at the end of the day, or the next morning – or not at all, if they continue to find new ideas for learning about them!

**TAKE IT FURTHER:**

**Pre-K/ K:** This may work better as a **circle time activity** than a small group activity. Depending on time and attention, you might just use the sealed box and the hand-hole box, or those two plus the bag. Talk about each box individually, and pass it around the circle so each student can make observations. You could have a piece of chart paper for each box and **have each student draw a picture on it of what they think is in that box.**

**WHAT'S THE SCIENCE?**

We use our senses every day to get information about the world around us. Sight gives us information about the size, shape, and color of objects, as well as distance and movement. Touch tells us about texture, temperature, and weight. Hearing tells us about sound—but also that sound’s location in relation to us. The senses of smell and taste give us information about an object’s smell and taste (which are actually related to what an object is made of – its chemical makeup).

The brain’s job is to collect all the information from our senses and compare it to things we already know or remember to help us figure out what the object (or place or situation) is. For example, when you hold a wooden block, your brain remembers what it looks like, but also what the sides and edges and corners feel like, and how heavy it is, and what it sounds like when you drop it on the floor – so that the next time you feel those sides and edges and corners or hear that sound, your brain recognizes it as a block, even if you can’t see it.

Humans rely very heavily on their sense of sight, which is why it is so much harder to know what an object is when you can’t see it! However, our brains can change. With practice, they can get better at recognizing things by touch or smell or sound, or interpreting the information that a tool might give us.
MYSTERY RIDDLES

ACTIVITY TYPE: Discussion/ problem solving
AUDIENCE: Grades 2-8
TIME FRAME: 30-40 minutes

SUMMARY:
Campers will practice problem solving and critical thinking to solve mysteries.

MATERIALS:
- Riddle stories (below)

PREPARE AHEAD:
The first set of riddles are for a younger, more general audience. The second set of riddles contain stories of murder or suicide. Choose from whichever list you feel is most appropriate for your campers.

ENGAGE:
What types of problem solving skills do detectives use? What types of questions do they ask in a crime case?

PROCEDURE:
1. Have campers discuss each riddle one at a time either in small groups or one large group.
2. Solutions are given on the last page. At the end of the activity, have campers to discuss the solutions.

TAKE IT FURTHER:
Does anyone have a riddle of their own they would like the group to try and solve? Have campers split up into groups and create their own riddles and share them amongst each other.
WHAT’S THE SCIENCE?

CSI agents and detectives need to use critical thinking skills and work together to solve mysteries. These are also important skills in day to day life, as they are needed for understanding the world around us, and to ensure that we are not misled by false information.

SOURCE:


http://diply.com/murder-mystery-riddles

**Riddle Set #1**

1. **Mystery Weight Loss**
   A man enters a room and presses a button. Within seconds he loses 20lbs. How did he lose the weight?

2. **Stolen Goods**
   A woman enters a big box department store and fills her shopping cart to the top. She leaves the store without paying yet no one tries to stop her or call the police. How did the woman get away with this?

3. **Driving in Circles**
   A man finds himself commuting to work in his car every day. Upon arrival to work each morning, he proceeds to drive his car in a circle 4 times before finally parking it and entering his office building. Why does the man drive in circles every day?

4. **The Chicken Coop**
   A family has a chicken coop containing one dozen egg producing hens. One night, there was a terrible storm that killed all but eight chickens. How many chickens did the family have in the morning?

5. **Angry Father**
   Jacob would not stop playing video games no matter what his father said. Angry at Jacob’s disobedience, the father decided he could fix the problem permanently with a hammer and a little elbow grease. To Jacob’s dismay, he could no longer play video games however his father could. What happened?

6. **The Missing Man**
   Three men enter a room but only two walk out. The room is empty. Where is the third man?
7. **Weird Weather**
   A man is driving on a sunny day when suddenly it starts to rain very hard. About five
   minutes later the rain stops and then the wind starts to pick up. Soon, it gets so windy
   that the car starts to shake. In just as much time as it took for the hurricane force
   winds to start, they stopped and the man was able to make it the rest of the way home
   safely. What's going on?

8. **Ferocious Tiger**
   It was a hot Sunday afternoon and a woman was walking slowly through the savanna
   when she spotted a ferocious tiger in the distance. Instead of turning around or
   seeking refuge, the woman began to walk towards the tiger. Why didn't she run
   away?

**Solutions**

1. **Mystery Weight Loss**
   The room that the man enters is an elevator. When he presses the button, the elevator
   begins to accelerate downward. This acceleration temporarily changes his apparent
   weight effectively helping him lose 20lbs in seconds.

2. **Stolen Goods**
   The woman is an employee of the big box department store. She fills her shopping
   cart with trash and leaves the store to take it to the dumpster.

3. **Driving in Circles**
   This man works in a congested part of town and is required to park up on the fifth
   floor of a nearby parking structure every day.

4. **The Chicken Coop**
   The family still had 12 chickens - 4 dead ones and 8 alive!

5. **Angry Father**
   The father used the hammer to install a shelf high up on the wall. He then placed the
   video game console and the controllers up on the shelf out of Jacob's reach.

6. **The Missing Man**
   The third man is in a wheelchair so he rolls out of the room instead of walking out.

7. **Weird Weather**
   The man actually drove his car into a drive-through style car wash. After about 10
   minutes his car was clean and he drove away.

8. **Ferocious Tiger**
   The woman was at the zoo.
Riddle Set #2

1. Iced Tea
   Two girls ate dinner together. They both ordered iced tea. One girl drank them very fast and had finished five in the time it took the other to drink just one. The girl who drank one died while the other survived. All of the drinks were poisoned. How did the girl who drank the most survive?

2. Dinner Time
   A woman shoots her husband, then holds him under water for five minutes. A little while later, they both go out and enjoy a wonderful dinner together. How can this be?

3. Numbers
   A detective who was mere days away from cracking an international oil smuggling ring has suddenly gone missing. While inspecting his last-known location, officers find a note: 710 57735 34 5508 51 7718. Currently there are 3 suspects: Bill, John, and Todd. Can you break the detective’s code and find the criminal’s name? *(Hint: write the numbers on the board or chart paper for campers to see.)*

4. Rich People
   A man is found murdered on a Sunday morning. His wife calls the police, who question the wife and the staff, and are given the following alibis: the wife says she was sleeping, the butler was cleaning the closet, the gardener was picking vegetables, the maid was getting the mail, and the cook was preparing breakfast. Immediately, the police arrest the murderer. Who did it and how did the police know?

5. Baggy Suit
   A crime has been committed at Freemont Street. The main suspect is a man named Sean Baker. It was said that a man had been walking along the pathway when he was suddenly shot in the stomach. The suspect had brown hair, blue eyes and wore a baggy Armani suit just like Sean Baker's. Sean was asked to tell the story right from the beginning. "Well," said Sean, "I was just hanging around the park when I saw this man walking along the pathway. Suddenly, a guy came up from behind him and shot him! I ran home as fast as I could." The policemen asked him to give a description of the murderer. "He had a red mustache, red hair and a baggy Armani suit on." "I think this man is telling a lie," said one of the policemen. How did he know?
6. Rooms
A murderer is condemned to death. He has to choose between three rooms: the first is full of raging fires; the second, assassins with loaded guns; and the third, lions who haven’t eaten in years. Which room is the safest?

7. Cars, knives, and wives
A man murders his wife with a knife in their car. Nobody is around to see this. He throws her out of the car being careful not to leave any fingerprints on her body. Next he throws the knife off of a cliff into a gorge where it will never be found and he goes home. An hour later the police call him and tell him that his wife has been murdered and he needs to come to the scene of the crime immediately. As soon as he arrives, he is arrested. How did they know he did it?

8. Coin Toss
A dead body is found at the bottom of a multistory building. Seeing the position of the body, it is evident that the person jumped from one of the floors, committing suicide. A homicide detective is called to look after the case. He goes to the first floor and walks in the room facing the direction in which the body was found. He opens the window in that direction and flips a coin towards the floor. Then he goes to the second floor and repeats the process. He keeps on doing this until he reaches the last floor. Then, when he climbs down he tells the team that it is a murder not suicide. How did he come to know that it was a murder?

9. Cottage Life
A wealthy man lives alone in a small cottage. Being partially handicapped, he had everything delivered to his cottage. The mailman was delivering a letter one Thursday when he noticed that the front door was ajar. Through the opening he could see the man’s body lying in a pool of dried blood. When a police officer arrived he surveyed the scene. On the porch were two bottles of warm milk, Monday’s newspaper, a catalog, flyers, and unopened mail. The police officer suspects it was foul play. Who does he suspect and why?

Solutions:
1. The poison was in the ice.
2. She shot her husband with a camera and then developed the photo.
3. Bill is the suspect, if read upside down the numbers read "Bill is boss. He sells oil."
4. There is no mail on Sundays.
5. How can the murderer shoot him in the stomach if he came up behind the man?
6. The room with the lions because they would have now died of starvation.
7. He never asked the cop where the scene of the crime was, so they knew that he had murdered his wife.
8. None of the windows were left open. If the person jumped, who closed the window?
9. The police officer suspects the newspaper delivery person. The absence of Tuesday’s and Wednesday’s newspaper indicates that the delivery person knew there was no one there to read it.
DETECTIVES AND SUSPECTS

ACTIVITY TYPE: Active game
AUDIENCE: Grades K-9
TIME FRAME: 15-30 minutes

SUMMARY:
Campers play an active game to reinforce detective-themed concepts and vocabulary.

MATERIALS:
Open area large enough for the group to stand and move around easily

SAFETY NOTES:
Players have a tendency to run. Ensure the play area is free of tripping hazards.

PREPARE AHEAD:
This activity is a variation on the children’s game “Ships and Sailors” (also called “Captain’s Orders”). If you are not familiar with the game, you may want to look up instructions or videos online to become comfortable with how to lead it.

PROCEDURE:

1. Explain the basic rules of the game: You (the leader) are the Chief Detective and will call out different commands for them to follow. Introduce the commands below and have children practice them until they are comfortable. For younger groups, start with just the first few commands, adding others in later:
   - Detectives: Line up against one wall/side of the space
   - Suspects: Line up against the opposite wall/side of the space
   - Find a Clue: Crouch and examine ground with imaginary magnifying glass
   - Footprint: Balance on one foot
   - Coffee Break: Lie on the ground as if napping. Don’t move until the command “Back to work!”
   - Collect Evidence: Three people; two people face each other and join arms, trapping the third “evidence” person inside
   - Dust for Prints: Turn around in a circle, making dusting motions with one hand

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- **Lab Test**: Two people; one person kneels on hands and knees to make a “lab bench”; second person kneels beside them and strikes a “science-y” pose of their choice—pouring into a test tube, looking into a microscope, etc.
- **Question the Witness**: Two people face each other; one poses as if writing in a notebook, the other poses with hands out in an “I-don’t-know” shrug
- **Solve the Case**: Point to the nearest person and say dramatically “Aha! It’s you!”

2. Anyone who makes a mistake gets “sent off the case.” Their job is to sit out and be on the lookout for others’ mistakes.
3. Start by giving commands slowly and gradually speed up to make it more challenging to follow.
4. After a few rounds, invite children to take turns being Chief Detective.
5. Challenge the group to come up with new commands of their own:
   - *What other objects or actions are part of detective work?*
   - *How could you show them with your body, or with two or three people?*

**ADAPTATIONS:**
- Depending on the age and size of your group, you could play the game until everyone is eliminated but one; that person is declared the winner and becomes Chief Detective for the next round.
- If youngest campers have difficulty being “out,” consider having them sit out for just one or two commands before coming back in; or leave it out altogether—just point out mistakes but allow them to continue playing.
MAFIA

ACTIVITY TYPE: Active game
AUDIENCE: Grades 3 - 12
TIME FRAME: 25 - 45 minutes

SUMMARY:
Campers receive roles based on cards and then try to determine which player is the “mafia” before the “townspeople” are all killed.

MATERIALS:
- Deck of playing cards

PREPARE AHEAD:
Pull out just enough cards for all the campers in your group. Use one suit for mafia members and a different suit for townspeople. There should be 1 mafia member for every 3 - 4 townspeople. Here are the roles that will be assigned:

- Narrator - can be an instructor or a trusted camper
- Townspeople - number cards of the chosen suit
- Mafia - any cards of the other suit
- Detective - King of the townspeople suit
- Doctor - Queen of the townspeople suit

PROCEDURE:

1. One person is the game's Narrator - they moderate the game, rather than participating. Everyone else is dealt a card that gives them their secret role as a player.
2. Players are secretly assigned roles: either mafia, who know each other; or townspeople, who know only the number of mafia amongst them.
3. In the game's night phase the mafia covertly 'murder' a townsperson. During the day phase, all of the surviving players debate the identities of the mafia and vote to eliminate a suspect.
4. Play continues until all of the mafia have been eliminated, or until the mafia
outnumber the townspeople.

Night Phase
The Narrator tells everyone to close their eyes. It is now nighttime and all the villagers are asleep. Each night, the Narrator tells the Mafia to open their eyes and quietly acknowledge their fellow members. They kill off one of the other players by silently gesturing to indicate their target and to show unanimity. Then the Narrator instructs the mafia members to sleep (close their eyes again). Now the Narrator instructs the Detective to open their eyes and point at a suspect; if that player is mafia, the Narrator nods. Then the Narrator instructs the Detective to sleep and the Doctor to open their eyes; they points at someone to save, then go back to sleep.

Day Phase
The Narrator tells everyone to wake up. Unless the Doctor and the mafia selected the same target a murder is announced, sometimes with a little creative narrative detail. This player is dead and may no longer participate in the game in any way (they may sit silently and watch, but not participate). During the daytime phase, the players deliberate over which suspected Mafia member they wish to nominate for jail. Once nominations are made, the Narrator administers an election between the nominees, in which all alive players vote - whoever receives the most votes is jailed; they may no longer participate in the game in any way. Because players have less information and more freedom to deliberate during the day, the day phase tends to be longer than the night phase. The day phase either has a set time limit or continues until a prison sentence has been carried out.

Win condition
Continue Night and Day phases until all Mafia members are killed, then the Townspeople win the game. Or if the townspeople are outnumbered by the Mafia during the day, then the Mafia win.

ADAPTATIONS:

This game can alternatively be called Werewolf, where the werewolves attack villagers and then are killed.

If no playing cards are available, you may assign roles by silently tapping students on the shoulder as you call out each role, instead of giving out cards.
CSI LOGBOOK
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>![Balloon]</td>
<td>![Basketball]</td>
<td>![Football]</td>
</tr>
<tr>
<td>![Foot]</td>
<td>![Hand]</td>
<td>![Banana]</td>
</tr>
<tr>
<td>![Strawberry]</td>
<td>![Cake]</td>
<td>![Duck]</td>
</tr>
<tr>
<td>![Ship]</td>
<td>![Brush]</td>
<td>![Pencil]</td>
</tr>
<tr>
<td>![Flower]</td>
<td>![Train]</td>
<td>![Button]</td>
</tr>
<tr>
<td>Red balloon</td>
<td>Basketball</td>
<td>Football</td>
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<td>-------------</td>
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</tr>
<tr>
<td>Foot</td>
<td>Hand</td>
<td>Banana</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Birthday cake</td>
<td>Rubber duck</td>
</tr>
<tr>
<td>Toy boat</td>
<td>Paint brush</td>
<td>Pencil</td>
</tr>
<tr>
<td>Daisy</td>
<td>Model train</td>
<td>Shirt button</td>
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### Three Types of Fingerprint Patterns

<table>
<thead>
<tr>
<th>Arches</th>
<th>Plain Arch</th>
<th>Tented Arch</th>
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</thead>
<tbody>
<tr>
<td>Arches are least common with ridges that enter from one side and exit the other side of the finger</td>
<td><img src="image1.png" alt="Plain Arch" /></td>
<td><img src="image2.png" alt="Tented Arch" /></td>
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</table>

<table>
<thead>
<tr>
<th>Loops</th>
<th>Plain Loop</th>
<th>Double Loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loops are most common and can enter from either side of the finger</td>
<td><img src="image3.png" alt="Plain Loop" /></td>
<td><img src="image4.png" alt="Double Loop" /></td>
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<table>
<thead>
<tr>
<th>Whorls</th>
<th>Plain Whorl</th>
<th>Pocket Loop Whorl</th>
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<tbody>
<tr>
<td>Whorls are the second most common with circles inside each other</td>
<td><img src="image5.png" alt="Plain Whorl" /></td>
<td><img src="image6.png" alt="Pocket Loop Whorl" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Whorls</th>
<th>Accidental Whorl</th>
<th>Accidental Whorl</th>
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</thead>
<tbody>
<tr>
<td>Any pattern that doesn’t fit into the above categories is called an accidental whorl</td>
<td><img src="image7.png" alt="Accidental Whorl" /></td>
<td><img src="image8.png" alt="Accidental Whorl" /></td>
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<tr>
<td>Properties</td>
<td>Sample A</td>
<td>Sample B</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texture - soft, stiff, smooth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glossy - high, low, none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UV - glows or not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watermarks - yes or no, what is it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edges - once attached, rough, smooth</td>
<td></td>
<td></td>
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<tr>
<td>Corners - shape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigment - yes or no, color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape marks - yes or no, where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staples or staple marks - yes or no, where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indents - yes or no, where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creases - yes or no, where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid marks - yes or no, where, what</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holes/Tears - yes or no, where</td>
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### Paper Observation Table

<table>
<thead>
<tr>
<th>Properties</th>
<th>Sample C</th>
<th>Sample D</th>
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<tr>
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<td></td>
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</tr>
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</table>
Riddle Set #1

1. Mystery Weight Loss
   A man enters a room and presses a button. Within seconds he loses 20lbs. How did he lose the weight?

2. Stolen Goods
   A woman enters a big box department store and fills her shopping cart to the top. She leaves the store without paying yet no one tries to stop her or call the police. How did the woman get away with this?

3. Driving in Circles
   A man finds himself commuting to work in his car every day. Upon arrival to work each morning, he proceeds to drive his car in a circle 4 times before finally parking it and entering his office building. Why does the man drive in circles every day?

4. The Chicken Coop
   A family has a chicken coop containing one dozen egg producing hens. One night, there was a terrible storm that killed all but eight chickens. How many chickens did the family have in the morning?

5. Angry Father
   Jacob would not stop playing video games no matter what his father said. Angry at Jacob's disobedience, the father decided he could fix the problem permanently with a hammer and a little elbow grease. To Jacob's dismay, he could no longer play video games however his father could. What happened?

6. The Missing Man
   Three men enter a room but only two walk out. The room is empty. Where is the third man?

7. Weird Weather
   A man is driving on a sunny day when suddenly it starts to rain very hard. About five minutes later the rain stops and then the wind starts to pick up. Soon, it gets so windy that the car starts to shake. In just as much time as it took for the hurricane force winds to start, they stopped and the man was able to make it the rest of the way home safely. What's going on?

8. Ferocious Tiger
   It was a hot Sunday afternoon and a woman was walking slowly through the savanna when she spotted a ferocious tiger in the distance. Instead of turning around or seeking refuge, the woman began to walk towards the tiger. Why didn’t she run away?
**Riddle Set #2**

1. **Iced Tea**
   Two girls ate dinner together. They both ordered iced tea. One girl drank them very fast and had finished five in the time it took the other to drink just one. The girl who drank one died while the other survived. All of the drinks were poisoned. How did the girl who drank the most survive?

2. **Dinner Time**
   A woman shoots her husband, then holds him under water for five minutes. A little while later, they both go out and enjoy a wonderful dinner together. How can this be?

3. **Numbers**
   A detective who was mere days away from cracking an international oil smuggling ring has suddenly gone missing. While inspecting his last-known location, officers find a note: 710 57735 34 5508 51 7718. Currently there are 3 suspects: Bill, John, and Todd. Can you break the detective's code and find the criminal's name? *(Hint: write the numbers on the board or chart paper for campers to see.)*

4. **Rich People**
   A man is found murdered on a Sunday morning. His wife calls the police, who question the wife and the staff, and are given the following alibis: the wife says she was sleeping, the butler was cleaning the closet, the gardener was picking vegetables, the maid was getting the mail, and the cook was preparing breakfast. Immediately, the police arrest the murderer. Who did it and how did the police know?

5. **Baggy Suit**
   A crime has been committed at Freemont Street. The main suspect is a man named Sean Baker. It was said that a man had been walking along the pathway when he was suddenly shot in the stomach. The suspect had brown hair, blue eyes and wore a baggy Armani suit just like Sean Baker's. Sean was asked to tell the story right from the beginning. "Well," said Sean, "I was just hanging around the park when I saw this man walking along the pathway. Suddenly, a guy came up from behind him and shot him! I ran home as fast as I could." The policemen asked him to give a description of the murderer. "He had a red mustache, red hair and a baggy Armani suit on." "I think this man is telling a lie," said one of the policemen. How did he know?
6. Rooms
   A murderer is condemned to death. He has to choose between three rooms: the first is full of raging fires; the second, assassins with loaded guns; and the third, lions who haven’t eaten in years. Which room is the safest?

7. Cars, knives, and wives
   A man murders his wife with a knife in their car. Nobody is around to see this. He throws her out of the car being careful not to leave any fingerprints on her body. Next he throws the knife off of a cliff into a gorge where it will never be found and he goes home. An hour later the police call him and tell him that his wife has been murdered and he needs to come to the scene of the crime immediately. As soon as he arrives, he is arrested. How did they know he did it?

8. Coin Toss
   A dead body is found at the bottom of a multistory building. Seeing the position of the body, it is evident that the person jumped from one of the floors, committing suicide. A homicide detective is called to look after the case. He goes to the first floor and walks in the room facing the direction in which the body was found. He opens the window in that direction and flips a coin towards the floor. Then he goes to the second floor and repeats the process. He keeps on doing this until he reaches the last floor. Then, when he climbs down he tells the team that it is a murder not suicide. How did he come to know that it was a murder?

9. Cottage Life
   A wealthy man lives alone in a small cottage. Being partially handicapped, he had everything delivered to his cottage. The mailman was delivering a letter one Thursday when he noticed that the front door was ajar. Through the opening he could see the man's body lying in a pool of dried blood. When a police officer arrived he surveyed the scene. On the porch were two bottles of warm milk, Monday's newspaper, a catalog, flyers, and unopened mail. The police officer suspects it was foul play. Who does he suspect and why?
Solution Set #1

1. Mystery Weight Loss
   The room that the man enters is an elevator. When he presses the button, the elevator begins to accelerate downward. This acceleration temporarily changes his apparent weight effectively helping him lose 20lbs in seconds.

2. Stolen Goods
   The woman is an employee of the big box department store. She fills her shopping cart with trash and leaves the store to take it to the dumpster.

3. Driving in Circles
   This man works in a congested part of town and is required to park up on the fifth floor of a nearby parking structure every day.

4. The Chicken Coop
   The family still had 12 chickens - 4 dead ones and 8 alive!

5. Angry Father
   The father used the hammer to install a shelf high up on the wall. He then placed the video game console and the controllers up on the shelf out of Jacob's reach.

6. The Missing Man
   The third man is in a wheelchair so he rolls out of the room instead of walking out.

7. Weird Weather
   The man actually drove his car into a drive-through style car wash. After about 10 minutes his car was clean and he drove away.

8. Ferocious Tiger
   The woman was at the zoo.

Solution Set #2:

1. The poison was in the ice.

2. She shot her husband with a camera and then developed the photo.

3. Bill is the suspect, if read upside down the numbers read "Bill is boss. He sells oil."

4. There is no mail on Sundays.

5. How can the murderer shoot him in the stomach if he came up behind the man?

6. The room with the lions because they would have now died of starvation.

7. He never asked the cop where the scene of the crime was, so they knew that he had murdered his wife.

8. None of the windows were left open. If the person jumped, who closed the window?

9. The police officer suspects the newspaper delivery person. The absence of Tuesday's and Wednesday's newspaper indicates that the delivery person knew there was no one there to read it.