

Virtual 4-H – Crime & Spy Science

adapted from Utah State 4-H Discover Club

Note: This virtual education program was developed to follow current health and safety guidelines. It has been adapted from existing 4-H curriculum and incorporates the Positive Youth Development theory and best practices for virtual learning. All virtual meetings are subject to the same Hawai'i 4-H Policies (go.hawaii.edu/ASz) as all other 4-H program activities and meetings. Youth without access to technology may require accommodations.

Scheduling Components can be done all in one day (similar to a traditional meeting) or spread out over a period of a time with two online meetings with offline project time between. It is recommended not to have online meetings too close together so a schedule of 1 day online, 2-3 days off format works best.

Supporting the Project

- Have youth participate in virtual county and statewide **Public Speaking / Demonstration** events to supplement project work
- Youth can contact law enforcement experts to present/record additional content or provide supplemental materials if the club wants to learn more
- Use pre-made materials and videos to supplement
 - Change blindness (<http://stem-works.com/subjects/3-forensics/activities/9>)
 - Handwriting analysis (<http://stem-works.com/subjects/3-forensics/activities/175>)
 - Wingspan (<http://stem-works.com/subjects/3-forensics/activities/625>)
 - Bill Nye Forensics (<https://www.youtube.com/watch?v=TzygW8eGoRs>)
 - DNA Fingerprinting to Catch Criminals (<https://www.youtube.com/watch?v=AkBUriMK9u8>)
 - Powder Analysis (<http://stem-works.com/subjects/3-forensics/activities/173>)
 - Finger the Perp Game (<http://stem-works.com/external/activity/67>)
 - Forensic Science Experiments (<http://stem-works.com/external/activity/42>)
- Ensure all content is available in both digital and print format if necessary
- Add additional adult leaders to the club (help with virtual meeting.... monitor chat, manage slides, manage Zoom (breakout rooms, participants checking in, etc.)
- Give families supply lists (supplies if possible) and ask members to have supplies ready each meeting

Before the First Meeting

- Review 4-H Best Practices for Program Delivery Under COVID (Link TBA)
 - View tips on delivering a hybrid program (Link TBA)
 - Review online safety guidelines (Link TBA)
- Survey families and 4-H members to determine best technology to use for the project
 - Copy the 4-H Google form and edit to include your questions
<https://docs.google.com/forms/d/1LtbrH0zGIGfaNOAulfkRcnc9TXrnRoJZSJvLmaO60Y0/copy?usp=sharing>
 - Create your own survey <https://zapier.com/learn/google-sheets/how-to-use-google-forms/>
 - Share surveys online, via email, and through phone/paper if needed
- Meet with additional leaders/volunteers (need to be screened to monitor youth in breakout rooms)
 - Discuss delivery process and practice with technology
 - Create an agenda with times to paste links in chat, show video, etc. and share with co-leaders



Project Supplies

Unit 1	Unit 2	Unit 3
<p style="text-align: center;">Spy Kits</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens <p>Spy Kits</p> <ul style="list-style-type: none"> • Pencil box (big enough for items) • Small flashlight • Magnifying glass • Pencil • Dark sunglasses • Note pad • Small Ziploc bag • Sharpie • Small paintbrush • Decorating supplies <p>Opening Letters</p> <ul style="list-style-type: none"> • Envelopes • Stove • Tea kettle • Tongs • Water • Oven mitt 	<p style="text-align: center;">Hidden Messages</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens <p>Invisible Ink</p> <ul style="list-style-type: none"> • Paper • Orange juice • Grape juice • Lemon juice • Cotton swabs • Hair dryer <p>Milky Messages</p> <ul style="list-style-type: none"> • 1/4 c whole milk • White paper • Bowls • Pencils (non-mechanical) • Cotton swabs • Sandpaper 	<p style="text-align: center;">Fingerprinting</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens <p>Fingerprinting</p> <ul style="list-style-type: none"> • White paper • Clear tape • Pencils (non-mechanical) <p>Dusting</p> <ul style="list-style-type: none"> • Cocoa power • Glass object • Small paintbrushes • Clear tape • Black paper
Unit 4	Unit 5	Unit 6
<p style="text-align: center;">Mystery Powder</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens • Grape juice • Vinegar • Iodine • 12 small cups • 3 pipettes/eye droppers • Baking soda • Baking powder • Flour • Measuring spoons • Paper towels • Sticky notes 	<p style="text-align: center;">DNA Extraction</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens • Clear shampoo Clear film canister • Table salt (non-iodized) • Meat tenderizer (not seasoned) • 2 plastic cups • Fresh/frozen fruit • Water • 91% Isopropyl rubbing alcohol (Absolute Ethanol-best) • Blender • Toothpick • Ice • Coffee filter (#4 size, cone-shaped) • Measuring spoon 	<p style="text-align: center;">A House Divided</p> <ul style="list-style-type: none"> • Activity Instructions • Paper & Pens • Shredded documents • Clear tape • Plastic bags

Club Meeting 1 - Spy Kits/Opening Letters

Online Component

Introduction

Change 3 things Icebreaker

- Demonstrate how youth can turn their video camera on and off in the online platform
- Tell them you are going to send them into breakout rooms with one other person for 5 minutes (groups could be four that work in pairs if there is a large group or not enough volunteers to monitor rooms)



Explain the process:

1. Tell them they will study the appearance of their partner for the first minute.
2. One person (or two if partners) will go first and turn off their video function for one minute and change three things about their appearance or background.
3. When they turn their video back on, their partner (or other two members of the group) has one minute to try and guess what three things they changed.
4. Then the partners (or members) will switch roles.
5. After both (all) have gone one time and if there is still time left before you bring them back to the large group, have them go again and change three more things.
6. When time is up bring them back to the main room.
7. If you are using a tool without breakout rooms you can choose volunteers to turn off their video and make changes and have the whole group guess.

Business Meeting

- Call to order
- Pledges
- Roll Call
- Reading of the minutes
- Treasurer's Report
- Other Reports
- Unfinished Business
- New Business
- Announcements
- Adjournment

Project Program

Goals (meeting 1)

- Ask youth to choose one or two learning goals and discuss how to work together to meet the goals
- Discuss short, medium, and long term goals for the project with/without COVID restrictions

Guidelines

Tell youth that the activities for this project will be used to investigate crime scenes and learn the skills necessary to become top detectives and solve mysteries. The activities for today are to make spy kits and learn how to open and reseal letters without a trace!

Tell youth they will complete the activities offline and then return to the online meeting in 45 minutes to discuss how the activities went and what they learned. Before they leave the meeting you will share some information they need to know.

Ask everyone to take their piece of paper and pen and write down what they think will happen during the envelope experiment. This will be the spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities.

Explain activities and remind youth they have copies of the activities.

ACTIVITY 1: SPY KIT DIRECTIONS

Time: 10 minutes

1. Each person should get a pencil box for a spy kit container and use a permanent marker to put his or her name on it. Each person should receive a magnifying glass, dark sunglasses, a few small Ziploc bags, a small paintbrush, small flashlight, pencil, and a note pad to put in the spy kit.
2. Have youth decorate the box using any supplies they wish.



3. These kits will be used throughout the club to help youth solve crimes.

ACTIVITY 2: OPENING LETTERS DIRECTIONS

Time: 20 minutes

1. Put the tea kettle (or pot of water) on the stove, heat until water boils, and then reduce heat to medium.
2. Write a message on a sheet of paper, put it in an envelope, and then seal it.
3. Wearing an oven mitt, use the tongs to hold the envelope. Carefully place the sealed flap of the envelope in front of the steam coming from the spout of the kettle. Hold it there for 30 seconds.
4. After 30 seconds remove the envelope and try to open the flap. If you cannot open it, return the envelope to the steam for another 30 seconds.
5. Continue the process until you are able to open the envelope.
6. After you read the letter you can put it back in the envelope, reseal it, and send it on its way!

At the end of the experiment, everyone should write down their observations and the results of the experiment and then discuss them as a group.

Resources

- Steam Your Envelope (moisture-based seals)
<https://www.youtube.com/watch?v=I96WId4NMSU>
- Freeze Your Envelope (works for self-adhesive kind)
<https://www.youtube.com/watch?v=I6qPdWPHKNA>
- Pencil Case Decorations
<https://www.pinterest.com/search/pins/?q=decorate%20pencil%20case>

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their spy kit to share when the group returns
- Tell youth to take notes during the process to share with the group later
- Ask youth to write down the time it took to open the envelope
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 45 minutes for a follow up discussion

Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- Play the Forensics Myths Kahoot! game. Players can click on the link in a separate window to play https://kahoot.it/challenge/07102321?challenge-id=3490ad49-5c5b-4534-ae0d-27d69338fe53_1600569525360
- Have youth share their kits and/or photos of kits and explain their decorations.



- Hold up each item and have youth hold up the same item and explain the items in the kits
 - All spies and detectives need to have a few necessities in a kit that is always with them while investigating. In this spy kit the magnifying glass is used to search for clues and fingerprints. The dark sunglasses are specifically designed for undercover purposes. The small Ziploc bags are evidence bags used for collecting any small bits of evidence to examine. The paintbrush is used to dust for fingerprints, while the flashlight is used for finding the way around in the dark on a secret mission or on a crime scene. Lastly, the pencil and note pad are necessary for making special notes to leave for others or to write down notes for you to remember.

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- What do you think real spies have in their kits?
- What are the most important things to have in your kit? How can spies and investigators use this method of opening letters?
- Were you able to open the envelope without any signs of struggle? How do you think this works?
- How can you seal your envelopes to avoid anybody from opening them?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?

Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)

- All spies and detectives need to have a few necessities in a kit that is always with them while investigating. In this spy kit the magnifying glass is used to search for clues and fingerprints. The dark sunglasses are specifically designed for undercover purposes. The small Ziploc bags are evidence bags used for collecting any small bits of evidence to examine. The paintbrush is used to dust for fingerprints, while the flashlight is used for finding the way around in the dark on a secret mission or on a crime scene. Lastly, the pencil and note pad are necessary for making special notes to leave for others or to write down notes for you to remember.
- The glue on the flap of the envelope is made of a chemical that is water soluble, meaning it dissolves, or it becomes liquid in water. When you lick the envelope flap, the glue dissolves, forming a sticky liquid. After sealing the envelope, the water evaporates (changing from a liquid to gas), causing the liquid to change from a sticky liquid back into a gas. The glue hardens, sealing the flap of the envelope, and the letter remains closed. When you boil water, it changes rapidly from a liquid to a gas. Water's gas form is called water vapor and it is invisible. However, the water vapor condenses (changing from a gas to a liquid) as it cools, changing into tiny droplets of water called steam.



- When the envelope is put in the steam, the steam causes the glue to dissolve again and become sticky. After reading the letter, put it back in the envelope, reseal it, and send it on its way. There are no signs that the letter has been opened. Transparent tape is the best known protection against opening letters. The glue on transparent tape is not water soluble. So far, no way has been found to remove the tape from an envelope and replace it without leaving telltale marks.

Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
- Provide a brief overview of the next step of the project
 - Briefly explain the concept for the next part of the project
- Confirm the next scheduled meeting
- Communicate supply lists and other information needed before the next meeting
- Have a virtual refreshment time (optional)

Club Meeting 2 – Hidden Messages

Online Component

Introduction

Within Reach Icebreaker

- The host introduces the activity by stating that they will be picking a category and everyone in the meeting has 30 seconds to find an object that fits into that category without leaving their seat and share it on video.
- After sharing is complete, the host picks someone else to choose a category. After that share, that person chooses someone to select a new category.
- This continues for as many rounds as needed. Winners can be the one with the most objects shown and the one with least objects to share.

Possible categories include:

- Something (color)
- Something shiny
- Something fuzzy
- A specific object (pen, phone, etc.)

Business Meeting

- | | |
|--------------------------|-----------------------|
| • Call to order | • Other Reports |
| • Pledges | • Unfinished Business |
| • Roll Call | • New Business |
| • Reading of the minutes | • Announcements |
| • Treasurer’s Report | • Adjournment |

Project Program

Guidelines

Tell youth that the activities today will be to discover the secrets behind writing invisible messages!



Ask everyone to take their piece of paper and pen and write down what they think will happen during the invisible ink experiments. This will be part of their spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities.

Explain activities and remind youth they have copies of the activities.

ACTIVITY 1: INVISIBLE INK MESSAGES DIRECTIONS

Time: 15 minutes

1. Write a message on a piece of paper with lemon juice using a cotton swab.
2. Allow the lemon juice to dry so there is no visible message on the paper.
3. Use a hair dryer on the paper and watch the message slowly appear.
4. Now you can write secret messages to your friends using invisible ink!

ACTIVITY 2: MILKY MESSAGES DIRECTIONS

Time: 20 minutes

1. Put the milk into a bowl.
2. Dip the cotton swab into the milk and write a message on the paper.
3. Allow the message to dry completely. Do not blot the message. You should not be able to see the message after it has dried.
4. When the message has dried, hold the pencil over the paper. Use the sandpaper to scrape the lead so that black powder covers the message.
5. Gently rub the powder over the message area on the paper.

At the end of the experiment, everyone should write down their observations and the results of the experiment and then discuss them as a group.

Ask for other ways someone could write an invisible message and try some of the activities below.

Resources

- How to Make an Invisible Ink Message (lemon juice, baking soda, milk, white crayon, no ink)
<https://www.wikihow.com/Make-an-Invisible-Ink-Message>
- Make an Invisible Ink Pen (challenging)
<https://www.youtube.com/watch?v=cTaNun-9Xkw>
- Turn Your Phone Into a Blacklight
<https://www.youtube.com/watch?v=0jrWqoHTS6c>

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their messages and/or pen to share when the group returns
- Tell youth to take notes during the process to share with the group later
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 30-45 minutes for a follow up discussion (longer time if creating an invisible ink pen as well)



Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- Play the Invisible Ink game. Share screen and have youth guess the drawn object. Host types the answers offered by youth.
<https://www.pirongames.com/invisible-ink/play/>
- Have youth share their hidden messages and/or photos of pens and messages.

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- What happened when you heated the paper with the hair dryer? How did this experiment work with each of the different juices? Which juice worked the best?
- Why do you think the ink shows up when you heat the paper?
- What happened when you spread the black powder over the paper? What other liquids do you think would work?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?

Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)

- Lemon juice is very light colored and is difficult to see after it has dried. However, when you use the hair dryer, the heat turns the lemon juice brown and the hidden message appears. Fruit juices, including lemon juice, and other liquids such as milk and soda, contain carbon atoms, which in lemon juice are bonded to other atoms to form carbon-containing molecules. These carbon-containing molecules have almost no color when dissolved in liquid. However, when these liquids are heated, a chemical reaction



occurs. The carbon-containing molecules break apart and produce the element carbon. An element is a substance that cannot be broken down further chemically.

- Milk contains many chemicals mixed with water. One of these chemicals is fat, a food nutrient. The milk used in this activity is homogenized, which means that the fat has been made very fine and spread evenly throughout the milk. The fat is nearly invisible when it dries on white paper. However, when you scrape the pencil lead, the fat becomes visible. Pencil lead is made of graphite, which is a form of the element carbon. The graphite scrapings stick to the fat in the dried milk, but not to the rest of the paper, thus allowing the hidden message to appear. Because there is less fat in 1% and 2% milk than in whole milk, the experiment does not work as well for those kinds of milk.

Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
 - Chemical reactions that are used in the process of identifying and examining evidence
- Provide a brief overview of the next step of the project
 - Briefly explain the concept for the next part of the project
- Confirm the next scheduled meeting
- Communicate supply lists and other information needed before the next meeting
- Have a virtual refreshment time (optional)

Club Meeting 3 - Fingerprinting

Online Component

Introduction

Alphabet Four Square Icebreaker

- Use the whiteboard, be sure to share instructions to annotate the whiteboard
- Draw a square almost the size of the board and divide it into 4 parts
- Write in the top corner of each square, one word per square (name, place, animal, thing)

Explain the process:

1. Tell them you will name a letter and then everyone will have to write, or draw something in one of the squares that fits that category.
2. If there is enough time they can do more than one square.
3. Pick another letter and continue until needed.

Business Meeting

- Call to order
- Pledges
- Roll Call
- Reading of the minutes
- Treasurer's Report
- Other Reports
- Unfinished Business
- New Business
- Announcements
- Adjournment

Project Program

Guidelines



Tell youth that the activities for today will be to will **examine our fingerprints as well as dust the crime scene for fingerprints in order to identify the culprit!**

Ask everyone to take their piece of paper and pen and write down what they think will happen during the fingerprinting experiment. This will be part of the spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities.

Explain activities and remind youth they have copies of the activities.

ACTIVITY 1: FINGERPRINTING DIRECTIONS

Time: 15 minutes

- Give each person a piece of white paper and a pencil. Rub the pencil on the paper in the same spot until it is dark with lead.
- Rub a finger over the spot until the end of the finger is covered with lead.
- Then press the finger with lead down on the sticky side of a piece of tape.
- Turn the tape over and stick it onto a black spot on the white paper.
- The fingerprint should now appear on the white paper.
- Find out what kind of fingerprint the youth have by comparing it to the example pictures.

ACTIVITY 2: DUSTING FOR FINGERPRINTS DIRECTIONS

Time: 15 minutes

- Give each person a glass container or any glass object.
- Wipe your finger alongside your nose so that it is oily and then make a fingerprint on the glass.
- Sprinkle cocoa powder onto the fingerprint. Lightly dust off the excess powder using a paintbrush.
- Place a piece of tape on the fingerprint, then lift it back off and stick the tape to a piece of black paper.
- The fingerprint should then be visible.

At the end of the experiments, everyone should write down their observations and the results of the experiment and then discuss them as a group. Expand the learning by incorporating the Balloon Fingerprints activity before starting the other activities.

Resources

- Crime 360 Fingerprinting
<https://www.youtube.com/watch?v=FkcSkADVMIM>
- Fingerprint Basics
<https://sciencespot.net/Media/FrnsScience/fingerprintbasicscard.pdf>
- Balloon Fingerprints (bottom of page)
<http://kidsahead.com/subjects/10-crime-scene-investigation/activities/355>
- Fingerprint Patterns
<https://www.pinterest.com/pin/190206784235038009/>

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their fingerprinting process to share when the group returns



- Tell youth to take notes during the process to share with the group later
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 45 minutes for a follow up discussion

Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- Play the Fingerprint Jeopardy Game (youth will not know most answers but can click to find the answer)
<https://www.playfactile.com/fingerprintswhs/play>
- Have youth share their kits and/or photos and explain their process.

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- How are fingerprints important when you are studying a crime scene?
- Why do you think we fingerprint babies when they are born? What kind of fingerprint do you have?
- How can fingerprints be classified?
- How would classification make it easier to match one print against a database of many?
- Where would you want to look for fingerprints at a crime scene? Why is it important to dust for fingerprints?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?

Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)



- Fingerprints must be removed and transported to the crime lab. They are often compared to the database of fingerprints on file. One way detectives collect fingerprints is by dusting for them. Fingerprints are coated with powder and then removed and taken to the lab for identification.
- The patterns of ridges on our finger pads are unique; no two individuals (even identical twins) have fingerprints that are exactly alike. We leave impressions, or prints, on everything we touch with even the smallest amount of pressure. The prints can be visible, as when our fingers are dirty or oily, or they can be latent, as when they are made only by the sweat that is always present on our finger ridges. Injuries such as burns or scrapes will not change the ridge structure; when new skin grows in, the same pattern will come back.

Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
 - Learn about fingerprints and how they are used to identify people
- Provide a brief overview of the next step of the project
 - Briefly explain the concept for the next part of the project
- Confirm the next scheduled meeting
- Communicate supply lists and other information needed before the next meeting
- Have a virtual refreshment time (optional)

Club Meeting 4 – Mystery Powder

Online Component

Introduction

County Fair Icebreaker

Using the 13 clues provided, see if the group can solve the mystery of **who baked each pie** and **which prize each pie won**. Using the whiteboard, share the following chart or have youth draw the chart on a piece of paper. Tell the group they will need to fill each box with either an x (if that person did not bake that pie) and the number of prize (place) they won (first, second, third, etc.) They will figure it out using a series of clues that you will share with them in the chat. They will work together as a group to figure out the answer.

	Apple	Cherry	Chocolate	Peach	Pecan	Blueberry
Sarah						
Dave						
Betty						
Andy						
Ellen						

Clues:

1. There were six entries in the pie contest at the county fair.



2. Judges awarded prizes for first, second third, fourth, fifth, and sixth place.
3. The contest judges awarded first prize to the apple pie.
4. The peach pie won second place.
5. The cherry pie was so sour the judges did not place it in the top five places.
6. Betty's pie place lower than Andy's pie and higher than Dave's pie.
7. Ellen's pie was one of the bet she ever made.
8. Sarah substituted brown sugar for regular sugar in her pie.
9. Sarah did not receive either first or sixth prize.
10. Andy has never entered a fruit pie in the county fair.
11. The chocolate pie placed one place higher than the pecan pie.
12. One person won two prizes, for fifth and sixth places and one of these pies was blueberry.

Solution (to help facilitate the process)

A mystery presented in thirteen pieces!

The potential places are then listed from the information provided (apple=1st prize, peach = 2nd prize, cherry = 6th prize, blueberry = 5th prize, leaving only 3rd and 4th prize. Chocolate placed one place higher than pecan, so chocolate = 3rd prize and pecan = 4th prize). Next, we need to eliminate some of the possibilities shown on the grid. Andy made the chocolate or pecan pie, eliminating all other fruit pie flavors for Andy (so we place X's there). Sarah did not receive 1st or 6th prizes, so cross those off for her. Betty placed lower than Andy (so we can cross off 1st, 2nd and 3rd place for her) and higher than Dave (so we can cross off 6th place as well). Betty placed lower than Andy (who either took 3rd or 4th prize), meaning Betty took 4th or 5th prize, and higher than Dave (who either took 5th or 6th prize). We know that the person taking 5th prize also takes 6th prize, so Dave is the double pie baker, winning 5th and 6th prizes. Ellen is the only pie maker left in the first column and wins 1st prize for her Apple pie. Betty wins 4th prize for her Pecan pie and Andy is one place above her, in 3rd place for his Chocolate pie. Leaving the final pie maker Sarah in 2nd place with her Peach pie.

	Apple	Cherry	Chocolate	Peach	Pecan	Blueberry
Sarah				2		
Dave		6				5
Betty					4	
Andy			3			
Ellen	1					

Reflection on the task:

1. Did everyone have the opportunity to contribute to the success of the group?
2. Was each person in the group heard by the other members of the group?
3. Did a leader emerge during the completion of the task?
4. What skills were required to complete the task?
5. Was there a significant 'break through' moment when the solution became obvious?
6. If you were to repeat a similar task, what would you do differently the next time?
7. What advice would you give to another group working on a similar task?

Business Meeting

- Call to order
- Pledges



- Roll Call
- Reading of the minutes
- Treasurer's Report
- Other Reports
- Unfinished Business
- New Business
- Announcements
- Adjournment

Project Program

Guidelines

Tell youth that the activities for this project will be used to investigate crime scenes and learn the skills necessary to become top detectives and solve mysteries. **The activities for today are to observe chemical reactions in order to identify the mystery substance found at the scene of the crime!**

Tell youth they will complete the activities offline and then return to the online meeting in 45 minutes to discuss how the activities went and what they learned. Before they leave the meeting you will share some information they need to know.

Ask everyone to take their piece of paper and pen and write down what they think will happen during the mystery powder experiment. This will be part of the spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities.

Explain activities and remind youth they have copies of the activities.

ACTIVITY 1: MYSTERY POWDER ANALYSIS DIRECTIONS

Time: 30 minutes

1. Start off by telling the group that there was a mystery substance discovered at the scene of the crime and it is their job to identify the powder in order to link it to the criminal!
2. Use the sticky notes to create labels for each of the three powders and three liquids. Arrange them in a grid, just as the diagram shows.
3. Put 1 teaspoon of baking powder into three different cups. Repeat this for the baking soda and the flour. You should have nine cups total. Line them up under their labels (see illustration).
4. Use the pipette to put 5-10 drops of grape juice into the baking powder. Record observations in the spy note book. Look for a chemical reaction. Some signs may include foaming, fizzing, or a change in color. In some cases no reaction will occur.
5. Now try the grape juice on the other two powders and continue to record observations.
6. Repeat the last two steps for both the vinegar and the iodine, so each powder is mixed with each of the three different liquids.

ACTIVITY 1: MYSTERY POWDER ANALYSIS CONTINUED

7. Now it is time for the mystery substance. Select one person to choose a mystery substance from one of the three different powders (baking soda, baking powder, flour) and put 1 teaspoon of it into each of the three cups. Make sure to keep the identity of the substance a secret so that the mystery doesn't get revealed!
8. Line each of the three mystery powder cups up to each liquid. Test and record observations.
9. Compare data and draw conclusions.
10. At the end of the experiments, everyone should write down their observations and the results of the experiment and then discuss them as a group.



At the end of the experiment, everyone should write down their observations and the results of the experiment and then discuss them as a group.

Resources

- WhoDunit Myster Powder
https://www-tc.pbskids.org/fetch/games/activities/pdf/FETCH_Whodunit.pdf
- Crime 360: Drug Reagent Test
<https://play.aetv.com/shows/crime-360/videos/drug-reagent-test>
- Christmas Cookie Mystery
<https://sciencespot.net/Pages/classchem.html#AnchorCookie>
<https://sciencespot.net/Media/cookiemy2.pdf> (teacher guide)

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their process share when the group returns
- Tell youth to take notes during the process to share with the group later
- Ask youth to write down the time it took to identify the powder
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 45 minutes for a follow up discussion

Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- Play the Forensics Myths Kahoot! game. Players can click on the link in a separate window to play
https://kahoot.it/challenge/07102321?challenge-id=3490ad49-5c5b-4534-ae0d-27d69338fe53_1600569525360

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- What was the mystery substance?
- Were you surprised by any of the chemical reactions? Which mixture made the biggest reaction?
- How can detectives use this technique to solve mysteries? Why is it important to write down your observations as you go?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?



Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)

In this activity you performed an experiment and analyzed data just like a scientist does. A chemical will react in the same way every time, as long as the conditions are the same. You set up the experiment so that each powder was tested in exactly the same way and then you observed the reactions and recorded your data. As you drew conclusions about what the mystery substance was, your conclusions were supported by scientific evidence.

Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
 - Chemical reactions and making observations and draw conclusions
- Provide a brief overview of the next step of the project
 - Briefly explain the concept for the next part of the project
- Confirm the next scheduled meeting
- Communicate supply lists and other information needed before the next meeting
- Have a virtual refreshment time (optional)

Club Meeting 5 – DNA Extraction

Online Component

Introduction

Detective

- Choose one person to be “Detective” and ask them to mute their mic, close their eyes, and count to thirty.
- Pick another student to be “It”.
- The player who is “It” begins an action, such as patting themselves on the head.
- All the other players follow suit and pat their heads.
- When the Detective is done counting, they open their eyes and observe the group.
- When “It” thinks the Detective is looking at someone else, they change the action, such as clapping their hands together.
- All the other students also change their actions.
- The Detective gets three guesses to catch the player that is “It”.
- If they guess correctly the person that was “It” becomes the “Detective”



Business Meeting

- Call to order
- Pledges
- Roll Call
- Reading of the minutes
- Treasurer's Report
- Other Reports
- Unfinished Business
- New Business
- Announcements
- Adjournment

Project Program

Guidelines

Tell youth that the activities for this project will be used to investigate crime scenes and learn the skills necessary to become top detectives and solve mysteries. **The activities for today are to learn about DNA and how it can be extracted from fruit!**

Tell youth they will complete the activities offline and then return to the online meeting in 45 minutes to discuss how the activities went and what they learned. Before they leave the meeting you will share some information they need to know.

Ask everyone to take their piece of paper and pen and write down what they think will happen during the DNA extraction experiment. This will be part of the spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities.

Explain activities and remind youth they have copies of the activities.

WHAT TO DO

ACTIVITY 1: DNA EXTRACTION DIRECTIONS

- Time: 30 minutes
- Measure 2 teaspoons of shampoo into a small cup.
- Add 2-3 pinches of salt (NaCl) to the shampoo.
- Add 4 teaspoons of tap water. Mix with a spoon, but try to avoid creating bubbles in the solution. DNA is soluble in water.
- Add 1 pinch or shake of meat tenderizer. Mix until dissolved.
- Use fruit for this step. Some suggested fruits are: 3-4 strawberries, ½ pint blueberries, ½ a nectarine, or ½ a banana.
- Place the fruit in a blender. Add 1 cup of water.
- Place the lid on the blender and blend for 20 seconds until the mixture is the consistency of a smoothie. Add fruit or water as needed.

ACTIVITY 1: DNA EXTRACTION CONTINUED

- Add 4 teaspoons of the fruit puree to the cup with the shampoo solution. Gently mix with a spoon for 5 minutes. Try not to create too much foaming. This will interfere with the filtration step and may damage the long, fragile DNA molecules. Save the remaining fruit puree in the blender container. This can be used to make a smoothie.
- Place the coffee filter into a cup. The bottom of the filter must not touch the bottom of the cup. Fold the edge of the filter over the cup.
- After the fruit-shampoo mixture has been mixed for 5 minutes, pour it into the coffee filter. Filter the mixture for approximately 5 minutes (or until there are at least 4 teaspoons of liquid in the cup).



- Pour 4 teaspoons of ICE COLD 91% Isopropyl rubbing alcohol into the clear film canister. It should be approximately half full.
- Add 2 teaspoons of the filtered fruit solution to the small container of cold alcohol. There will be two layers in your container. Do not mix these layers! After a few minutes a white “glob” will start to form in the solution. This is DNA! You can try to spool out the DNA using a toothpick.
- To save the DNA, remove it from the container and store it in a different container containing only alcohol.
- When you are finished with the DNA you can make a smoothie with your leftover fruit puree!
- At the end of the experiments, everyone should write down their observations and the results of the experiment and then discuss them as a group.

Resources

- Crime 360 DNA Extraction
<https://play.aetv.com/shows/crime-360/videos/dna-testing>
- Create a DNA Fingerprint Game
https://hawaii.pbslearningmedia.org/asset/tdc02_int_creatednafp2/
- Double Helix Game
http://educationalgames.nobelprize.org/educational/medicine/dna_double_helix/dnahelix.html

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their process to share when the group returns
- Tell youth to take notes during the process to share with the group later
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 45 minutes for a follow up discussion

Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- DNA Match Game
<https://phylo.cs.mcgill.ca/play.php>
- BrainPOP DNA
<https://www.brainpop.com/health/geneticsgrowthanddevelopment/dna/>
- BrainPOP DNA Quiz
<https://www.brainpop.com/health/geneticsgrowthanddevelopment/dna/quiz/>
- Genes and Traits Game
<https://games.legendsoflearning.com/games/WyJnYW1lcylsMTI2MF0=>



- Genetic Escape
<https://games.legendsoflearning.com/games/WyJnYW1lcylsNTQyXQ==>

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- What is DNA?
- Why did you have to shake the strawberry solution? Why do you think you needed to add the soap?
- What was the purpose of the ice cold alcohol? Why do you need to store the DNA in alcohol?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?

Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)

- The lipid bilayer of the cell membrane and nuclear membrane is broken down by soaps, such as lauryl or laureth sulfate found in shampoo and dish soap. Shampoo also contains EDTA (ethylene diamine tetracetic acid), which binds to cations such as Mg^{2+} . Cations are sometimes used as cofactors that help enzymes work properly. Without the cofactor the enzyme can't function. One enzyme that is detrimental to DNA is nuclease, which breaks down the DNA. EDTA binds to Mg^{2+} and prevents it from assisting nucleases in their destruction of DNA.
- The positively charged sodium ions (Na^+) are attracted to the negative charge of the DNA. This creates a "shield" around the DNA molecules and causes them to stick together. This enables the DNA to precipitate out of the solution when added to the alcohol in a later step. Salt also causes proteins in the fruit mixture to denature and precipitate out of the solution.
- Meat tenderizer contains the molecule papain, which breaks down certain proteins including other enzymes. The meat tenderizer helps to protect the DNA by breaking down nucleases.
- Blending the fruit with water causes some of the cells in the fruit to break open. Because DNA has a negative charge it is able to dissolve in the water. Many other cell parts are not soluble in water.
- Filtering the soapy fruit solution through a coffee filter removes extra cell debris (cell membranes, precipitated proteins, and excess fruit pieces that didn't get pureed in the blender).
- DNA molecules are soluble in water, but not in an alcohol solution. When the fruit DNA solution comes in contact with alcohol, the long, stringy DNA molecules precipitate into the alcohol. The long, stringy precipitated DNA is thousands of DNA molecules that are stuck together.
- Pure DNA is a colorless molecule. Any visible color is caused by fruit pigment molecules that got trapped in the string DNA.



Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
 - How DNA can be extracted from fruit
 - Enzyme activity and how it all relates to the human body
- Provide a brief overview of the next step of the project
 - Briefly explain the concept for the next part of the project
- Confirm the next scheduled meeting
- Communicate supply lists and other information needed before the next meeting
- Have a virtual refreshment time (optional)

Club Meeting 6 – A House Divided

Online Component

Introduction

Impromptu Presentation

Use either the Wheel Spinner (<https://www.google.com/search?q=10%20value%20spinner>) or Random Number Generator (<https://www.google.com/search?q=randomnumbergenerator>) to assign each youth a number. This will be the order in which they give their presentation.

Create a presentation of selected topics from the list below and add images to each slide. Youth will present in the order determined by the wheel or number generator and will present on the slide showing on their turn.

Before each person goes, they will have 30 seconds to think about their presentation topic (as appears on the slide) and then 1 minute to give their presentation.

Choose from the topics below or use your own.

1. Let me tell you about my imaginary friend
2. Let me tell you about my family
3. My family's traditions
4. What is my favorite song
5. My favorite season of the year is...
6. My favorite time of day or week.
7. 5 of my favorite words
8. My favorite thing about summer
9. My favorite New Year's tradition
10. The most delicious meal I've ever had
11. How many things can you make with a potato
12. I don't like to eat ...
13. What would it be like if dinosaurs roamed the Earth?
14. How do animals talk to each other
15. What planet I visit if I had my own rocket ship
16. How water is so important
17. Coolest superhero power
18. If I could change one thing about the world, it would be...
19. How I care for the environment every day
20. Why are farmers important
21. What you could do without television or video.
22. How to plan a surprise party
23. The strangest place I've ever been
24. The best letter of the alphabet.
25. If I had a million dollars to give away.
26. If I could only eat three foods forever.
27. A job I'd love to have.
28. If I could travel through time.
29. An important lesson I've learned.
30. How to spend a rainy day.
31. Great things about the ocean.
32. Interesting things you see in the sky.
33. If you were an animal, what would you be?
34. Tell us how to become a millionaire.



- 35. Tell us how to make a new friend.
- 36. Tell us how to make your favorite meal.
- 37. If everything in the world had to change to the same color, what color would you choose and why?

- 38. Your favorite or least favorite sound
- 39. The greatest gift we can give others is...
- 40. What I would do if I knew I could not fail

Business Meeting

- Call to order
- Pledges
- Roll Call
- Reading of the minutes
- Treasurer’s Report
- Other Reports
- Unfinished Business
- New Business
- Announcements
- Adjournment

Project Program

Guidelines

Tell youth that the activities for this project will be used to investigate crime scenes and learn the skills necessary to become top detectives and solve mysteries. **The activities for today are to piece together the evidence to find out which suspect has been stealing money from the mortgage company!**

Tell youth they will complete the activities offline and then return to the online meeting in 45 minutes to discuss how the activities went and what they learned. Before they leave the meeting you will share some information they need to know.

Ask everyone to take their piece of paper and pen and write down what they think will happen during the experiments in their spy notebook.

Depending on the age of the 4-H members, you may need to remind them to have adult supervision as they complete the activities. Explain activities and remind youth they have copies of the activities.

WHAT TO DO

First, everyone should write their predictions about what will happen during the experiments in their spy notebook.

Background Information

A large mortgage company suspects that one of its loan officers is preparing fraudulent loan applications and pocketing the money. They are not sure which officer is involved although they believe they have it narrowed down to three individuals: Cameron Robinson, Luis Rothstein, and Amanda Remillard. However, the culprit learned of the company’s suspicions and shredded the evidence! Your lab has been asked to assist in reconstructing the evidence to determine which of the three suspects is guilty of this fraud.

Prior to the Activity

The following pages (provided to youth before activity) are documents that have been recovered from the offices of the mortgage company. They include: four shredded loan applications, an email describing the purchase of several stolen identities, and a partial list of the stolen identities. These documents need to be photocopied, and then individually shredded (either by hand or with an electric paper shredder). Do not use a cross cut paper shredder. Place the remains of each individual document in separate plastic bags.

ACTIVITY 1: A HOUSE DIVIDED DIRECTIONS

- Time: 30 minutes



- Divide into groups and give each group a plastic bag containing a shredded document. Reassemble the document and use the tape to hold it together.

ACTIVITY 1: A HOUSE DIVIDED CONTINUED

- Once all the documents have been pieced together, examine the documents and discuss the allegations.
- No one document is enough to incriminate any of the suspects. However, after reviewing all six documents youth should be able to reconstruct the crime and identify the culprit.
- At the end of the experiments, everyone should write down their observations and the results of the experiment and then discuss them as a group.

Resources

- Cryptography Game 1
<http://highschool.spsd.org/encrypt/easy1.html>
- Cryptography Game 2
<http://highschool.spsd.org/encrypt/easy2.html>
- Cryptography Game 3
<http://highschool.spsd.org/encrypt/easy3.html>

Discussion

- Share further thoughts and facilitate a discussion of next steps

Next Steps

- Ask youth to take a photo of their repaired message to share when the group returns
- Tell youth to take notes during the process to share with the group later
- Ask youth to write down the time it took to put the message back together
- Remind youth that you will remain online if they want to log in to ask questions
- Remind youth to return to the group in 45 minutes for a follow up discussion

Resources

- Youth should have all supplies for the activities
- Youth should have the instructions for the activities

Offline Component

Project Activities

- Have youth use this time to work on the project activities

Reflection Component (Online)

Youth Engagement

- Explain that messages are often encrypted (explain terminology) so that even if a shredded or deleted message were put back together, the message would still be unknown. Have youth play or share screen and play together the following cryptography games.
 - Cryptography Game 1
<http://highschool.spsd.org/encrypt/easy1.html>
 - Cryptography Game 2
<http://highschool.spsd.org/encrypt/easy2.html>
 - Cryptography Game 3
<http://highschool.spsd.org/encrypt/easy3.html>



- Have youth play or share screen and play together the following hidden pictures game.
https://hiddenpictures.highlights.com/daily_challenges

Experiential Learning Process

Go through the questions below and allow each youth to answer questions:

Reflect

- Who was the culprit?
- What was the evidence that incriminated the suspect? What was difficult about this activity?
- Were your initial allegations correct?
- Why was it important to read all of the documents before accusing any one suspect?

Share

- Tell me about your most/least favorite things about working on your project/activity.
- What made this activity challenging? What made this activity enjoyable?

Process

- How did you make your decisions? What steps did you take?
- What suggestions would you have for someone else who wanted to do a similar project/activity?

Generalize

- What skills or ideas did you learn from this activity?
- Why are these skills important?

Apply

- What other activities might require this knowledge or skills?
- How can you use these skills and ideas in school or at home?

How This Works (share with youth)

- This is a good activity to emphasize attention to detail, patience, and the accuracy that are required by many forensic careers. Things don't happen nearly as quickly in real life as they do on television. In this instance, this is a real case from a document examiner. **IMPORTANT: ALL IDENTITIES ON THESE DOCUMENTS ARE FICTITIOUS!**

Conclusion

- Summarize life skills and themes learned from the project as provided by the youth
 - Paying attention to details
 - Critical Thinking
 - Science behind identifying and examining evidence
 - Make observations and draw conclusions based on evidence
- Mastery
- Youth will focus on attention to detail, patience, and accuracy, which are all required by many forensic careers.
- Provide a brief review of the entire project
- Confirm the next scheduled meeting (If there is one)
- Communicate information needed before the next meeting
- Have a virtual refreshment time (optional)

