This document is not intended to give you all of the information you need to lead the module. You can find the complete instructions at [http://www.chem.ucsb.edu/scitrek/module](http://www.chem.ucsb.edu/scitrek/module). This document is intended to be used as a reference during the module.

**Important Things to Remember During the Module**

1. You are responsible for keeping track of time in the classroom and making sure that ALL activities run smoothly. There will be a time card in the lead box with suggested times to start/stop each activity.
2. You are responsible for keeping volunteers and students on track.
3. Walk around during times volunteers are working with students and help struggling groups.

**Day 1: Conclusion Assessment/Observations/Variables**

**Schedule:** *You are responsible for BOLD sections*

- Introduction (SciTrek Lead) – 2 minutes
- Conclusion Assessment (SciTrek Lead) – 10 minutes
- Observation Discussion (SciTrek Lead) – 2 minutes
- Observations (SciTrek Volunteers) – 26 minutes
- Variable Discussion (SciTrek Lead) – 5 minutes
- Variables (SciTrek Volunteers) – 12 minutes
- Wrap-Up (SciTrek Lead) – 3 minutes

**Preparation:**

1. If the classroom has a document camera ask the teacher to use it for the class question (front cover, student notebook).
2. Make sure that volunteers are setting up for the initial observation. Details of how to do this are on a picture in the volunteer boxes.
**Observations**

**Experimental Setup:**
- graduated cylinder with 2 ml of water
- paper with line on it at 2 cm
- black Mr. Sketch marker
- timer
- 5 boxes of crayons

**Observations / Measurements:**
- Small black dot on line (2 cm)
- Dot turned into a smear (got longer)
- Smear got bigger (3.5 cm)
- Water went up paper (6.0 cm)
- Blue, pink, red, orange

<table>
<thead>
<tr>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 sec</td>
<td>3 min 20 sec</td>
<td>7 min 15 sec</td>
</tr>
</tbody>
</table>

**Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>How changing this variable affect the smear?</th>
</tr>
</thead>
<tbody>
<tr>
<td>pen type</td>
<td>Different black pens might be made up of different colors so the smear colors will be different but the height won't.</td>
</tr>
<tr>
<td>paper type</td>
<td>If the paper is thicker the dot will not travel as far up the paper.</td>
</tr>
<tr>
<td>liquid type</td>
<td>If the liquid is thinner the dot will travel farther up the paper.</td>
</tr>
<tr>
<td>time</td>
<td>If there is more time there will be more separation between the colors and the smear will be longer.</td>
</tr>
<tr>
<td>pen color</td>
<td>Pens that are different color will have smears that are the same height but different colors.</td>
</tr>
</tbody>
</table>
**Introduction:** (2 minutes – Full Class – SciTrek Lead)

- Introduce the module/SciTrek volunteers.

**Conclusion Assessment:** (10 minutes – Full Class – SciTrek Lead)

- Pass out assessments.
- Page 1: Read each statement and have students circle if statement is a claim, data, or opinion.
- Page 2: Work with students to underline controls, circle changing variable(s), and box information about data collection on the data table.
  - Circle: time
  - Underline: shoe type, trail type, number of stops
  - Box: distance traveled, sock cleanliness
- Page 2: Have them individually decide if the group could make a conclusion.
- Page 2: Read each statement and have students identify if the statement is a claim or data and then circle if statement is a correct claim, correct data, or incorrect based on the data table.
- Page 3: Repeat the process for page 3.
- Collect assessments.

**Observation Discussion:** (2 minutes – Full Class – SciTrek Lead)

- Review the definition of an observation (a description using your five senses).
- If needed tell students to take a pencil and move to their group.
  - If a student does not have a nametag, identify the group with the least number of students in it and write the student’s name on one of the extra nametags that are in the lead box using that color of marker.

**Observations:** (26 minutes – Large Groups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that groups are moving along and only spending ~6 minutes on the experimental set-up, ~2 minutes setting up the experiment, ~7 minutes with the strip in the water (they should not remove their strip from the water at time 1), and ~11 minutes measuring the smear.

**Variable Discussion:** (5 minutes – Full Class – SciTrek Lead)

- Have groups share what they did/learned.
  - They put a strip of paper with a black dot on it in water and over time the dot spread out into a smear that had many colors.
- Ask the students what the most interesting thing they observed and have them decide as a class to investigate the question: What variables affect smears?
  - Write the class question on the front cover of the example notebook and have students copy the question onto their notebook.
- Review the definition of a variable (something in an experiment that can be changed).
- Explore one possible changing variable with the class and have students share why/how this variable might affect the height and color of the smear.
Variables:  (12 minutes – Large Groups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure volunteers are having their group come up with three possible variables as well as how/why these variables might affect smears.
- Make sure students are generating at least one additional variable by themselves.

Wrap-Up: (3 minutes – Full Class – SciTrek Lead)

- Have each group share one variable with the class and how/why they think it will affect smears.

Day 2: Question/Materials Page/Experimental Set-Up/Procedure/Results Table

Schedule: You are responsible for BOLD sections

- Introduction (SciTrek Lead) – 13 minutes
- Question (SciTrek Volunteers) – 10 minutes
- Materials Page (SciTrek Volunteers) – 7 minutes
- Experimental Set-Up (SciTrek Volunteers) – 8 minutes
- Procedure (SciTrek Volunteers) – 14 minutes
- Results Table (SciTrek Volunteers) – 5 minutes
- Wrap-Up (SciTrek Lead) – 3 minutes

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the question (page 4, student notebook), experimental set-up (page 5, student notebook), results table (pages 7, student notebook), and example day 1 strip (page 1, picture packet).
2. Have volunteers set out the notebooks so that students within the same numbered group can work together.
   a. If students are not in the classroom before SciTrek starts have volunteers set out the notebooks where students should sit as they come into the class.
   b. If students are in the classroom before SciTrek starts have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.
**Experimental Considerations:**

1. You will only have access to the materials on the materials page.
2. The strips of paper cannot be in the liquid for more than 5 minutes.
3. All strips of paper must be put into the liquid at the same time.

**Changing Variable(s) (Independent Variable(s)):**

You will get to perform two experiments. For your first experiment decide which variable(s) (match some) that you would like to test. For each changing variable that you select, discuss with your group why you think that variable will affect the smear.

**Changing Variable 1:**

Dissolve with your group how you think changing variable 1 will affect the smear.

**Changing Variable 2 (optional):**

Dissolve with your group how you think changing variable 2 will affect the smear.

**Changing Variable 3 (optional):**

Dissolve with your group how you think changing variable 3 will affect the smear.

**QUESTION**

Question our group will investigate:

* If we change the pen color and liquid type, what will happen to the height and color of the smear?

Get a materials page from your SciTrek volunteer and fill it out before moving onto the experimental set-up.

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**EXPERIMENTAL SET-UP**

Determine the values of your changing variable(s) (e.g., pen color) from the materials page and write the values for each trial under each strip of paper.

- **Changing Variable(s):**
  1. pen color
  2. liquid type
  3. 

- **Controls (variables you will hold constant):**
  

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**PROCEDURE**

**Procedure Note:**

Make sure to include all values of your changing variable(s) in the procedure. (Example: for a group that decided to change pen color and a group that decided to change liquid type, we would put colored dots with Mr. Sketch pens A, red, B, blue, C, green, and D, yellow on original paper at 2 cm.)

1. Put 5 mL of RA in test tubes.

2. Draw a dot at A, 2 cm B, 5 cm C, and D, 7 cm with a black pen Mr. Sketch B, and blue Bic D,图为 on a coffee filter. See paper and paper Diperforated.

3. Drop strips in test tube and then cork the test tube.

4. Wait 5 minutes.

5. Remove strips.

6. Measure smear height and observe smear colors.

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SciTrek Member Approval: [Signature]
Introduction: (13 minutes – Full Class – SciTrek Lead)

- If needed have SciTrek volunteers set out notebooks where students will sit so students are sitting next to members of their small group.
  - Tell students not to move the notebooks.
- Review the class question and what they learned last SciTrek visit.
- Review experimental considerations with the class (top of page 4 student notebook):
  - You will only have access to the materials on the materials page.
  - The strips of paper cannot be in the liquid for more than 5 minutes.
  - All strips of paper must be put into the liquid at the same time.
- Design an example experiment with the class.
  - For the changing variables pick two changing variables (example: pen color and liquid type). (page 4, student notebook)
  - Show students how to write the question.
    - If we change the pen color and liquid type what will happen to the height and color of the smear?
  - Fill out the materials page for the example experiment. (lead box)
  - Fill out the experimental set-up for the example experiment (only trials A and B for the changing variable). (page 5, student notebook)
  - Read the example procedure step for the changing variable. (page 6, student notebook)
  - Show students how to fill out one changing variable and one control on the results table. (page 7, student notebook)
- If needed tell students to move to their notebooks.
Question: (10 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- **MAKE SURE VOLUNTEERS ARE NOT GIVING ADVICE ON HOW MANY CHANGING VARIABLES TO USE.**
- Make sure groups are picking changing variable(s) that are allowed.
- Try to encourage groups to pick different changing variables.
- Make sure for the second part of the question (what you are measuring/observing) that students are specific (example: they should write “the height and color of the smear,” and not just “the smear”).

Materials Page: (7 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure students fill out the materials page correctly and completely.

Experimental Set-Up: (8 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that within one group all students have the same order for their changing variable(s) values.
- Make sure all control blanks are filled out.

Procedure: (14 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure procedures are not too long but include all values of the changing variable, controls, and what data will be collected.

Results Table: (5 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that control values are written in trial A with a line through the rest of the trials and that changing variable(s) values are written in each trials box.

Wrap-Up: (3 minutes – Full Class – SciTrek Lead)

- Tell students what they will do next time.

Day 3: Experiment/Graph/Conclusion Activity

Schedule: You are responsible for **BOLD** sections

- Introduction (SciTrek Lead) – 8 minutes
- Experiment (SciTrek Volunteers) – 20 minutes
- Graph (SciTrek Volunteers) – 10 minutes
- **Conclusion Activity (SciTrek Lead) – 20 minutes**
- Wrap-Up (SciTrek Lead) – 2 minutes
**Preparation:**

1. If the classroom has a document camera, ask the teacher to use it for the example filled out results table (page 2, picture packet), graph (page 8, student notebook), and conclusion activity (pages 9 and 10, student notebook).
2. Make sure that volunteers are pouring liquids into the small cups and putting test tubes in the test tube stands.
3. Have volunteers set out the notebooks so that students within the same group can work together.
   a. If students are not in the classroom before Sci Trek starts have volunteers set out the notebooks where students should sit as they come into the class.
   b. If students are in the classroom before Sci Trek starts have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.

**Sci Trek Notebook Pages:**

![Sci Trek Notebook Pages](image-url)
Introduction: (8 minutes – Full Class – SciTrek Lead)

- If needed have SciTrek volunteers set out notebooks where students will sit.
  - Tell students not to move the notebooks.
- Make sure that volunteers are setting up for the experiments.
- Review the class question with students.
- Use the steps on the top of page 8 (student notebook) to go over how to graph results.
  - A filled out results table is on page 2 of the picture packet.
  - Only graph the results for the first two smallest smear heights (2 cm and 3 cm).
- If needed tell students to move to their notebooks.

Experiment: (20 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups with their experiment and make sure they will finish their experiment on time.
  - Make sure that students are labeling the test strips and test tube stand with pencil.
  - Make sure that students are putting in all the papers at the same time.
  - Make sure to remove all of the liquids as soon as students are done with them.
  - Make sure students are drawing the liquid line as soon as the strips come out of the test tubes.

Graph: (10 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- If none of the dots smeared, students can graph the liquid height instead of smear height.
- Make sure students are graphing their data from smallest smear/liquid height to largest smear/liquid height.
- Make sure students have their changing variable values not the trail letters on the x-axis.
- Make sure students are writing the smear/liquid height on top of each column.
Conclusion Activity: (20 minutes – Full Class – SciTrek Lead)

- MAKE SURE TO START THE CONCLUSION ACTIVITY AT LEAST 15 MINUTES BEFORE THE END, EVEN IF STUDENTS ARE NOT DONE WITH THEIR GRAPHS.
- Review the definition of a conclusion (claim supported by data). (page 9, student notebook)
- Review the definition of a claim (something that can be tested).
  - Have students give a few examples of claims.
- Review the forms of data (observation/measurements).
- Read each statement.
  - As a class, discuss if each statement is a claim, data, or opinion and then circle the correct statement type.
  - As a class, annotate the statement by boxing data (measurements or the word observed), double underlining opinion word, and underlining descriptive numbers.
  - For claim statements, have students tell you what data would need to be collected to back up the claim.
  - For data statements, have students tell you the claim that could be paired with it to make a conclusion.

  - **Letter a:** McDonald’s served **100 customers** and Taco Bell served **75 customers**
    - **Data**
    - Possible Claim: McDonalds serves more customers than Taco Bell
  - **Letter b:** blue is the **best** color
    - **Opinion**
  - **Letter c:** butterflies that are larger than **15 cm** are attracted to bright colors
    - **Claim**
    - 15 cm is not a measurement. It is called a descriptive number because it describes the experiment.
    - Possible Data: counting the number of butterflies that land on bright colored paper compared to the number of butterflies that land on black or brown paper.
  - **Letter d:** ice was **observed** floating on water
    - **Data (Data Collected: observed ice)**
    - Possible Claim: ice is less dense than water
  - **Letter e:** people buy more pizza than hamburgers
    - **Claim**
    - Possible Data: count the number of people that buy pizza and hamburgers
  - **Letter f:** the average male blue whale weighs **91,000 kg**, while the average female blue whale weighs **122,000 kg**
    - **Data (Data Collected: measured the mass of blue whales (male and female))**
    - Possible Claim: female blue whales weigh more than male blue whales
  - **Letter g:** the tastier the fruit the more bugs on the fruit
    - **Opinion**

- Read the directions on page 10, student notebook.
- Have students make matches between claims and data and then share out matches.
  - **Correct matches**
    - Sony TVs are brighter than Samsung TVs because Sony TVs give off 20 lumens of light and Samsung TVs give off 10 lumens of light.
    - The color purple is made from blue and red because when blue and red paint were mixed the paint was observed to turn purple.
- Discuss why the statement “Wind turbines produce less energy than solar panels in California” does not match with “wind turbines produce 6,000 MW of energy and solar panels produce 5,000 MW of energy.”
• Discuss that only the claim can be changed when data and claims do not match.
• If there is extra time you can continue on to the next page of the conclusion activity.

Wrap-Up: (2 minutes – Full Class – SciTrek Lead)

• Tell students what they will do next time.

Day 4: Conclusion Activity/Conclusion/Question/Materials Page/Experimental Set-Up/Procedure

Schedule: You are responsible for BOLD sections

Introduction (SciTrek Lead) – 2 minutes
Conclusion Activity (SciTrek Lead) – 25 minutes
Conclusion (SciTrek Volunteers) – 5 minutes
Question (SciTrek Volunteers) – 5 minutes
Materials Page (SciTrek Volunteers) – 5 minutes
Experimental Set-Up (SciTrek Volunteers) – 5 minutes
Procedure (SciTrek Volunteers) – 11 minutes
Wrap-Up (SciTrek Lead) – 2 minutes

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the conclusion activity (pages 11-13, student notebook).
2. Set out student notebooks.
   a. If students are not in the classroom before SciTrek starts set out the notebooks where you want students to sit when they come into the classroom.
   b. If students are in the classroom pass out student notebooks to them. They will move to their group seats after the conclusion activity.
**SciTrek Notebook Pages and Materials Page:**

### SCIENTIFIC PRACTICES

#### Conclusions

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Type</td>
<td>Water</td>
<td>Soap</td>
</tr>
<tr>
<td>Initial Height</td>
<td>2 cm</td>
<td>1.5 cm</td>
</tr>
<tr>
<td>Initial Liquid Height</td>
<td>5 cm</td>
<td>3.5 cm</td>
</tr>
</tbody>
</table>

#### Final Observations/Measurements:

<table>
<thead>
<tr>
<th>Type</th>
<th>Correct/Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type C</td>
<td>Correct/Incorrect</td>
</tr>
<tr>
<td>Type D</td>
<td>Correct/Incorrect</td>
</tr>
</tbody>
</table>

1. a. the paper type affects the height of the liquid on the paper. **Correct Claim, Correct Data, Correct Infer.**
2. b. blocks can contain up of different dye colors. **Correct Claim, Correct Data, Correct Infer.**
3. c. when a block was put in water for 5 min, different type paper made the same height of water. **Correct Claim, Correct Data, Incorrect Infer.**
4. d. the color type and paper type have great effects. **Correct Claim, Correct Data, Incorrect Infer.**

What data can be used to support claim b above?

_dye type was observed to contain green, blue, and red dye. Crayola contained yellow, blue, and red dyes._

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### SCIENTIFIC PRACTICES

#### Conclusions

6. **Making a conclusion from your data**

How many changing variables did you have in your experiment? _2_

Can you make a conclusion from your data? **YES**

**IF NO**

Why I cannot make a conclusion because my experiment had more than one changing variable.

**IF YES**

We can conclude ______ claim because ______ data (observation/measurement).

SciTrek Member Approval _Sg_
Making a Conclusion from Your Data

How many changing variables did you have in your experiment? __________

Can you make a conclusion from your data?  YES  NO

IF NO
Why?__________________________________________________________

IF YES

CONCLUSION

We can conclude that the thicker the liquid the less the smear will travel up the paper

because soap traveled 1 cm up the paper and the smear in the water traveled 1 cm up the paper.

Scitrek Member Approval ____________________________

Materials Page

You will only have access to the following materials. Check the materials that you need for your experiment.

- General Materials: 2 test tubes with caps, test tube rack, droppers, graduated cylinders
- Liquid Types: rubbing alcohol (R), water
- Liquid Amount: 3 ml
- Paper Types: You may only have 4 strips of paper (the exact paper and the number of strips that you need in the line. All of the numerals should add up to 4)
- Color (circle one): Orange, Blue, Green, Brown

EXPERIMENTAL SET-UP

Determine the values of your changing variable(s) (ie: pen color) from the materials page and write the values (ex: blue) for your four trials under each strip of paper.

Changing Variable(s):

- Liquid type
- Water
- Soap
- Vinegar

Test Tube / Original pen type / crayola

Time / 5 min  liquid amount 3 ml

Paper Type / Original pen color / black

Initial Dot Height 2 cm

Scitrek Member Approval ____________________________
**Introduction:** (2 minutes – Full Class – SciTrek Lead)

- If needed have volunteers set out student notebooks.
- Review class question and what they did last SciTrek visit.
- If needed tell students to move to their notebook.

**Conclusion Activity:** (25 minutes – Full Class – SciTrek Lead)

- Review the definition of a conclusion (claim supported by data).
- Have students identify and circle the changing variables, underline the controls, and box information about data collection on the results table. (page 11, student notebook)
- Read each statement.
  - As a class discuss if each statement is a claim or data and write a C or D on the line.
  - Have students help you annotate the statement by circling changing variables (every claim statement will have a changing variable), underlining controls, and boxing and data.
  - Have students look at the results table to see if the statement is a correct claim, correct data, or incorrect.
    - Statements are incorrect if they are not supported by the results table of have not be tested.
- Questions used for statements that are claims.
  - What type of statement is this and how do you know?
  - What would need to be the changing variable for this claim to be correct?
  - Is that variable a changing variable in the experiment?
    - If answer is yes
      - Is this claim consistent with the data?
      - Is the statement a correct claim, correct data, or incorrect?
    - If answer is no
• Is the statement a correct claim, correct data, or incorrect?
  • Questions used for statements that are data.
    o What type of statement is this and how do you know?
    o Is the data correct based on the results table?
    o Is the statement a correct claim, correct data, or incorrect?
  • Letter a: the paper type affects the height the liquid travels up the paper
    o Claim/Incorrect (Claim/Variable Held Constant)
  • Letter b: black pen types are made up of different dye colors
    o Claim/Correct Claim
  • Letter c: when a black dot sits in water for 5 min, different pen types give different smear heights
    o Claim/Correct Claim
      ▪ The number in this claim is a descriptive number.
    o Letter d: the black Crayola was observed to contain green dye
      o Data/Incorrect
  • Have students determine data that backs up claim b.
    o Black Mr. Sketch was observed to contain green, blue, and red dyes while black Crayola contained yellow, blue, and red dyes.
  • Have students repeat the process for page 12.
  • Letter a: the stronger the pen odor the larger the smear height
    o Claim/Incorrect (Claim/No Data Gathered)
  • Letter b: the black pen had a smear height of 3 cm and the red pen had a smear height of 1.5 cm
    o Data/Correct Data
  • Letter c: black and red pens are made from green dye
    o Claim/Incorrect (Claim/Inconsistent with Data)
  • Letter d: the thicker the liquid the shorter the smear height
    o Claim/Incorrect (Claim/More than One Changing Variable)
  • Go over the two questions on the bottom of page 12.
  • On page 13 have students identify and circle the changing variable(s), underline the controls, and box information about data collection and then determine if the group can make a conclusion.
  • Tell students they will now determine if they can make a conclusion from their first experiment and then design another experiment.

**Conclusion: (5 minutes – Subgroups – SciTrek Volunteers)**

• If groups have not finished the graph DO NOT make them go back and finish it. Most likely these groups will not be able to make a conclusion, therefore, they will not use the data from their first experiment.
  • Walk around and help groups that are struggling.
  • Groups that can make a conclusion will need more help than those that cannot.
    o If a group can make a conclusion make sure they are making a claim and using data to support it.

**Question: (5 minutes – Subgroups – SciTrek Volunteers)**

• Walk around and help groups that are struggling.
  • Make sure that groups are only picking one changing variable.
  • Try to encourage groups to pick different changing variables.
  • Make sure for the second part of the question (what you are measuring/observing) that students are specific (example: they should write “the height and color of the smear” and not just “the smear”).

**Materials Page: (5 minutes – Subgroups – SciTrek Volunteers)**

• Walk around and help groups that are struggling.
• Make sure students fill out the materials page correctly and completely.

**Experimental Set-Up: (5 minutes – Subgroups – SciTrek Volunteers)**

• Walk around and help groups that are struggling.
• Make sure that within one group all students have the same order for their changing variable values.
• Make sure all control blanks are filled out.

**Procedure: (11 minutes – Subgroups – SciTrek Volunteers)**

• Walk around and help groups that are struggling.
• Make sure procedures are not too long but include all values of the changing variable, controls, and what data will be collected.

**Wrap-Up: (2 minutes – Full Class – SciTrek Lead)**

• Tell students what they will do next time.

**Day 5: Results Table/Experiment/Graph/Conclusion**

**Schedule: You are responsible for BOLD sections**

- Introduction (SciTrek Lead) – 20 minutes
- Results Table (SciTrek Volunteers) – 5 minutes
- Experiment (SciTrek Volunteers) – 20 minutes
- Graph (SciTrek Volunteers) – 5 minutes
- Conclusion (SciTrek Volunteers) – 8 minutes
- Wrap-Up (SciTrek Lead) – 2 minutes

**Preparation:**

1. If the classroom has a document camera, ask the teacher to use it for the conclusion example (page 18, student notebook).
2. Make sure that volunteers are pouring liquids into the small cups and putting test tubes in the test tube stands.
3. Set out student notebooks.
   a. If students are not in the classroom before SciTrek starts set out the notebooks where you want students to sit when they come into the classroom.
   b. If students are in the classroom pass out student notebooks to them. They will move to their group seats after the conclusion activity.
**Scientific Practices**

**Conclusions**

**Question:** If we change the paper height, what will happen to the liquid height?

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Tube</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Type</td>
<td>Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Color</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type</td>
<td>Mr. Sketches</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weight Height</td>
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</tr>
<tr>
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</tr>
<tr>
<td></td>
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<td>red</td>
<td>red</td>
<td>red</td>
</tr>
</tbody>
</table>

Write a conclusion from the results above:

We can conclude that the liquid will reach the top of the paper if the paper is 11 cm or shorter, because when the paper height was 5 cm and 10 cm, the liquid level was 5 cm and 10 cm and when the paper height was 15 cm and 20 cm, the liquid level was only 11 cm.

**Results**

**Table**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial E</th>
<th>Trial F</th>
<th>Trial G</th>
<th>Trial H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Tube</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>5 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Type</td>
<td>R A water soap vinegar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Amount</td>
<td>3 mL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Type</td>
<td>Original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Color</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pen Type</td>
<td>Crayola</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Dot Height</td>
<td>2 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Predictions**

<table>
<thead>
<tr>
<th>Trial E</th>
<th>Trial F</th>
<th>Trial G</th>
<th>Trial H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent variable(s) is/are: the changing variable(s) and the dependent variables are shadow length, shadow picture, and other.

**Graph**

Check off the steps as you complete them:

- Record what you measured (in your height) on the y-axis (vertical).
- Determine an appropriate scale which will allow you to graph off your data points and write the numbers on the given graph.
- Write your changing variable(s) (1), (2), and (3) on the x-axis (horizontal) example: liquid type.
- Change variable (1) and (2) in only one experiment (start with a 1 or 2 changing variables).
- In your results table, label your measurements from 1 to 4, with 1 being the trial with the smallest measurement and 4 being the trial with the largest measurement.
- For your data increasing lines:
  - Write each of the changing variables values example: soap for the trial that you labeled 1 under y-axis column.
  - Graph your data for that trial and write the measurement above the bar.
- Repeat the process for the other trials.

- 4.5 cm
- 6 cm
- 1 cm
- 3 cm

**Data**

**Final Observations/Measurements**

- 4.5 cm
- 6 cm
- 1 cm
- 3 cm

**Conclusion**

We can conclude that the thicker the liquid type, the smaller the height of the smear.

- The thicker the liquid, soap, had a smear height of 1 cm while the thin liquid, water, had a smear height of 6 cm.

Can you test the first part (claim) of the conclusion? 
- **Yes**
- **No**

If you checked this box go back and revise your claim so that it can be.

The second part of the conclusion is data because it contains a measurement.

I acted like a scientist when I wrote a set-up of my experiment and the procedure.
Introduction: (20 minutes – Full Class – SciTrek Lead)

- If needed have SciTrek volunteers pass notebooks to students.
- Make sure that volunteers are setting up for the experiments.
- Have students identify and circle the changing variable, underline the controls and box information about data collection on the data table. (page 18, student notebook)
- Have students identify the question the group was investigating.
- From the data have students tell you how to draw the strips, smears, and water lines so that students can visualize the experiment.

- Have students make a conclusion from the data.
  - We can conclude the liquid will reach the top of the paper if the paper is 11 cm or shorter because when the paper height was 5 cm and 10 cm the liquid level was 5 cm and 10 cm (top of paper) and when the paper height was 15 cm and 20 cm the liquid level was only 11 cm.
- If needed tell students to move to their groups.

Results Table: (5 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that control values are written in trial E with a line through the rest of the trials and that changing variable values are written in each trials box.

Experiment: (20 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups with their experiment and make sure they will finish their experiment on time.
  - Make sure that students are labeling the test strips and test tube holder with pencil.
  - Make sure that students are putting in all the papers at the same time.
  - Make sure to remove all of the liquid as soon as students are done with them.
  - Make sure students are drawing the liquid line as soon as the strips come out of the test tubes.

Graph: (5 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups with their graphs.
- Make sure that students are graphing their data from smallest smear/liquid height to largest smear/liquid height.
- Make sure students have their changing variable values, not trial letters on the x-axis.
- Make sure that students are writing the smear/liquid height on top of each trial.
Conclusion: (8 minutes – Subgroups – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that groups are generating claim (ideally the claim will allow them to make a prediction about future experiments) and using data to back it up.
  - If groups use an observation as data make sure the data statement includes “we observed.”
  - Do not reference trial letters in conclusion.
- If groups do not finish their conclusions they can work on them the next SciTrek visit.
- Volunteers struggle with conclusions, therefore, try to check at least one conclusion for each large group.

Wrap-Up: (2 minutes – Full Class – SciTrek Lead)

- Tell students what they will do next time.

Day 6: Conclusion/Poster Making

Schedule: You are responsible for BOLD sections

Introduction (SciTrek Lead) – 2 minutes
Conclusion (SciTrek Volunteers) – 18 minutes
Poster Making (SciTrek Volunteers) – 35 minutes
Wrap-Up (SciTrek Lead) – 5 minutes

Preparation:

1. Ask the classroom teacher for a place to leave the student posters.
2. Have volunteers set out the notebooks.
   a. If students are not in the classroom before SciTrek starts have volunteers set out the notebooks where students should sit as they come into the class.
   b. If students are in the classroom before SciTrek starts have volunteers set out the notebooks where they want students to sit and students will move to these spots after the introduction.
CONCLUSION

We can conclude that the thicker the liquid type, the smaller the height of the smear.

because the thick liquid, soap, had a smear height of 1 cm while the thin liquid, water, had a smear height of 10 cm.

Can you test the first part (claim) of the conclusion?

☑ YES ☐ NO (If you checked this box go back and revise your claim so that it can be)

The second part of the conclusion is data because it contains a measurement.

I acted like a scientist when I wrote a set-up of my experiment and the procedure.

EXPERIMENTAL SET-UP

Liquid type:

R. water, soap, vinegar

PROCEDURE

1. Set four test tubes with each of the following: E. water, F. water, G. soap, H. vinegar

2. Put a dot of each solution on a blank graph paper starting 2 cm from the bottom

3. Test papers in test tubes

4. Time for 5 minutes

5. Remove paper from test tube

6. Measure smear height and observe color

SciTrek Number Approved: ___
Introduction: (2 minutes – Full Class – SciTrek Lead)

- If needed have SciTrek volunteers set out notebooks where students will sit.
  - Tell students not to move the notebooks.
- Review the class question.
- Tell the students that they will be finishing their conclusion, filling out the sentence frame “I acted like a scientist when____,” and making a poster today.
- If needed tell students to move to their notebooks.

Conclusion: (18 minutes – Full Class – SciTrek Volunteers)

- Walk around and help groups that are struggling.
- Make sure that groups are generating a claim (ideally the claim will allow them to make a prediction about future experiments) and using data to back it up.
  - If groups use an observation as data make sure the data statement includes “we observed.”
  - Do not reference trial letters in conclusion
- Volunteers struggle with conclusions, therefore, try to check at least one conclusion for each large group.
- Have students fill out the sentence frame on page 21, “I acted like a scientist when____.”

Poster Making: (35 minutes – Subgroups – SciTrek Volunteers)

- Help volunteers glue poster pieces onto the poster. When gluing, make sure that the volunteers are gluing the poster in the exact order that is shown in the diagram and that the poster has a landscape orientation.
- Make sure that the student in each group who is presenting the results graph has a sentence frame sticker in their notebook and the volunteer has gone over how to present the four sentences with the student several times.
- Each student should have the part(s) that they are presenting highlighted and numbered in their notebook. (1) scientists’ names, (2) question, (3) experimental set-up, (4) procedure, (5) results graph, and (6) conclusion.) (see pictures above)

Wrap-Up: (5 minutes – Full Class – SciTrek Lead)

- Ask students the following questions:
  - How did you act like a scientist during this project?
  - What did you do that scientists do?
Day 7: Poster Presentations

Schedule: You are responsible for BOLD sections

- Introduction (SciTrek Lead) – 2 minutes
- Practice Posters (SciTrek Volunteers) – 5 minutes
- Poster Presentations (SciTrek Volunteers/SciTrek Lead) – 51 minutes
- Wrap-Up (SciTrek Lead) – 2 minutes

Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the notes on presentations (page 3-4, picture packet). If there is no document camera write the class question on the board.
2. Organize posters so that experiments about the same changing variable will be presented back to back.
3. Have volunteers pass out student notebooks.

SciTrek Notebook Pages:

- Introduction: (2 minutes – Full Class – SciTrek Lead)
  - Tell students that they will have 5 minutes to practice their posters.
  - DO NOT GIVE STUDENTS MORE THAN 5 MINUTES OR YOU WILL RUN OUT OF TIME FOR POSTERS.
Practice Posters: (5 minutes – Subgroups – SciTrek Volunteers)

- Organize posters so that experiments about the same changing variable are presented back to back.
- Make sure students are reading from their notebook and practicing the poster in the following order: 1) scientists’ names, 2) question, 3) experimental set-up, 4) procedure, 5) results graph, and 6) conclusion. They will NOT read the “I acted like a scientist when _______” or results table from their poster.

Poster Presentations: (51 minutes – Full Class – SciTrek Volunteers/SciTrek Lead)

- Tell students that if they ask a scientific question (a question that helps summarize what the group did/learned) they will receive a SciTrek pencil after the presentations are done.
- Have students present their posters.
- While posters are being presented, record each group’s changing variable and data on pages 3 and 4 of the picture packet while students record the information on pages 22 and 23 of their notebook.
  - When groups read their question, record the changing variable.
    - Stop the presentation after the group says their question and have the class identify the changing variable.
  - When groups read their graph, record what the group was measuring, the values of the changing variable, and their measurements.
- After each presentation ask students
  - What questions do you have for this group?
  - Can someone summarize what we learned from this group?
- Record what they learned under the summary on pages 3 and 4 of the picture packet while students record the summary of pages 22 and 23 of their notebook.
- Students will not record information about their group’s poster presentation.
- After all presentations are over have students summarize the variable values that they would select to make the longest smear.

Wrap-Up: (2 minutes – Full Class – SciTrek Lead)

- Tell the students that the volunteers that have been working with them are undergraduate and graduate students that volunteer their time so that they can do experiments. Have the students say thank you to the volunteers. This is the last day with their SciTrek volunteers, therefore, they should say goodbye to them.
- Have volunteers give students SciTrek pencils.
- Tell students to remove the paper part of their nametag from the plastic holder and that they can keep the paper nametag but need to give the plastic holder back to their SciTrek volunteer.

Day 8: Conclusion Assessment/Tie to Standards

Schedule: You are responsible for BOLD sections

Conclusion Assessment (SciTrek Lead) – 10 minutes
Tie to Standards (SciTrek Lead) – 50 minutes
Preparation:

1. If the classroom has a document camera, ask the teacher to use it for the tie to standards activity (pages 24-26, student notebook) and tie to standards pictures (pages 5 and 6, picture packet).
2. Tape up the Matter and Physical Property charts.
3. Have the mixtures and pure substances available for use during the tie to standard activity.
4. Pass out the conclusion assessments and student notebooks.
5. Remind the teacher to give you their lab coat at the end of the day.

SciTrek Notebook Pages and Charts:
Conclusion Assessment: (10 minutes – Full Class – SciTrek Lead)

- Pass out assessments.
- Page 1: Read each statement and have students circle if statement is a claim, data, or opinion.
• Page 2: Have students underline controls, circle changing variable(s), and box information about data collection on the data table. Then have them decide if the group could make a conclusion.
• Page 2: Read each statement and have students identify if the statement is a claim or data and then circle if statement is a correct claim, correct data, or incorrect based on the data table.
• Page 3: Repeat the process for page 3.
• Collect assessments.

Tie to Standards: (50 minutes – Full Class – SciTrek Lead)

Mysterious Robbery (15 minutes)

• Explain to student that 10 years ago a robbery happened that was never solved. The police have contacted you to solve the cold case. At the time of the crime a note, written in black pen, was passed to the teller which read “Give me all your money.” The teller handed over the money but kept the note. In the confusion that followed, the robber managed to get away. At the time there were eight suspects. Each of these suspects was found with a black pen on them (which the police still have). The only other evidence that the police have from the original crime was the note.
  o If asked, tell students that no fingerprints or DNA was found.
• Have students determine how they could help the police solve the crime.
  o If they took all the pens they could determine what colors the black pens separate into and match it to the colors the pen on the note separated into.
• Ask students if it would be easier to identify the robber if they had a tall or short smear.
  o Tall smear.
• Have students help you decide which values of the variables they should tell the police to use to get the biggest smear for question 1. (page 24, student notebook)
  o Time: 10 minutes
  o Liquid type: Water
  o Dot size: “All would give similar height smears”
  o Liquid amount: Liquid level just below the dot
• Tell students that you gave the police their suggested values and they ran the test. Show them the data. (page 5, picture packet)
• Have the students identify the robber and then write a conclusion about their findings for question 2. Make sure that for the data statement contains “we observed”
Mixture Discussion (10 minutes)

- Ask students what they have learned about black ink and have them fill in question 3.
  - That it is a mixture.
- Tell students the definition of matter and ask them if several objects around the room are matter. Then tell them that things like dreams, ideas, and energy are not matter.
- Ask students if the black ink is matter and then tell them the definition of a mixture and review mixtures.
  - Give the example mixture of Lucky Charms and have students identify the parts of the mixture.
  - Have students come up with at least one other mixture that can be distinguished by eye and record it and its parts on the chart.
  - Tell students that sometimes you cannot see the individual parts of a mixture and give the example of the black pen and air and have students give you the parts of the mixture.
  - Have students come up with one other mixture that cannot be distinguished by eye and record it and its parts on the chart.
- Tell students that mixtures can be separated into pure substances.
- Review the definition of a pure substance with the students from the Matter chart.
  - Give the example of water.
  - Have students come up with two more pure substances and record them on the chart.
- Tell students that mixtures can be separated into pure substances by using differences in the physical properties of the parts of the mixture and review the definition of physical properties from the Physical Properties chart.
- Ask students what properties they could use to separate the luck charms and record these properties on the physical properties chart. Make sure they come up with ~3 physical properties.
  - Make sure the record the physical property (ex: color) and not the values of the property (ex: red, blue, etc.)
- Ask students the following questions:
  - Is black ink a mixture or a pure substance? (mixture)
  - Were we able to separate the black ink into parts? (yes)
  - How were we able to separate out the different dye colors? (put the strips in liquids)
  - How come some colors traveled farther up the paper than others? (some dyes are attracted to water more than the paper and were carried up the strip farther).
- Tell student that the physical property that we were using to separate the blank ink was the “attraction to water” and “attraction to paper” and record these on the Physical Properties chart while students record these for question 4.
- Show students the example strip from day 1 (page 1, picture packet) and have them answer questions 5 and 6.
- Have students answer question 7.

Separating Mixtures/Physical Properties (10 minutes)

- Show students the jar of water and sand (tie to standards box) and have them determine the following:
  - Types of physical properties they could use to separate the mixture (ex: state of matter).
  - Physical properties of each component of the mixture (ex: liquid and solid).
  - If water and sand are pure substances.
- Record any new types of physical properties students come up with on the Physical Properties chart.
- Pass out the mixture baggies to pairs of students. Each pair will only get 1 mixture type.
- Tell students to open their mixture bag.
- Have students determine the following:
  - Types of physical properties they could use to separate the mixture.
  - Physical properties of each component of the mixture.
  - If each component of the mixture is a pure substance.
- Have students share their type of physical properties/physical property for each substance.
- Record any new types of physical properties on the Physical Properties chart.
- Discuss whether each part of the mixtures is a pure substance or not.
- Collect mixture bags.

**Pure Substances (15 minutes)**

- Tell students that physical properties can also be used to identify pure substances and have student fill out question 9.
- Pass out the labeled pure substances
- Have students write down the physical properties of each of the pure substances.
- Collect labeled pure substances and pass out lettered pure substances.
- Have students identify the lettered pure substances.

**Extra Practice Solutions:**

![Extra Practice Solutions](image)