Investigating Water Transformations
Keeping Track of Water
Dear student scientist,

The science notebook is a scientist's essential tool for doing science and it's yours too! Scientists always keep their notebooks open and at their side and remember to record the date before they begin to work. You'll do this too.

What you write depends on where you are in an investigation. You might record a prediction, report an observation or some measurements, make a claim and describe the evidence you think backs it up. Your notebook is a place to write down things you wonder about or questions you have so you don't forget them.

Your notebook will contain different kinds of writing. You might make a numbered list to describe steps in a procedure, make a data table to organize your measurements, create a drawing with labels and notes to explain what you think is going on when something is too small to see.

Your notebook is for you, to help you remember what you were thinking, what you did, what you found out. Scientists' notebooks – and yours - are for others too, in case they want to replicate a procedure, compare their findings, or understand what another scientist was thinking or reasoning.

In the back of this notebook, you'll find suggestions for annotated drawings and different ways to represent data.

Time for science: open your notebook, enter the date, and fill it up with your ideas, questions, drawings, measurements, claims, and explanations!
Why are these ships in a field?

Staecker, via Wikimedia Commons

Staecker, via Wikimedia Commons
Why are these ships in a field?

Glad Rom, via Wikimedia Commons

TwoWings, via Wikimedia Commons
## Data Table: Weight of mini-lake

<table>
<thead>
<tr>
<th>Date</th>
<th>Day #</th>
<th>Weight of mini-lake (grams)</th>
<th>Notes</th>
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</thead>
<tbody>
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</tbody>
</table>
## Data Table: Weight of mini-lake (continued)

<table>
<thead>
<tr>
<th>Date</th>
<th>Day #</th>
<th>Weight of mini-lake (grams)</th>
<th>Notes</th>
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<tbody>
<tr>
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</table>
Making mini-lakes

Mini-lake components:

Weight of empty vial with cap (tare weight): ____________________________

Estimate of volume of sand (Investigation 2) ____________________________

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (grams)</th>
<th>Volume (cubic centimeter) (Investigation 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sandwich box and cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sand only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gravel only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rocks only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Weights</td>
<td></td>
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</tr>
</tbody>
</table>

Weight of completed mini-lake (Investigation 2): ____________________________
Making mini-lakes

Procedure:
Measure volumes and assemble mini-lake

Record estimate and measurements in Making mini-lakes table.

1. *Estimate* and record the volume of sand
2. Measure and record the volume of sand
3. Measure and record the volume gravel
4. Arrange the gravel, sand, and rocks in the sandwich box
5. Measure and record the volume of water
6. Add water to the mini-lake and mark the water level on a piece of tape
7. Name your mini-lake. Write the name on a piece of tape on the cover.
8. Put on the cover so it’s tight.
9. Weigh the completed mini-lake and record the weight.
Reflection:
When we compared the Sum of Weights of the components of our mini-lake with the completed mini-lake, we found:

_____________________________________________________________________________

_____________________________________________________________________________

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_____________________________________________________________________________

I would expect the Sum of Weights and Weight of complete mini-lake to be (the same or different) because:

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

As we measured and arranged materials in our mini-lake, I was surprised that:

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________
Weight and volume data

Leila, Deneb, Tomas, and Fern measured the weight and volume of a sample of material, and recorded their measurements in a data table. Two of the samples were water. They forgot to write down the kind of material they used.

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight of sample</th>
<th>Volume of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leila</td>
<td>42 g</td>
<td>41 cc</td>
</tr>
<tr>
<td>Deneb</td>
<td>28 g</td>
<td>20 cc</td>
</tr>
<tr>
<td>Tomas</td>
<td>178 g</td>
<td>178 cc</td>
</tr>
<tr>
<td>Fern</td>
<td>76 g</td>
<td>59 cc</td>
</tr>
</tbody>
</table>

The two people who used samples of water are:

Reasons are:
Reflecting on the weight of small bits of matter

If a 1 cubic centimeter dropper filled with water made 100 drops, I think a single drop would weigh:

Reasons are:

My ideas about the weight of a single grain of sand are:
What happens when salt dissolves in water?

Put a strip of masking tape on the cup and mark the water level before adding the salt.

**Weight Data:**

**Water:**

- Weight of water and cup: __________________________
- Weight of empty cup (tare weight): __________________________
- Weight of water **only:** __________________________

**Salt:**

- Weight of salt and cup: __________________________
- Weight of empty cup (tare weight): __________________________
- Weight of salt **only:** __________________________

**Weight of water only and salt only** __________________________

**Water and Dissolved Salt:**

- Weight of cup and water and dissolved salt: __________________________
- Weight of empty cup (tare weight): __________________________

**Weight of water and dissolved salt only** __________________________
What happens when salt dissolves in water?

Volume Data:
Drawings to show the water level before and after dissolving salt.

What happens when salt dissolves in water?

Claim:
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

Evidence that supports the claim (use weight and volume data):
_____________________________________________________________________________
_____________________________________________________________________________
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Procedure:
Adding salt to the mini-lake
  1. Weigh your mini-lake and record the weight
  2. Put 2 spoons of salt into the water in your mini-lake (don’t stir)
  3. Weigh your mini-lake again and record the weight
What happens to drops of water?

Observations:
Observations of water drops placed on a paper towel.

Observations of water drops in mist sprayed on the outside of the plastic cup.
What happens to drops of water?

Explanation:
Annotated drawing to explain what happened to the water drops sprayed onto the outside of a plastic cup.
Uncovering the Mini-lakes

I predict that when we take off the cover of our mini-lake:

_____________________________________________________________________________
_____________________________________________________________________________
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Reasons for my prediction are:

_____________________________________________________________________________
_____________________________________________________________________________
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Evidence needed to test the prediction is:

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Investigation 7
2-bottle closed systems – Initial Observation

Investigation 7
Predict what will happen in the 2-bottle system?

Notes/Observations:

System Type:

Date:
What is happening in the 2-bottle system?
What is happening in the 2-bottle system?
What is happening in the 2-bottle system?
Date: _________________________

Notes about the 2-bottle system

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Comparing ice and water

<table>
<thead>
<tr>
<th>Same</th>
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<table>
<thead>
<tr>
<th>Different</th>
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<tbody>
<tr>
<td>Ice</td>
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</table>
Predictions about freezing water

What will happen to weight when water freezes?
Prediction (and reasoning):
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What will happen to volume when water freezes?
Prediction (and reasoning):
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Procedure:
Freezing water samples
1. Place a strip of masking tape vertically on the outside of water bottle.
2. Write your initials on the tape.
3. Mark the water level. If necessary, adjust the water level to align with the mark, using the pipette.
4. Weigh the water bottle and water and record the data in the table, What happens to weight and volume when water freezes and ice melts?
What happens to weight and volume when water freezes and ice melts?

Data:

<table>
<thead>
<tr>
<th>Inv #</th>
<th>Bottle of (water or ice)</th>
<th>Weight (grams)</th>
<th>Volume (use labeled drawings)</th>
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<tr>
<td>10</td>
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<td>12</td>
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</table>
What happens to weight and volume when water freezes?

Reflections:
A comparison of my prediction and our findings:

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If there are differences, some possible reasons are:

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Questions I have about water freezing:

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What changes and what stays the same as ice melts?

Claim about what changes and what stays the same when ice melts (and the evidence to support the claim):

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I think the most convincing evidence for the claim that water and ice are the same kind of matter is:

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Particle Magnifier
ice and water particles

As the temperature of ice or water changes:
• Does the size of the particles change or stay the same?
• Does the motion of the particles change or stay the same?
• Does the space between the particles change or stay the same?

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Compare the particles of ice and water:
• Is the size of the particles the same or different?
• How does the motion of particles compare?
• How does arrangement of particles compare?

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Does air take up space?

Observations of coupled syringes:

Claim (air does or doesn’t take up space):

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_____________________________________________________________________________
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Evidence that supports the claim.

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Does air have weight?

Observations of air in balloons:

Claim (air does or doesn’t have weight):

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_____________________________________________________________________________

Evidence that supports the claim.

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Predicting the compressibility of water and air

**Predictions:**
Imagine the plungers of these **sealed** syringes are pushed.

Water syringe
I predict:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Air syringe
I predict:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

I think so because:

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_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
Observe the compressibility of water and air

**Observations:**
When the plunger is pushed in the air syringe:

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When the plunger is pushed in the water syringe:

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Explaining the compressibility of water and air

Annotated drawing to explain observations:

- How do you explain the difference in the compressibility of air and water?
- What would you see at the particle level to explain what is going on?
Investigation 16

Particle Magnifier
air particles

When the air is heated:
• Does the size of the particles change or stay the same?
• Does the motion of the particles change or stay the same?
• Does the space between the particles change or stay the same?

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When the air is cooled:
• Does the size of the particles change or stay the same?
• Does the motion of the particles change or stay the same?
• Does the space between the particles change or stay the same?
Heating and cooling air

Annotated drawing to show what happens when a bottle of room temperature air was placed in warm water and cold water – observations and explanations:
New Ideas

In the real world, water is constantly transformed from liquid to vapor (gas) or ice (solid) and back again. Here's what I learned from each of the following to help understand these transformations.
Reference
Annotated Drawings

Annotated drawings explain a scientific process or answer a scientific question. They help communicate your ideas to others. These are not finished products – as your ideas change, you can make changes to your annotated drawing!

An annotated drawing should:
- Provide an explanation.
- Use simple outline drawings.
- Use labels, arrows, and a color key.
- Have notes that explain important ideas.

To draw something you cannot actually see, draw an imaginary “magnifying lens” to zoom in and make visible something that is invisible to the human eye.

Questions for Reviewing Annotated Drawings

1. What is the drawing trying to explain?
2. Is there anything that you don’t understand and would like clarified?
3. If you compare two annotated drawings, how are they the same? How are they different?
Data Representations

Compare

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<td>Different</td>
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List

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<tr>
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<td>3)</td>
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<td>4) ...</td>
<td>● ...</td>
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</table>

Table

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<tr>
<th>Case</th>
<th>property #1</th>
<th>property #2</th>
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Data Representations

Labeled Drawing

Measure Line

Graph

Bar Graph