

**Can Scientific Method Be Used to Solve a Problem?**

**Learning Target:** ***Scientific Process***

***I Can***… Use the scientific process to determine if two unknown liquids are similar or different.

***I Will***…

* Make careful observations of the properties/characteristics of the liquids.
* Form a hypothesis about whether the two test liquids are similar of different.
* Conduct an experiment that compares the characteristics of the two liquids.
* Record data collected during the experiment.
* Create a claim to answer whether the liquids are similar of different.
* Use evidence and reasoning to support your claim.

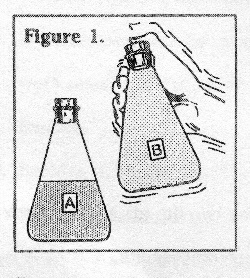
**PROCEDURE:**

**Part A. Observation**

***Accurate observations are a necessary part of the scientific method.***

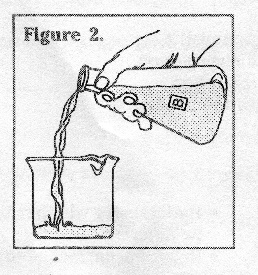
1. **DO NOT** remove the caps stoppers and **DO NOT** shake the contents. **Examine** the two flasks.
2. Record in Table 1. (on your lab sheet) two or three observed similarities and differences between the contents of flask A and flask B AND answer the set of questions.

**Part B. Experimentation**

****In determining if the two liquids are the same or not, a scientist would carry out some experiments. Experimentation is another component of the scientific method.

**Experiment 1.** ***What happens if you shake the liquids?***

1. Making sure your thumb covers the cap/stopper as you shake; give each flask **one** *hard-shake using an up-and-down motion* with your hand. See Figure 1.
   1. Observe each flask carefully.
2. Record your observations in Table 2. (on your lab sheet) Again look for similarities and differences in the contents of the two flasks. Answer the set of questions below the data table.

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**Experiment 2. *What happens if you remove some of the liquid in flask B so it contains the same volume of liquid as flask A?***

1. Go over to the lab counter (by Mrs. O’s desk). Remove the cap/stopper from flask B and pour out half the contents into a beaker. See Figure 2. Make sure that the volume of liquid in flask B is equal to the volume of liquid in flask A. Replace the cap/stopper. Pour out the liquid in the beaker into the sink & rinse the beaker with water. Return to your lab group.
2. Holding the cap/stopper in place; give both flasks **one** *hard-shake using an up-and-down motion*.
3. Observe each flask carefully.
4. In Table 3. (on your lab sheet) record any similarities or differences observed. Answer the set of questions below the data table.

**Experiment 3. *What happens if you shake the flask more than once?***

1. Use a timer (phone) to record the number of seconds it takes each flask to return to its original condition after **shaking once hard with an up-and-down** motion.

-Record the time under Trial 1 in Table 4. (on your lab sheet)

1. Now, record the number of seconds it takes each flask to return to its original condition after **shaking hard TWICE.** 
   1. Record your data under Trial 1 in Table 4. (on your lab sheet)
2. Now, record the number of seconds it takes each flask to return to its original condition after **shaking hard THREE TIMES.** 
   1. Record your data under Trial 1 in Table 4. (on your lab sheet)
3. In any experiment, running several trials reduces the probability of making errors and increases the potential validity consistent data.
   1. Run two more trials for each part of Experiment 3. Be sure to keep track of the amount of time needed for the liquids to return to their original conditions.
4. Record the results of Trials 2 and 3 in Table 4. (on your lab sheet)
5. Answer ALL analysis questions and complete a C-E-R conclusion.

**DATA AND OBSERVATIONS**

**Table 1.**

|  |  |
| --- | --- |
| **First Observations** | |
| **Similarities** | **Differences** |
|  |  |
|  |  |
|  |  |
|  |  |

1. Do you think the two flasks contain the same liquid? YES / NO

Explain why.

1. Do both flasks contain the same volumes of liquid? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What gas might be in the upper half of flask A that is not in flask B?
3. Is there any direct evidence for your answer to question 2c?

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1. Make a hypothesis about the contents of the two flasks. Are they the same or different? (Remember a hypothesis is a testable statement written in the form of ***If…, then; because…***)

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**Table 2.**

|  |  |
| --- | --- |
| **Results of Experiment 1** | |
| **Similarities** | **Differences** |
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|  |  |
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|  |  |

1. After shaking the flasks, do you think they contain different liquids? YES / NO
2. What was present in flask A that might have been responsible for the change in the liquid?

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**Table 3.**

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| --- | --- |
| **Results of Experiment 2** | |
| **Similarities** | **Differences** |
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1. Do both flasks now appear to contain the same or similar liquid? YES / NO
2. What might have been added to flask B that was not present before?

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**Table 4.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Three Trials of Experiment 3** | | | | | | | | | | |
|  | **Time in seconds to return to original condition** | | | | | | | | | |
| **1 shake** | | | **2 shakes** | | | **3 shakes** | | | |
| **Trial** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| **Flask A** |  |  |  |  |  |  |  |  |  |
| **Flask B** |  |  |  |  |  |  |  |  |  |

1. Look at your data in Table 4. Does flask **A** show an increase or decrease in the time needed to return to its original condition as the number of shakes increases from one to three? INCREASE / DECREASE
2. Does flask **B** show a similar change YES / NO
3. Do three trials give better evidence that the liquid in flask A is “behaving” in a way similar to the liquid in flask B after shaking each flask:

once? YES / NO

twice? YES / NO

three times? YES / NO

1. Do three trials give better evidence that an increase in time is needed for the liquid to return to its original condition as the number of shakes increase from one to three:

for flask A YES / NO

for flask B YES / NO

**CONCLUSION**

*Answering these question should help your form your claim-evidence-and reasoning.*

1. Which experiment or experiments might have helped you to decide that the liquids in flask A and B were similar or different? **Explain the support for your answer**.

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1. Besides the liquid itself, what else seems to be needed for the liquid to change color?

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1. Explain why flask B did not change color when shaken in Experiment 1.

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1. Why must the liquids in the half-filled flasks be shaken to produce a color change?

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1. Why did more shaking increase the amount of time needed for the liquids in flasks A and B to change back to their original condition?

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**C-E-R Experimental Question: *Do you think both the flasks contain the same liquid?***

**Claim (one sentence):**

**Evidence & Reasoning (at least one paragraph):**