Investigative Science

Learning goal: Properly apply all steps in the scientific method when problem solving.

Tuesday, August 6, 2019

Learning goal: Properly apply all steps in the scientific method when problem solving.

Learning scale:

1	2	3	4
Name the steps	Name the steps and follow directions in an investigation	Can design and conduct an investigation leading to a conclusion	Design and carry out an investigation leading to a valid and rational conclusion

Student's self-evaluation: *Complete at home or at the end of class, use the 4-3-2-1 Learning scale (two to three sentences).*

4
Design, complete, valid conclusion

3
Design & complete

2
Know steps, follow directions

1
Know the steps

Review

Identifying the parts of a experiment

Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious! He wondered if salt can improve the taste of sweets? He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food. So he thought that yes, adding more salt to sweets would improve the taste. He decided to test this by adding various amounts of salt and measuring the quality of the ice cream. He came up with the experimental question; how does the amount of salt affect the quality of ice cream? His hypothesis was, If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter. He made four batches of ice cream. One batch of ice cream had no salt. The other three had more and more salt. He tasted the ice cream and rated the texture, saltiness, sweetness and over all flavor on a scale from 0-4. He discovered that his hypothesis was supported by the data! As the amount of salt increased, the ice cream tasted better and better!

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Review

Identifying the parts of a experiment

But how are experiments developed? Not really one way.. This is just one path.

1. **Make an observation (senses, instruments, data, previous experiments, etc..)**
2. **Ask an informal, how, what or why question about observation**
3. **Find evidence that helps you come up with an answer to your informal question**
4. **Make an inference (informal hypothesis) that may explain an observation and answer your question**
5. **Design an experiment that will help answer your question**
6. **Identify variables, one variable you will change (independent), one variable you will measure (dependent) and the variables you need to control**
7. **Identify the control group to compare your results to.**
8. **Change your informal question into an experimental question (How does… affect..)**
9. **Change the inference to a formal hypothesis (if, then, because…)**
10. **Conduct experiment and determine if the data supports or disproves your hypothesis.**
11. **Report your results!! Ask new questions!!**

Know steps, follow directions

1

Know the steps

Review

Identifying the parts of a experiment

Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious! He wondered if salt can improve the taste of sweets? He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food. So he thought that yes, adding more salt to sweets would improve the taste. He decided to test this by adding various amounts of salt and measuring the quality of the ice cream. He came up with the experimental question; how does the amount of salt affect the quality of ice cream? His hypothesis was, If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter. He made four batches of ice cream. One batch of ice cream had no salt. The other three had more and more salt. He tasted the ice cream and rated the texture, saltiness, sweetness and over all flavor on a scale from 0-4. He discovered that his hypothesis was supported by the data! As the amount of salt increased, the ice cream tasted better and better!

What was the observation? **Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious!**

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Identifying the parts of a experiment

Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious! **He wondered if salt can improve the taste of sweets?** He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food. So he thought that yes, adding more salt to sweets would improve the taste. He decided to test this by adding various amounts of salt and measuring the quality of the ice cream. He came up with the experimental question; how does the amount of salt affect the quality of ice cream? His hypothesis was, If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter. He made four batches of ice cream. One batch of ice cream had no salt. The other three had more and more salt. He tasted the ice cream and rated the texture, saltiness, sweetness and over all flavor on a scale from 0-4. He discovered that his hypothesis was supported by the data! As the amount of salt increased, the ice cream tasted better and better!

What was the informal question? **He wondered if salt can improve the taste of sweets?**

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Identifying the parts of a experiment

Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious! He wondered if salt can improve the taste of sweets? **He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food.** So he thought that yes, adding more salt to sweets would improve the taste. He decided to test this by adding various amounts of salt and measuring the quality of the ice cream. He came up with the experimental question; how does the amount of salt affect the quality of ice cream? His hypothesis was, If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter. He made four batches of ice cream. One batch of ice cream had no salt. The other three had more and more salt. He tasted the ice cream and rated the texture, saltiness, sweetness and over all flavor on a scale from 0-4. He discovered that his hypothesis was supported by the data! As the amount of salt increased, the ice cream tasted better and better!

What evidence was used to answer the question? **He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food.**

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Review

Identifying the parts of a experiment

Mr. Fireng tried salted caramel for the first time and he thought it tasted delicious! He wondered if salt can improve the taste of sweets? He remembers reading an article that stated that combining salt sugar and fat can improve the taste of food. **So he thought that yes, adding more salt to sweets would improve the taste.** He decided to test this by adding various amounts of salt and measuring the quality of the ice cream. He came up with the experimental question; how does the amount of salt affect the quality of ice cream? His hypothesis was, If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter. He made four batches of ice cream. One batch of ice cream had no salt. The other three had more and more salt. He tasted the ice cream and rated the texture, saltiness, sweetness and over all flavor on a scale from 0-4. He discovered that his hypothesis was supported by the data! As the amount of salt increased, the ice cream tasted better and better!

What was the inference (informal hypothesis) **So he thought that yes, adding more salt to sweets would improve the taste**

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How was the question going to be tested? **He decided to test this by adding various amounts of salt and measuring the quality of the ice cream**

Review

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Identify variables: independent variable: **amounts of salt,** dependent variable. **and measuring the quality of the ice cream.**

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Identify the control group to compare your results to. **One batch of ice cream had no salt.**

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What was the experimental question **How does the amount of salt affect the quality of ice cream?**

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What was the formal hypothesis **If the amount of salt increases, then the quality of the ice cream will increase because the salt will make it sweeter.**

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Did the results support or disprove Mr. Fireng's hypothesis? Look at the results! **the ice cream tasted better and better! It was supported.**

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I-TALK

I = Information: Type of information matches the graph. The correct type of graph is being used (bar vs. line graph, etc..).

T= Title: The graph contains a title that describes what the graph is about. An experimental question works well for a title.

A= Axis: The X, Y-axis are scaled correctly and spaced evenly. The graph takes up as much of the paper as possible.

L= Labels: Each axis is label with units

K= Key: If more than one data set is in the graph, the key describes which line is which.

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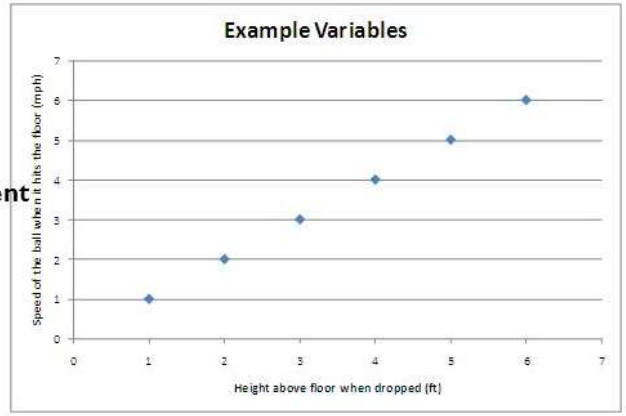
Write this on graph handout

DRY MIX

Dependent variable

Responding

Y-Axis



Dependent Variable

Manipulated

Independent variable

X-Axis

Independent Variable

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THE FIGHTER PILOT CHALLENGE: IN THE BLINK OF AN EYE

To be a fighter pilot you must have very fast reactions – travelling at speeds of over 2500 km per hour (twice the speed of sound) means about 700m every second! So splits of a second can make all the difference, you blink your eyes and you have moved an incredible 140m! Could you respond to outside events with minimal delay and take appropriate action... let us test your reaction time?

The simple experiment described on this page is dead simple; you test the time it takes to react to catch a falling ruler. Just make sure it is not a metal ruler ...it could seriously injure your foot!

The Science Of Catching The Ruler

The experiment tests how long it takes the brain to translate visual information (falling ruler) into your voluntary (or conscious) motor commands and actions (grasping finger movements) that lead to the ruler being caught. The shorter the time, the faster your reactions. That is if you were paying attention in the first place! Indeed, practice specifically affects the 'associative centres' in the brain, so that you can respond faster to what is happening in your visual world. The flow of information along the 'visual' and 'motor' nerve pathways is relatively constant even with lots of practice. It all comes down to 'attention' or '...being on the ball!'

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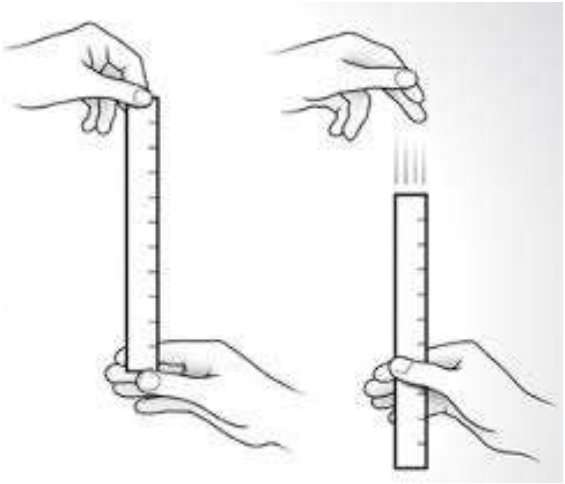
Experimental Procedures

1. Get a 30cm ruler…
2. One person holds the ruler near the 30cm mark and lets it hang vertically…
3. The other person places their thumb and index finger either side of the 0cm mark ready to catch it when it falls - their fingers shouldn't touch the ruler.
4. Without warning the person holding the ruler lets go and the subject tries to catch the ruler as soon as possible.
   [Hint: To prevent guessing, vary the time before letting go of the ruler].
5. The level (in cm) just above the subject's first finger where the ruler was caught is recorded.
6. ***At any time if you do not catch the ruler in time, record this as 35 cm.***
7. The same person is tested 5 times and then calculate the mean average of their results (add all five numbers together and then divide by five).
8. Now swap over and test your partner.



Trial	Dominate Hand		Non-Dominate Hand	
	Distance Ruler Falls (cm)	Time in milliseconds (See chart)	Distance Ruler Falls (cm)	Time in milliseconds (See chart)
1				
2				
3				
4				
5				
Total				
Average				

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DISTANCE – REACTION TIME CONVERSION TABLE

From the table below, the 'mean catch distance' on the ruler can be converted into a 'mean reaction time' in milliseconds (Remember: 1 millisecond is one thousandth of a second).

Distance (cm)	Reaction time (milliseconds)	Distance (cm)	Reaction time (milliseconds)
1	50	16	180
2	60	17	190
3	70	18	190
4	80	19	200
5	90	20	200
6	100	21	210
7	120	22	210
8	130	23	220
9	140	24	220
10	140	25	230
11	150	26	230
12	160	27	230
13	160	28	240
14	170	29	240
15	170	30	250

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Science basics (These are all review)

Qualitative observation: An observation using your senses, just words, no numbers.
Quantitative observation: An observation that includes a number and/or a measurement.
Inference: an interpretation that explains an observation.
Control group: A group that remains under normal conditions during an experiment
Independent (*Manipulated*) variable (*IV*): The variable you manipulate in the experiment.
Dependent (*Responding*) variable (*DV*): The variable you measure, it is affected by changing the IV.
Conclusion: A summary of what is learned in an experiment.
Control Variable: The variables keep constant in the experiment.
Experimental Question: A formal cause-effect question. Asks about the relationship between two variables.
** Must be in "How does the _____ affect _____?"
(Independent variable) *(Dependent variable)*
Hypothesis: A possible explanation for a set of observations or to a scientific question; must be testable.
Hypothesis: If the _____ is used, the _____
(Independent variable) *(Dependent variable)*
Will increase because _____

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Guided Experiment

Experimental Question: How does the use of the dominate hand affect reaction time?

(Independent variable) *(dependent variable*

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Guided Experiment

Experimental Question: How does the use of the dominate hand affect reaction time?

(Independent variable) *(dependent variable*

Independent variable: _____use of the dominate hand _____

Dependent Variable: _____reaction time _____

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Investigative Science

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Guided Experiment

Experimental Question: How does the use of the dominate hand affect reaction time?
(Independent variable) *(dependent variable*

Independent variable: use of the dominate hand

Dependent Variable: reaction time

Control variables:

1. Sitting/standing
2. The type of ruler used
3. The student doing the dropping

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Investigative Science

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Guided Experiment

Experimental Question: How does the **use of the dominate hand** affect **reaction time**?
(Independent variable) *(dependent variable*

Independent variable: ____**use of the dominate hand** _____
Dependent Variable: _____**reaction time** _____
Control variables:
1. ___**Sitting/standing**_____
2. ____**The type of ruler used**_____
3. ___**The student doing the dropping**_____

Hypothesis: If the _**use of the dominate hand** _ is used, the __**reaction time** ____
(Independent variable) *(Dependent variable)*
Will increase because _____**Why?**_____
_____.

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I-TALK

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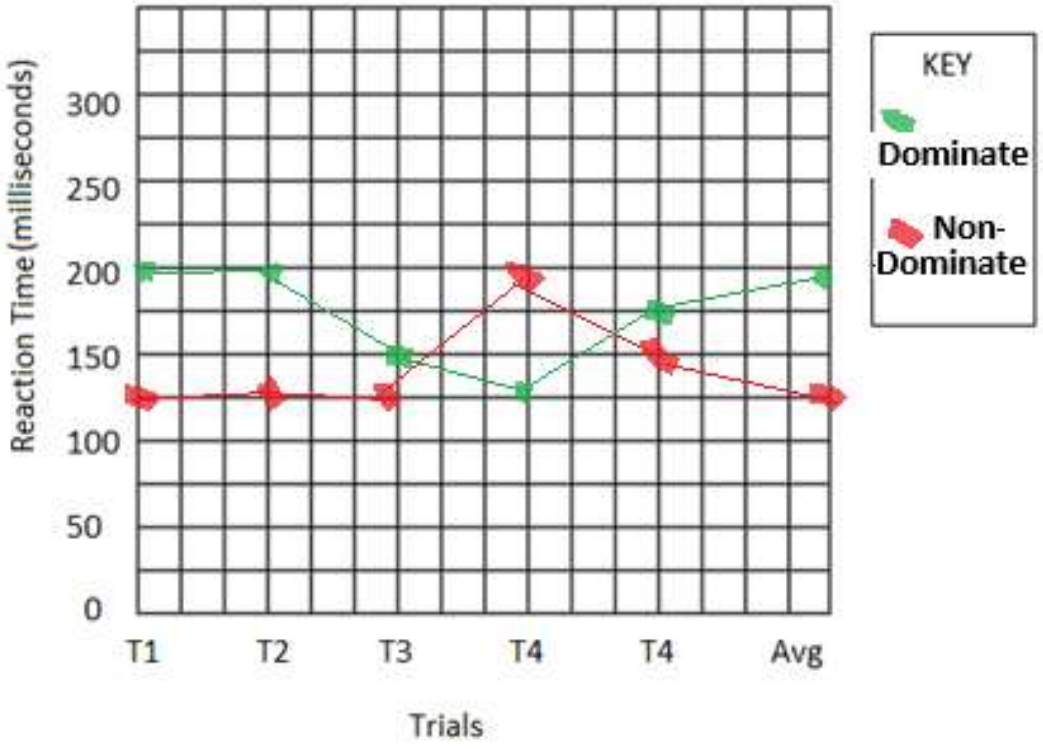
Experimental Question:

How does the use of the dominate hand affect reaction time?



You will be graphing one line for your dominant hand, one for your non-dominant. Make a key!

steps

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Data analysis:

The data tables and graphs show *(Describe the data in words)* _____

_____

_____

_____

The hypothesis, *(restate hypothesis)*, is *(supported or refuted)* by the data because *(use the data to support this)* _____

_____

Conclusion

The problem being studied in this experiment was *(experimental question)* _____

_____

It was proposed that if *(hypothesis)* _____

_____

If the hypothesis is supported by the data, the results SHOULD *(say what the results should look like)* _____

_____

_____

The data in this experiment ACTUALLY showed that *(describe actual results)* _____

_____

_____

_____

Although the experiment was controlled, there were still some possible sources of error. Sources of error in this experiment include *(What could have changed your data? What variables were not controlled or could not be controlled? Was your experimental setup successful and effective? Why or why not?)*

_____

_____

Use the sentence starters

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Curiosity Zone – Time To Experiment

After you've tested yourself, why not experiment further. Here's a few suggestions, do reaction times vary: Choose one as your independent variable.

- for people of different ages (children versus adults)?
- if you use your dominant hand versus non-dominant hand?
- if you are tired or alert?
- for men or women?
- Depending on your mood?
- Time of Day?
- Length of fingers?

Experimental Question: How does the _____ affect _____?
(Independent variable) *(dependent variable)*

Independent variable: _____
Dependent Variable: _____
Control variables:
1. _____
2. _____
3. _____

Hypothesis: If the _____ is used, the _____
(Independent variable) *(dependent variable)*
will increase because _____
_____.

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Data analysis:
The data tables and graphs show *(Describe the data in words)* _____

The hypothesis, *(restate hypothesis)*, is *(supported or refuted)* by the data because *(use the data to support this)* _____

Conclusion
The problem being studied in this experiment was *(experimental question)* _____

It was proposed that if *(hypothesis)* _____

If the hypothesis is supported by the data, the results SHOULD *(say what the results should look like)* _____

The data in this experiment ACTUALLY showed that *(describe actual results)* _____

Although the experiment was controlled, there were still some possible sources of error. Sources of error in this experiment include *(What could have changed your data? What variables were not controlled or could not be controlled? Was your experimental setup successful and effective? Why or why not?)*

Data analysis/ Conclusion: Complete sentences, paragraph form, no personal pronouns. Use the wording in the previous experiment as a guide

Required components

Data analysis:
- Summarize the data
- Restate hypothesis
- Explain if your hypothesis was supported by the data or was disproven

Conclusion:
- Restate the experimental question
- What would the results be if the hypothesis was supported?
- Future Research
- Restate the hypothesis
- describe actual results
- Describe Error
- How to avoided error

Data Analysis:

3 sentences

Conclusion

7 sentences

Use these sentence starters as a guide

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Know steps, follow directions

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