Name: _____ Packet Due Date: _____

Science

Module 1	**The Nature of Science**
Part 2	**How is Science Done?** (Standards: Scientific Practices SP.1, SP.2, SP.3, SP.4, SP.6, & SP.8)

Lessons & Objectives

Lesson 3: The Mystery Tube

- ❑ **I can…** make detailed observations.
- ❑ **I can…** design, build, and test a hypothesis.
- ❑ **I can…** communicate my ideas effectively to others and evaluate the claims made by others.

Lesson 4: How is Science Done?

- ❑ **I can…** identify important components of a scientific investigation.
- ❑ **I can…** differentiate between qualitative and quantitative data.
- ❑ **I can…** identify independent variables, dependent variables, control groups, and constants in a scientific investigation.
- ❑ **I can…** organize, analyze, and interpret data in the form of data tables and graphs.

Lesson 5: Interpreting Real Life Examples of Scientific Processes

- ❑ **I can…** I can identify and interpret the components of a real world scientific investigation.

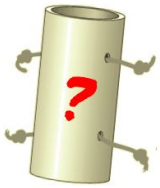
Packet Completion Rubric

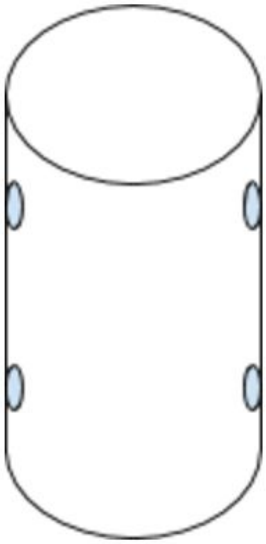
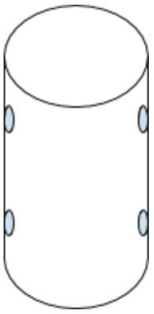
4	3	2	1	0
Nothing in packet is missing. Responses consistently meet ALL of the criteria for high quality work. Exemplary effort is evident throughout entire packet.	Packet is 75-100% complete/accurate. Work/effort misses the criterion for high quality consistently.	Packet is 50-75% complete/accurate. Work/effort has evidence of quality but not consistently.	More than 50% of the packet is incomplete or incorrect. Work does not meet the expected level of quality.	Packet is entirely incomplete or not turned in.

Grading Breakdown: 0 - 1.9 = F 2 - 2.4 = D 2.5 - 2.9 = C 3 - 3.4 = B 3.5 - 4 = A

Lesson 3: The Mystery Tube

Objectives: I can make detailed observations.
I can design, build, and test a hypothesis.
I can communicate my ideas effectively to others and evaluate the claims made by others.

The Mystery Tube	
Your Challenge: Over the next two days, you will collaborate in teams to determine the interior construction of the Mystery Tube. **The Catch:** You will not be allowed to open the tube or look inside at any time.	

The Mystery Tube	
My Observations *Write down ALL the observations you make in this column. Each time you make a new observation about the Mystery Tube, record it here!*	**My Hypotheses** *Sketch your pictures of what you think the inside of the Mystery Tube looks like. As you make more observations, you may revise your prediction by sketching a new picture on the following page.*
•	**Initial Hypothesis:** 
•	**Revised Hypothesis:** 

Have You Developed a Strong Hypothesis?

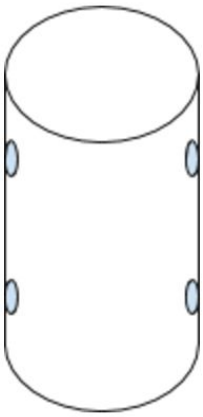
Argumentative Writing with CERs

Why should your hypothesis be tested tomorrow?

Spend the remainder of class silently constructing a written argument to defend your hypothesis. Your response should include the three components below. Use the rubric at the bottom as a guide.

1. **Claim**: Sketch and label your revised hypothesis on the template below.
2. **Evidence** *(2-3 sentences)*: What evidence or observations support your claim?
3. **Reasoning** *(2-3 sentences)*: How does your evidence support your claim? Why did you choose these pieces of evidence/observations?

Hypothesis (Your Claim):



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Making Models in Science

What ideas in science required the development of models?

Building a Model of the Mystery Tube

1. **As a team, decide on <u>one</u> hypothesis to test.**
2. **<u>Build</u> your model using the materials provided.**
3. **When building is complete, <u>test</u> your model. Ask yourself:**
    a. Does my model mimic the mystery tube?
    b. Can my model replicate all the observations made about the mystery tube?

Presenting Your Model

As a group, use the answers to the Do Now questions to come up with a 1-2 minute presentation that describes your group's mystery tube and argues why <u>your hypothesis</u> is the most correct.

Use the space below to organize your thoughts and presentation.

Lesson 4: How is Science Done?

Objectives: I can identify important components of a scientific investigation.
I can differentiate between qualitative and quantitative data.
I can identify independent variables, dependent variables, control groups, and constants in a scientific investigation.
I can organize, analyze, and interpret data in the form of data tables and graphs.

How is Science Done?

The Process of Science Explained

Process Description	You Try!
A. Observations	
Science usually begins by making _____ about the natural world. This is the process of gathering information about events or processes in a careful, orderly way (using only your _____.) _____ is information gathered from making observations. **Two types of data:** 1. **Quantitative data:** Involves _____ and are obtained by counting or measuring. 2. **Qualitative data:** Are _____ and involve characteristics that cannot be counted.	1. Suppose a marine biologist observes the behavior and activities of a group of dolphins. She records detailed observations about their behaviors every day for a month. Identify each of her observations as qualitative (L) or quantitative (T). 1. Dolphin colors range from gray to white. _____ 2. Dolphins eat the equivalent of 4-5% of their body mass each day. _____ 3. The sonar frequency most often used by the dolphins is around 100 kHz. _____ 4. Dolphins in a pod engage in play behavior. _____ 5. Dolphins have smooth skin. _____ 6. There are nine dolphins in this pod. _____ 2. Suppose you are a biologist studying sea turtles in Hawaii. You observe their behaviors and interaction, and take photographs to study later. Examine the photograph on the board. Come up with 2 examples of quantitative data and 2 examples of qualitative data. **Quantitative:** 1. _____ 2. _____ **Qualitative:** 1. _____ 2. _____
B. Questions	
Observations about events or processes in nature generally lead to heightened _____, a desire to know more! A curious scientist often identifies a problem to solve or a question to answer. ex. *What's inside the mystery tube???*	Come up with your own question that could be investigated through science: _____ _____ _____ _____

C. Hypotheses

Before designing an experiment, scientists propose a <u>possible explanation</u> to the question or problem. In other words, scientists use what they already know to make a _____.

This possible explanation is known as a _____.

A hypothesis must be stated in a way that is _____.

A statement is considered testable if _____ can be collected that either does or does not support it.

A hypothesis is generally (but not always) stated in the format:

If <u>[I do this]</u>, then <u>[this will happen]</u>.

What might a suitable hypothesis be when investigating the question:

What effect does temperature have on heart rate?

If

_____,

then

_____

_____.

D. Variables & Controlled Experiments

To test a hypothesis, scientists design _____ _____.

In a controlled experiment, **only one factor, or variable, is changed at a time**. All other variables should be unchanged, or kept _____.

There are **3 types of variables** in a <u>controlled experiment</u>:

- The _____ variable is the variable that is deliberately changed by the scientist. It is the variable being tested.
- The _____ variables are all of the variables that remain unchanged throughout the experiment. They are deliberately kept the same.
- The _____ variable is the variable that changes as a result of the independent variable being changed. The dependent variable is the data that is collected.

Sometimes experiments include _____ groups.

In a **control group**, the variable being tested (the independent variable) is completely _____.

1. Susan wants to know the effect of different colors of light on the growth of plants. She believes that plants can survive best in white light. She buys 5 ferns of the same species, which are all approximately the same age and height. She places one in white light, one in blue light, one in green light, one in red light and one in the closet. All of the ferns are planted in Miracle-Grow and given 20 mL of water once a day for 2 weeks. After the two weeks, Susan observes the plants and makes measurements.

a) What is the **independent** variable?
_____

b) What are the **constant** variables?
_____

c) What is the **dependent** variable?
_____

d) What is the **control** group?
_____

2. A pharmacologist is testing the effects of a new anti-anxiety medication called Moodcor. She separates her group of participants into 4 groups. She gives the first group 50 mg of Moodcor everyday for a month, the second group 100 mg of Moodcor every day for a month, the third group 150 mg of Moodcor everyday for a month, and the last group is given a placebo pill (containing no medication) everyday for a month. All participants are female and between the ages of 30 and 40. Throughout the month, she ensures that all participants follow a similar diet and receive at least 7 hours of sleep a night.

a) What is the **independent** variable?
_____

b) What are the **constant** variables?
_____

c) What is the **dependent** variable?
_____

d) What is the **control** group?
_____

E. Data

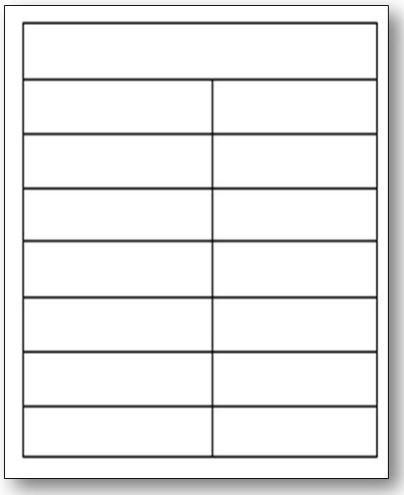
Throughout a scientific investigation, **data is collected**. This data must be _____ and _____ to ensure reliability and to note trends.

Data is most often organized in the form of a _____ _____. Data tables include **rows, columns, headers, and titles**.

Star	Color	Elements in Spectrum	Class	Other Observations
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

1. The following data were collected for the growth of a plant over a 5-day period. Can you organize this data into the table provided? Be sure to title the table and provide "headers" for each column.

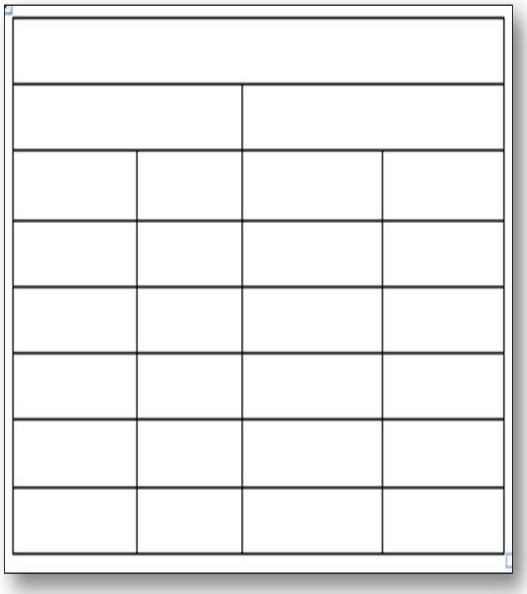
On day 0, there was 0 growth. On day 1, there was 2.0 cm of growth. On day 2, there was 5.3 cm of growth. On day 3, there was 6.1 cm of growth. On day 4, there was 8.4 cm of growth. On day 5, there was 11 cm of growth.



2. Make a data table to organize the following information.

The number of cricket chirps was recorded on two different nights at various temperatures (Celsius).

On night 1, the following data was obtained: Temp 16, cricket chirps 33; Temp 18, cricket chirps 38; Temp 20, cricket chirps 42; Temp 22, cricket chirps 46; Temp 24, cricket chirps 50.



On night 2, the following data was obtained: Temp 16, cricket chirps 32; Temp 18, cricket chirps 36; Temp 20, cricket chirps 41; Temp 22, cricket chirps 43; Temp 24, cricket chirps 51.

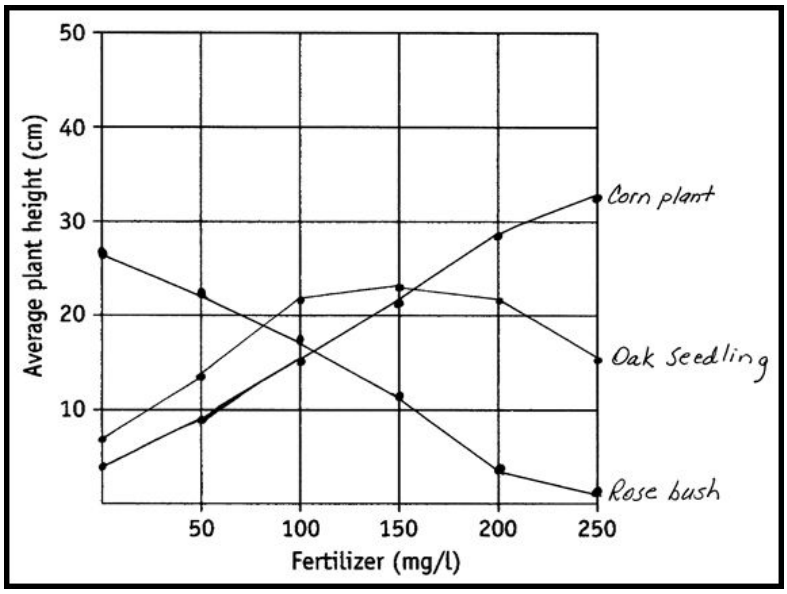
Scientists often analyze and interpret their data by constructing _____. Graphs make it easier to **visualize trends and patterns** in data.

_____ graphs are a particularly useful tool when measuring change over time or comparing two or more sets of quantitative data.

- The _____ variable is always placed on the _____ -axis.
- The _____ variable is always placed on the _____ -axis.

Can you interpret the data in this graph?

Answer the questions that follow.



a. What information is being shown in this graph?

_____

_____

_____

b. Describe the results shown for corn plants.

_____

_____

_____

c. At what fertilizer concentration do oak seedlings stop improving?

_____

_____

d. Which plant shown the best growth when fertilizer concentration is 100 mg/L?

_____

_____

e. What was the height of the tallest plant used in this experiment?

_____

_____

f. Predict how tall corn plants might be when the fertilizer concentration is 75 mg/L.

_____

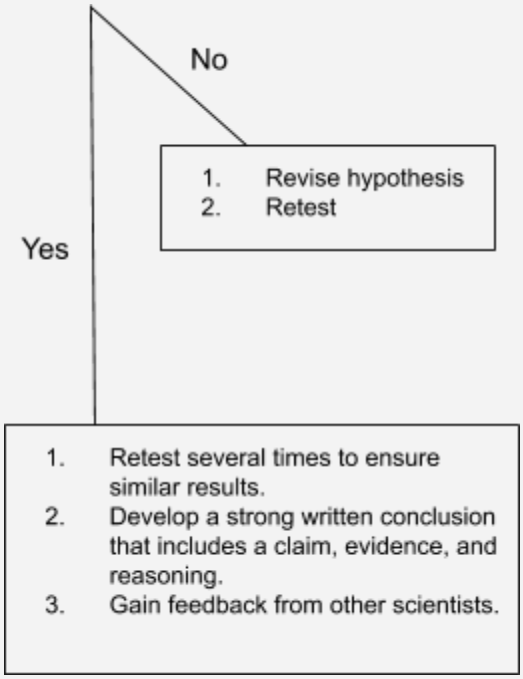
_____

_____

F. Conclusions

Once data is collected, organized, and interpreted, scientists are usually able to draw _____from it.

Does the data support my hypothesis?



Look back at the table you constructed on the # of cricket chirps. Suppose you conducted several more trials to test the effect of temperature on number of cricket chirps. In every trial, the same trend was noted.

Using the data from the table, can you draw a conclusion?

[Claim] There is strong evidence to suggest that as temperature increases, the number of cricket chirps _____.

[Evidence] For example, _____

_____

_____

_____

[Reasoning] We noted similar patterns on every night of the experiment. This evidence supports our claim because _____

_____

_____

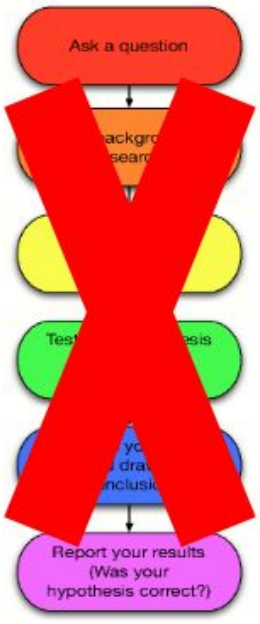
_____

_____

THINGS TO KEEP IN MIND…

- ➔ Regardless of how many times we test and retest a hypothesis, _____ in science is known with absolute, 100% certainty.
- ➔ The goal of science is **NOT** to _____ that ideas are true. Science is about constructing the best possible explanation for a natural event given current evidence.
- ➔ As we learned from the *Mystery Tube,* science is **NOT** a _____ like we're often lead to believe. Rarely do scientists follow the exact same set of steps in the same order.
- ➔ Instead, science is a complex and flexible process. Although we looked at only one particular order of events, there are MANY _____ scientists can take when approaching a problem.

The Scientific Method



Lesson 5: Interpreting Real Life Examples of Scientific Processes

Objective: I can identify and interpret the components of a real world scientific investigation.

Do-Now Scenario: Practice with Variables

Read the scenario below and answer the questions that follow.

A scientist at Biotecnol Pharmaceuticals set up an investigation to test the effect of a new sleep medicine. First, she located 20 volunteers who reported experiencing insomnia (or an inability to sleep through the night) at least 3-4 times per week. The volunteers were of all ages, races, and genders. She randomly split the volunteers into two groups. Participants in both groups were required to sleep in rooms located in her sleep lab every day for a month. This ensured that their sleep patterns could be carefully monitored throughout the night. One group was given the sleep medication 1 hour before going to bed every night for the month. The second group was unknowingly given a placebo pill (a pill that did not contain the medication) every night for the month. The scientist did not monitor or control any other aspect of the participants' lives (diets, amount of exercise, stress levels,etc.). At the end of the investigation, her results were inconclusive. She did not note any patterns or trends in her data.

1. Circle the **independent variable.**
2. Underline the **dependent variable**.
3. Highlight all **constant variables**.
4. Put a box around the **control group**.
5. List two ways the scientist could improve her investigation.
   a. _____
   _____
   b. _____
   _____

Real-World Scenarios

The scenario to the right is an excerpt from a *Scientific American* article published last year.

Read the article and answer the questions on the following page.

Major Cell Phone Radiation Study Reignites Cancer Questions

Exposure to radio-frequency radiation linked to tumor formation in rats

The National Toxicology Program (NTP) just concluded a massive 2-year study investigating the possible link between cancer and chronic exposure to the type of radiation emitted from cell phones.

Researchers at the National Toxicology Program (NTP) chronically exposed rats to carefully calibrated radio-frequency (RF) radiation levels designed to mimic what humans with heavy cell phone use or exposure could theoretically experience in their daily lives. The animals were placed in specially built chambers that dosed their whole bodies with varying amounts and types of this radiation for approximately nine hours per day throughout their two-year life spans.

The study found that cell phone exposure increases the incidence of malignant gliomas of the brain (brain cancer) and schwannomas (non-cancerous tumors) of the heart in the male rats.

1. What question were the NTP researchers trying to answer in this investigation?

2. What might a possible hypothesis have been?

3. What variable did the researchers change (the independent variable)?

4. What variable changed in response to the changing levels of radiation (the dependent variable)?

5. What other information would help you to decide if this is a reliable scientific experiment?

Watch the video on exciting scientific research currently happening in Hawaii.

Answer the questions that follow.

Can Lab Grown "Super" Coral Rescue Our Rapidly Dwindling Reefs?

1. What question is Dr. Ruth Gates currently investigating?

2. What variable in her investigation is she changing or manipulating (the independent variable)?

3. What variable is she hoping will change as a result (the dependent variable)?

4. Why is Dr. Gates' experiment somewhat controversial within the scientific community?

Lesson 3A DO NOW	Sitting in the front of the room is a **MYSTERY TUBE** that looks similar to the one in the picture on the screen. **Record as many observations about the mystery tube as you can without touching the mystery tube.** _____ _____ _____ _____ _____
Lesson 3A EXIT SLIP	***Complete your CER in the space provided on page 2 of your packet***
Lesson 3B DO NOW	**How could you test your hypothesis from yesterday?** In other words, what could you do to become even more confident that your hypothesis is correct (without seeing the inside of the mystery tube)? _____ _____ _____ _____ _____ _____
Lesson 3B EXIT SLIP	***An important part of any lab is leaving the space as clean as you found it. Follow the clean-up instructions on the board.***
Lesson 3C DO NOW	**Explain your answer to each question below using at least one COMPLETE sentence.** Was your team's hypothesis supported? _____ _____ _____ Did your model perfectly mimic the mystery tube? Explain. _____ _____ _____ If you had more time to test and revise your hypothesis, would you? Why or why not? _____ _____ _____

Lesson 3C

EXIT SLIP

In your opinions, which presentation presented the best model for what's inside the mystery tube? Why?

Explain your thinking in at 2-3 sentences.

_____

_____

_____

_____

_____

_____

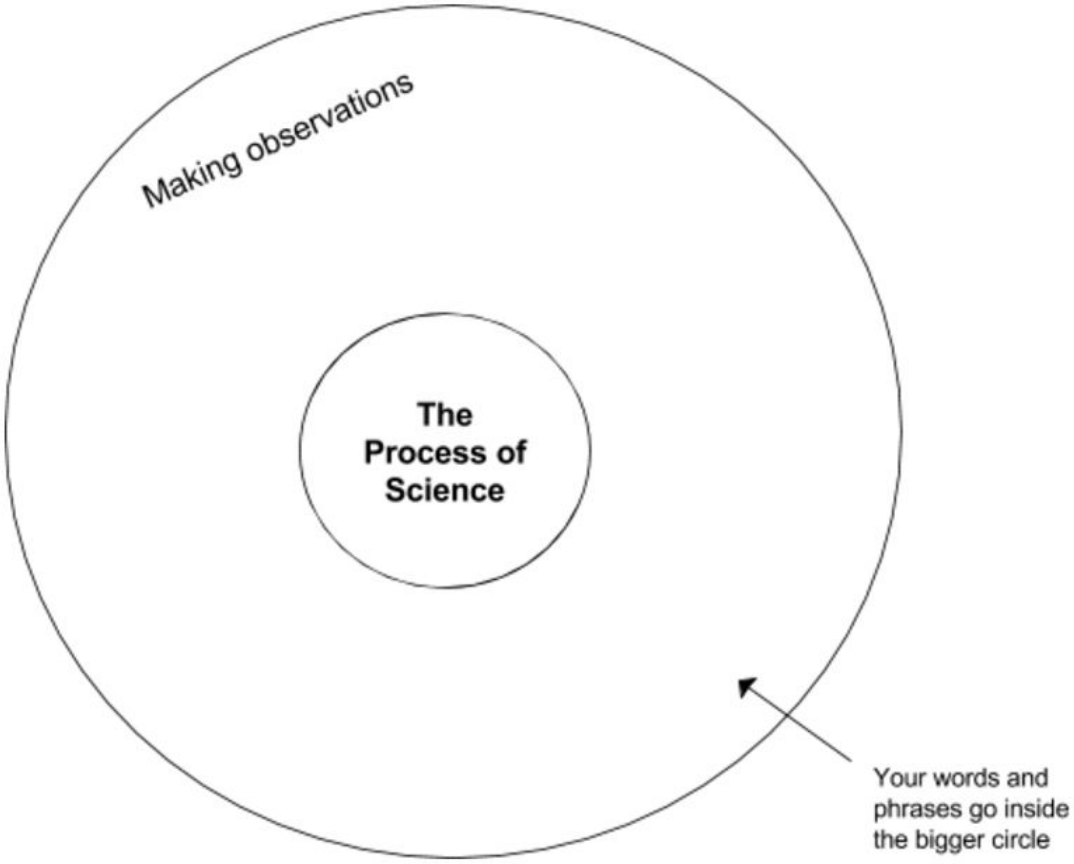
Lesson 4

DO NOW

During the mystery tube activity, we mimicked a process similar to one that scientists follow when trying to answer questions or solve problems.

What do you remember about this process?

Add to the Circle Map using words and phrases that come to mind when you think of the process of science (or the process we followed on Monday & Tuesday.



Lesson 4

EXIT SLIP

We spent the last several lessons investigating the following essential question:

How is science done?

Answer this essential question by **summarizing** what you've learned about the process of science.

Lesson 5

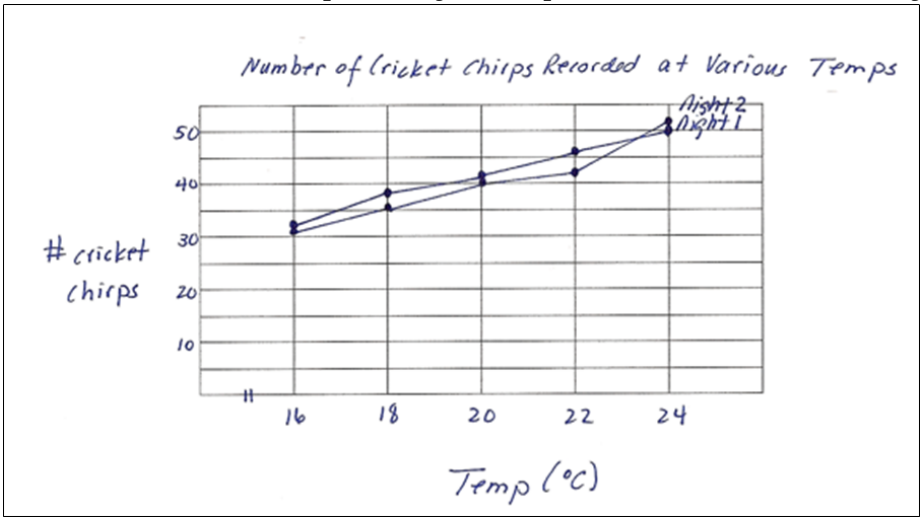
DO NOW

Read the scenario on page 9 of your packet and answer the questions that follow.

Lesson 5

EXIT SLIP

Joey was asked by his teacher to design and conduct his very own scientific investigation. He set up an experiment to test the effect of temperature on the number of times a cricket chirps. He collected data on two separate nights and presented it to his teacher in a graph.



1. What was Joey's **independent variable?**

2. What was Joey's **dependent variable?**

3. From Joey's data, does there seem to be a relationship between temperature and number of cricket chirps?