EXPERIMENTAL BREAKDOWN

Background Information: *The purpose of science is to answer questions in order to build knowledge about the natural world.* This knowledge is open to question and revision as we come up with new ideas and discover new evidence. Because it has been tested through the scientific method process, scientific knowledge is reliable. In this assignment, you will examine several biological investigations. The information in these experiments will serve as a preview for what you can expect to study throughout the year in this Biology course as well as assess your understanding of the nature of scientific investigations.

Science checklist:
How scientific is it?

- [x] Focuses on the natural world
- [x] Aims to explain the natural world
- [ ] Uses testable ideas
- [ ] Relies on evidence
- [ ] Involves the scientific community
- [ ] Leads to ongoing research
- [ ] Benefits from scientific behavior

Investigation #1 – Is Bigger Really Better?

[THEORY OF EVOLUTION – Charles Darwin and "Survival of the Fittest"]

Charles Darwin, best known as the Father of Evolution, first presented the idea that organisms best adapted for their environment are more likely to survive and reproduce. You have probably heard this described as "*Survival of the Fittest*", or **natural selection**. Evolutionary biologists often work to see how differences in traits, such as body size, relate to differences in survival among individuals.

Brown anole lizards are useful for studies of natural selection because they are abundant in South Georgia and Florida, easy to catch, and have a short life span. Because of their small size, young anole hatchlings are eaten by many different animals, including birds, crabs, and even larger anoles! Predators could be a significant force of selection on brown anole hatchlings. Traits that help young brown anoles avoid predation and reproduce will get passed on to future generations.

Austin, a 16 year old in South Georgia, observed that in early summer there were thousands of hatchling lizards on the island where he lived, but by the end of the summer, only a few hundred of those lizards remained alive. He also observed that hatchlings varied greatly in body size and wondered if those differences in size affected the chances that an individual would survive to adulthood. He predicted that smaller hatchlings are more likely to die than larger ones because they are not as fast, and therefore not as likely to escape from predators.

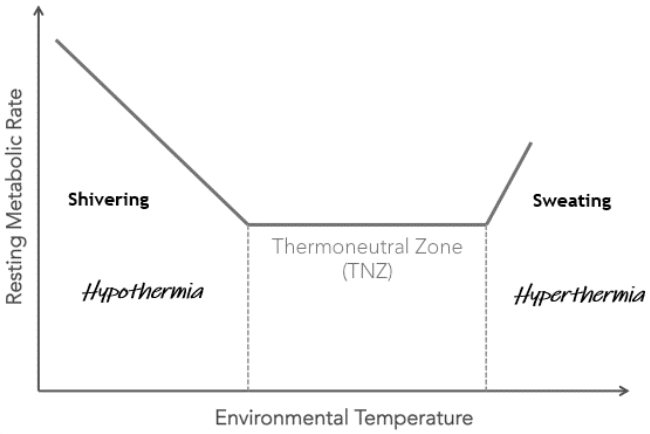
Body Length in July (mm)	Number of Individuals Captured in July	Number of Individuals Recaptured in October	Survival Rate
18	34	8	24%
19	92	30	33%
20	69	27	39%
21	78	31	40%
22	69	30	44%
23	58	30	52%
24	52	24	46%
25	52	24	46%
26	50	25	50%
27	41	22	54%
28	31	18	58%
29	36	21	58%
30	27	18	67%
31	23	18	78%
32	23	13	57%

To test this, Austin captured hatchlings in July, assigned a unique ID to each anole, measured their body length, and then released them back onto the island. In October of the same year, they returned to the island to capture and measure all surviving lizards. They calculated the average percent survival for each size category. The data is shown to the left.

Investigation #2 –Things are heating up!

[CELLS – Maintaining Homeostasis]

All living things must be able to maintain a relatively stable internal environment. This ability to maintain equilibrium is known as **homeostasis**. For endothermic ("warm-blooded") organisms, a consistent internal temperature is critical. A healthy internal body temperature for humans falls within a narrow window. *Thermoregulation* is a process that allows your body to maintain its core internal temperature. All thermoregulation mechanisms are designed to return your body to homeostasis.

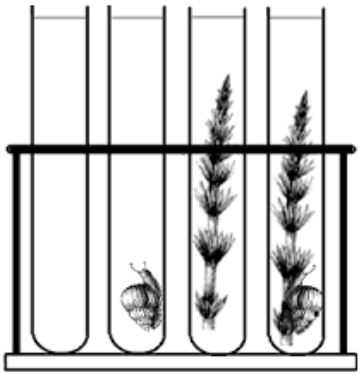


The average person has a baseline temperature between 98°F (37°C) and 100°F (37.8°C). Your body has some flexibility with temperature. However, if you get to the extremes of body temperature, it can affect your body's ability to function. For example, if your body temperature falls below Lower Critical Temperature (LCT), you begin shivering and can reach "hypothermia". This condition can potentially lead to cardiac arrest, brain damage, or even death. If your body temperature goes above Upper Critical Temperature (UCT), you begin sweating. If "hyperthermia" is reached, you can suffer brain damage or even death.

Investigation #3 –What Goes Around, Comes Around

[CELLS – Photosynthesis and Cellular Respiration]

All organisms are dependent on a healthy carbon dioxide-oxygen balance. **Photosynthesis** and **cellular respiration** are key processes in maintaining this balance! From his background research, Jarvis knows that the process of photosynthesis uses water, carbon dioxide, and energy absorbed from sunlight in order to produce sugars (glucose) and oxygen. He also read that the process of cellular respiration takes in oxygen and sugars (glucose) in order to produce carbon dioxide, water, and the energy needed to maintain life (ATP).



1	2	3	4
green	*turned yellow*	*turned blue*	*stayed green*

After researching these complicated processes, Jarvis is still unsure of the answer to the question *"Do animals utilize photosynthesis, cellular respiration, or both?*" His teacher tells him about a chemical indicator called **Bromothymol Blue** which changes color in the presence of carbon dioxide (CO_2). When little to no CO_2 is present, the chemical is BLUE. When a moderate amount of CO_2 is present, the chemical is GREEN. When CO_2 levels are high, the Brothymol Blue indicator turns YELLOW. This is exactly the information Jarvis needs to perform an experiment which tests his question!

Jarvis sets up four test tubes and pours 25 mL of Bromothymol Blue in each test tube. In **test tube 1** he places *nothing*. In **test tube 2** he places a *single snail*. In **test tube 3** he places a *small branch of Elodea* (an aquarium plant). In **test tube 4** he places both a *snail and elodea*. His results after 48 hours are seen in the image above. Jarvis studies the test tubes and realizes the color of the indicator tells him whether CO_2 is being produced (cell respiration - yellow), taken in (photosynthesis - blue), or a mixture of both (green).

Name _____

Date _____ Period _____

EXPERIMENTAL BREAKDOWN

Investigation #1 – Is Bigger Really Better?

[THEORY OF EVOLUTION – Charles Darwin and "Survival of the Fittest"]

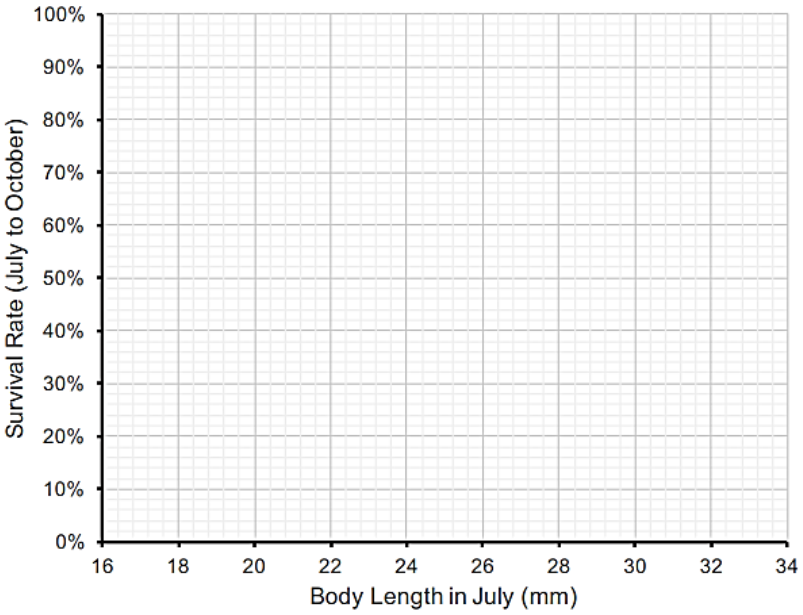
Identify the SCIENTIFIC QUESTION being tested by Austin:

A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies. *What is Austin's hypothesis?*

Identify the scientific variables in Austin's investigation.

- ➔ ***Independent Variable:*** _____
- ➔ ***Dependent Variable:*** _____

Graph Austin's data below.



Interpret the data in order to *answer the scientific question*. Using the data as evidence, construct an argument to support your claim.

Using the data as evidence, do you think predation can serve as a force of natural selection on brown anoles? *Justify your answer with an explanation.*

Investigation #2 –Things are heating up!

[CELLS – Maintaining Homeostasis]

Define *homeostasis*:

Identify the scientific variables in your investigation.

- ***Independent Variable:*** _____
- ***Dependent Variable:*** _____
- ***Constant Variables (at least three):*** _____

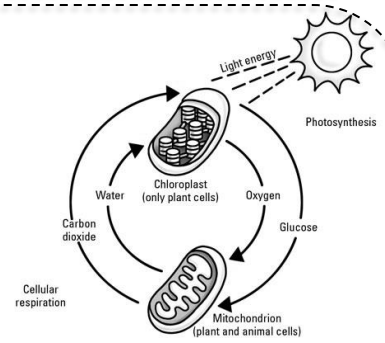
Use the graph as evidence in order to complete the following conclusions.

As temperature increases, humans maintain homeostasis by.....

Thermoregulation mechanisms are necessary in endothermic ("warm-blooded") animals because...

Investigation #3 –What Goes Around, Comes Around

[CELLS – Photosynthesis and Cellular Respiration]



Organize the results from Jarvis's experiment into a data table.

Identify the scientific variables in your investigation.

- ***Which test tube (1, 2, 3 or 4) serves as the control in this experiment?*** _____
- ***Independent Variable:*** _____
- ***Dependent Variable:*** _____

Which process takes place in animals – *photosynthesis*, *cellular respiration*, or *both*? *Use evidence from the experiment to justify your claim.*

Give an example of a future investigation (in the form of a question) Jarvis might be interested in testing.