P1 (9/5) AGENDA

- New seats!
- U1T2 (Lab Safety) Quiz; Trade & Grade
- U1T3 (Scientific Method) Notes
  - Practice

Next Quiz: Friday (U1T3- SciMeth)

Fire Drill Today @ start of 2nd

P4/6 (9/5) AGENDA

- New seats!
- U1T2 (Lab Safety) Quiz; Trade & Grade
- P6: go over POGIL (if they received it)
- U1T3 (Scientific Method) Notes
  - Practice embedded

P3/7 (9/6) AGENDA

- New seats!
- U1T2 (Lab Safety) Quiz; Trade & Grade
- P3: Go over POGIL (7th period did not receive)
- U1T3 (Scientific Method) Notes
  - Practice

THE SCIENTIFIC METHOD

PRE-AP BIOLOGY; UNIT 1 TOPIC 3

Objectives:

- I can collect quantitative and qualitative data
- I can distinguish between observations and inferences
- I can develop a well-written hypothesis based on observations and research
- I can identify independent and dependent variables in an experiment
- I can identify constants in an experiment
- I can differentiate between a control group and experimental groups

DEFINITION OF SCIENCE

- Science = an organized way of using evidence to learn about the natural world

AND

- Science = the body of knowledge scientists have built up over the years using this process

CHARACTERISTICS OF SCIENCE

1. Relies on evidence
2. Expands scientific knowledge
3. Challenges accepted theories and claims
4. Questions results
5. Tests claims
6. Undergoes peer review
   - Peer review = a process by which the procedures used during an experiment and the results are evaluated by other scientists.
7. Uses the metric system (Meter, gram, liter, second)

SCIENCE AND HUMAN VALUES

- We use science to inform decisions about health care, environmental policy, etc.

- Many of science's major discoveries have been considered controversial because they call into question certain beliefs (ethics)

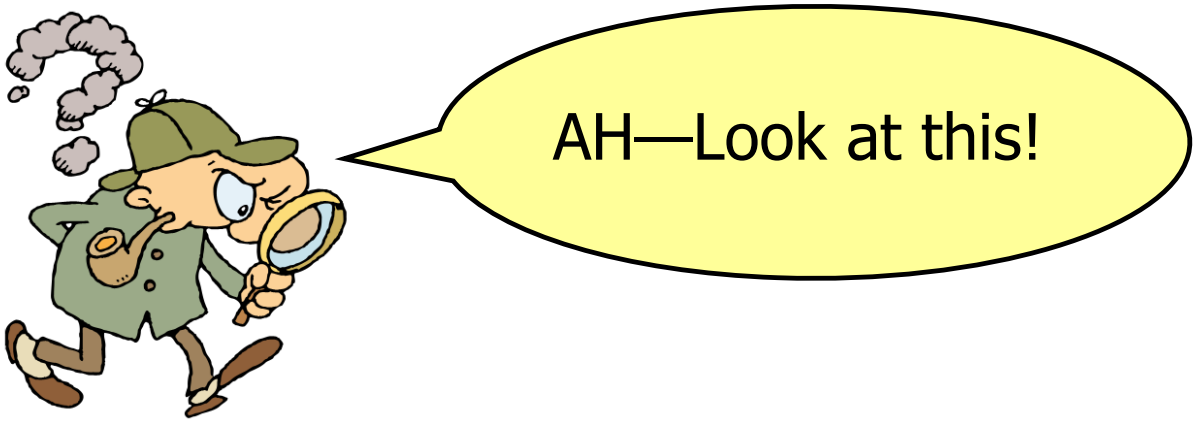
  Example: Cloning, stem cell research, evolution

SCIENTISTS MAKE OBSERVATIONS

What observations can you make about this image???

OBSERVATIONS VS. INFERENCES

- Observation = a direct method of gathering information in an orderly way
  - Recording information using the five senses or tools



OBSERVATIONS VS. INFERENCES

- **Inference** = a possible explanation or conclusion based on the observations you've made and the experiences you've had.
  - *Example:* You leave school and ***observe*** that the ground is wet. You ***infer*** that it rained.

Observations and Inferences

Observations are what you notice

Inferences are your reactions, thoughts or explanations

Let's practice making observations and inferences with some new images!!!

#1

#2

#3

#4


Sitting in a 3.8-metre sea
kayak and watching
a four-metre great
white approach you is
a fairly tense experience

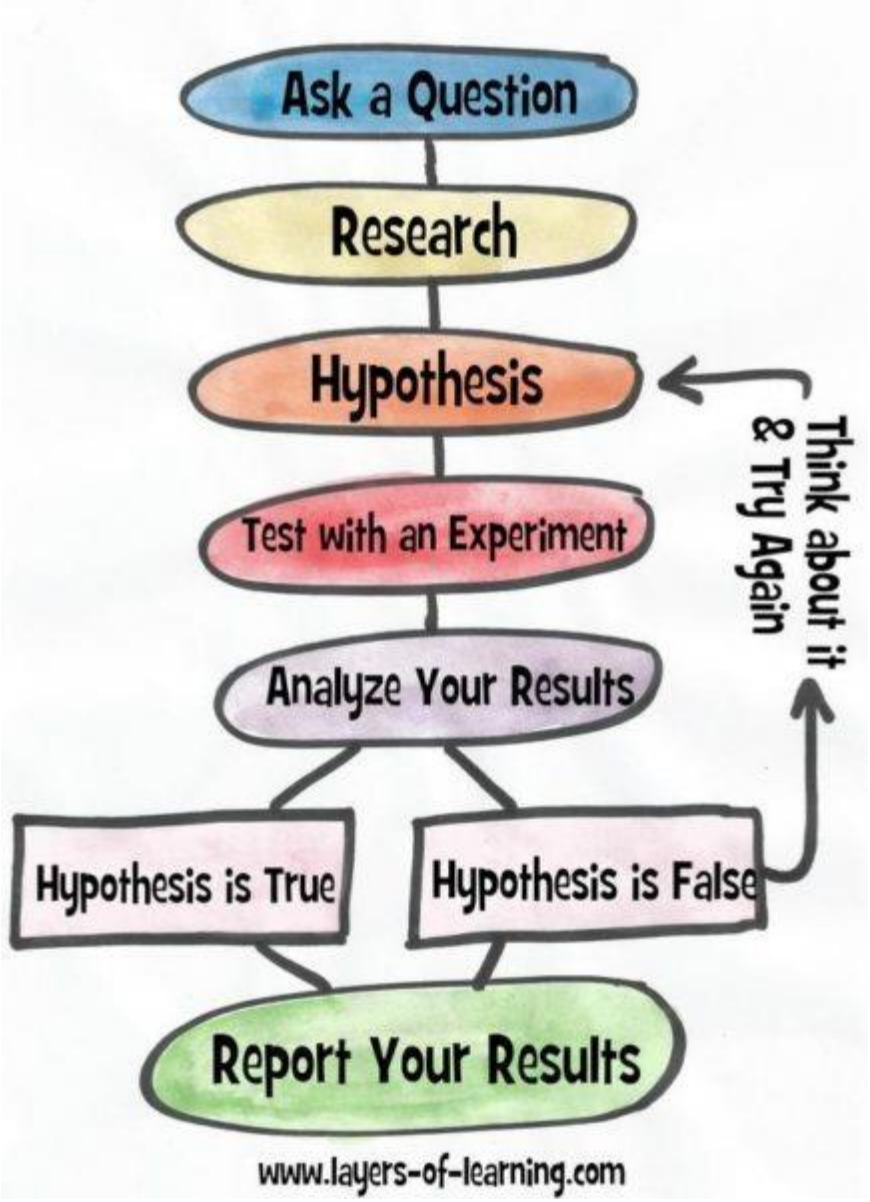
#5

#6

BIO PRE-ASSESSMENT

In your notes, write the ***independent variable, dependent variable, constants, control group, experimental group(s), and a plausible hypothesis.***

Ten seeds were planted in five pots (two seeds per pot) that Erica found around the house. Each contained exactly 500g of Peat's Potting Soil. The pots were given the following amounts of purified water each day for 40 days. Pot 1: 50mL, Pot 2: 100mL, Pot 3: 150mL, Pot 4: 200mL, Pot 5: 250mL. Pot 3 received the recommended amount of water. The dry mass of each pot with soil and plant was measured at the end of the experiment after being placed in a drying oven for 4 days.



THE SCIENTIFIC METHOD

STEP #1: ASK A QUESTION / STATE THE PROBLEM

*A **scientific question** must be testable, meaning that you can perform an experiment to solve it.*

- Scientists base their questions upon:
  - Observations (after information has been collected)
  - Prior knowledge (experiences or things they've learned)
  - Related research (observations they or others have made)

STEP #1: ASK A QUESTION

What questions can we ask about the behavior that we observed with the Japanese Macaques?

STEP #2: FORM A HYPOTHESIS

- Hypothesis= a testable explanation of a situation
  - Written in an "If…then…" format.
  - "**If** *[insert what you're going to do to CAUSE a change]*, **then** *[insert what change you predict will happen]*"
  - Example: "If dogs receive three training sessions per day, then they will learn/recall tricks faster than dogs that receive one training session per day."

HYPOTHESIS IS NOT…

NOT TO BE CONFUSED WITH:

- Theory = a well-tested explanation that unifies a broad range of observations

- Law = a statement of **fact**, deduced from observation, that a natural or scientific phenomenon **always occurs** if certain conditions are present *(ex: law of gravity)*.

PAUSE – PRACTICE WITH HYPOTHESES (20+ MINS)

- On your own, read through the background info. Annotate the passage.
- With a partner, discuss what is necessary and what is useless for our assignment.
- Complete the hypothesis AND provide your explanation/reasoning (RUBRIC)

Unit 1 Topic #3 Scientific Method - Making Hypotheses

Background Information:

Pillbugs—also known as sowbugs, woodlice, or rolly pollies—can be found right in your backyard. They are mostly found in the northern central United States, though there are some species that live as far south as Florida. They have rounded backs and seven pairs of legs. Some species can roll up into a ball when they sense danger in the environment. Pill bugs play an important role in the environment by helping to decompose dead organisms and recycle nutrients into the soil.

Because pillbugs do not have a waxy outer coating (i.e. a cuticle) that covers their bodies, they are extremely vulnerable to "drying out." Pillbugs in environments with **lower than 50% humidity will die of dehydration within one day.** (Note: 50% humidity means that the air is "filled" with only 50% of the water vapor that it CAN hold.) Once the humidity levels reach over 87%, pillbugs can absorb water through their body walls to rehydrate.

When outdoors, pillbugs typically choose to forage for food in cool, humid locations (ex: underneath a log). When inside a house, pillbugs can be found on water pipes or in cellars.

KM **Kara M. Bedford**
This intro paragraph is all just about the organism. None of it deals with the actual assignment/prompt. We can skip it & move on!

KM **Kara M. Bedford**
Suggests a wet environment may be necessary.

KM **Kara M. Bedford**
This is super important! Dry environment = DEAD bugs!

STEP #2: FORM A HYPOTHESIS

- Let's form a hypothesis about why our Japanese Macaques are exhibiting this behavior
  - Make sure that this is a testable hypothesis!

STEP #3: DESIGN AN EXPERIMENT

- Experiment = an investigation of a phenomenon in a controlled setting to test a hypothesis

- Let's look at a new experiment:
  - A scientist observes that grass grows taller in the part of his lawn right next to the sprinkler.
    - Hypothesis: If the grass is given extra water, then it will grow taller.

STEP #3: DESIGN AN EXPERIMENT

- **Variable** = any factor that can change or be changed and affect the outcome of an experiment *(VARY = to change)*
  - Water, sunlight, disease, height of grass, soil type, etc.
- Independent Variable = the manipulated variable; what is changed by the experimenter.
  - Amount of water
- Dependent Variable = the measured variable; the results we're looking to find.
  - Change in height of grass

MEMORY TRICKS

- **I** change the **I**ndependent Variable
  - In this experiment, I would change how much water the plants receive.
  - This is the **CAUSE.**
- The **depend**ent variable **depends** on the independent variable.
  - How tall the plant grows DEPENDS on how much water I give it.
  - This is the **EFFECT** we're looking to measure.

STEP #3: DESIGN AN EXPERIMENT

- Constant = a factor/variable that is kept the same during an experiment.
- What are some constants in our grass experiment???

STEP #3: DESIGN AN EXPERIMENT

- Control Group = a group used for comparison that does not receive "the treatment."
  - The plot of grass that **was not** given extra water.

- Experimental Groups = the groups exposed to "the treatment" (the variable being tested).
  - The plots of grass that **were** given any amount of extra water.

STEP #4: PERFORM AN EXPERIMENT / GATHER DATA

Data = Information gained from observations

- **Quantitative Data:** numerical data (measurements of quantities like time, temperature, length, mass, area, etc.)
  - Grass experiment = ?
- **Qualitative Data:** descriptions of what our senses detect (qualities, not numerical)
  - Grass experiment =?

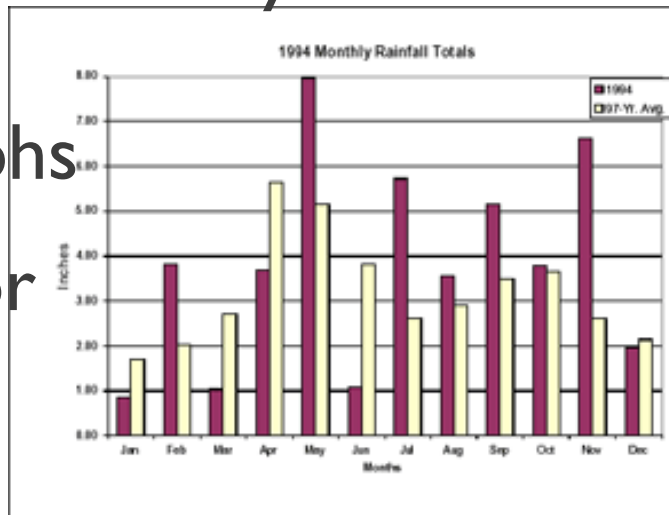
QUANTITATIVE VS. QUALITATIVE

- **Quantitative Example:**
  - There are 10 apples in the basket.
  - The basket weighs 5.3 kilograms.

- **Qualitative Example:**
  - The apples in the basket are a dark red.
  - The apples are smooth.

STEP #5: ANALYZE THE DATA

- Questions that scientists ask:
  - "Has my hypothesis been supported?"
  - "Is more data needed?
  - "Are different procedures needed?"
  - "What are the possible sources of errors?"
- Work in groups to analyze data!
- Tables and graphs are good tools for data analysis



STEP #6: DRAW CONCLUSIONS

- Conclusions may:
  - Support original hypothesis
  - Refute original hypothesis
  - Indicate that further research is needed

YOUR CONCLUSIONS SHOULD INCLUDE:

- A **conclusion statement** that indicates whether your data supports or rejects your original hypothesis.
- A **summary of the data** that supports your conclusion statement. You must discuss **specific numerical values**.
- An explanation of **HOW this specific data supports** your conclusion statement. You should **relate this to science** you're learning in class. Define vocabulary words, etc.
  - Often scientists will explore further research options at the end of their conclusion. "If I continued my study, I would next test…"

STEP #7: COMMUNICATE RESULTS

- Scientists report their conclusions and findings in scientific journals (peer-reviewed journals)
  - What examples can you think of?

COMMUNICATE RESULTS

- Share results with science community

THE CULTURE OF SCIENCE

Figure 1.22

- Scientists build on what has been learned from earlier research.
  - They pay close attention to contemporary scientists working on the same problem.
- Both cooperation and competition characterize the scientific culture.
  - Scientists check the conclusions of others by attempting to repeat experiments.

FUN FACT: JAPANESE MACAQUES BUILD SNOWBALLS FOR FUN!!!

FINISH PILLBUG PRACTICE!

- In addition to developing a research-driven and testable hypothesis, you will make a table with the following:
  1. Independent variable
  2. Dependent variable
  3. Constants (at least 3!)