Scientific Method
Part 1

Ask a Question

Form a Hypothesis

Make Observations

Analyze the Results

Draw Conclusions

Do they support your hypothesis?

Ask a question

START

Form a hypothesis

Make observations

Test the hypothesis

Question

Background Research

Construct Hypothesis

Think! Try again....
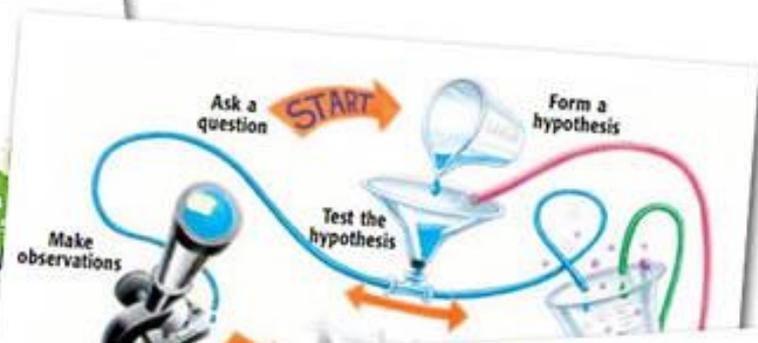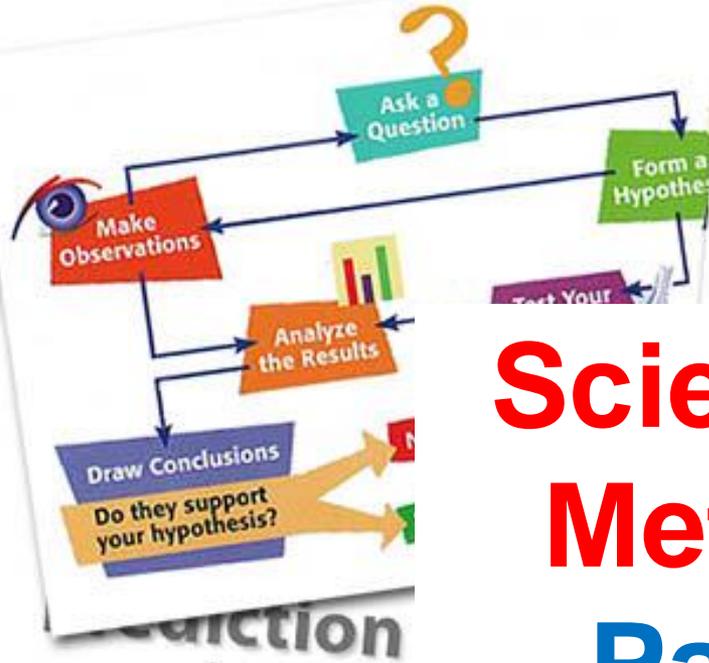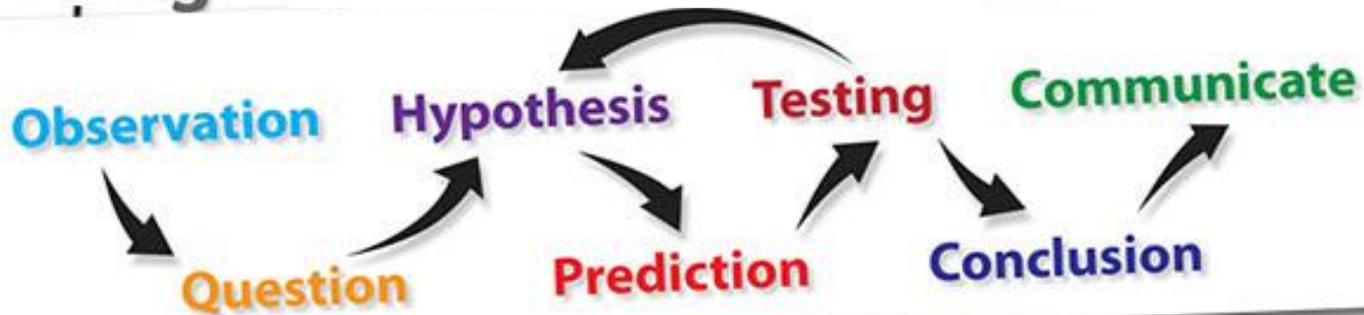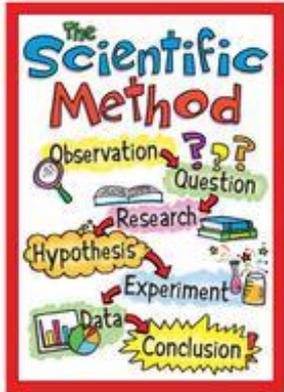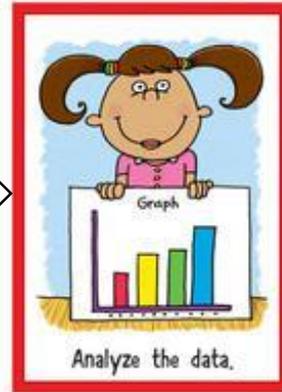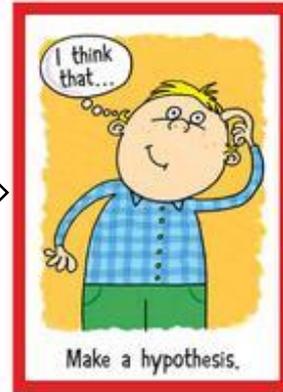
Test with an Experiment /Data

Analyze Results &

Prediction

Testing

Observation   Hypothesis   Testing   Communicate

Question   Prediction   Conclusion

Observation
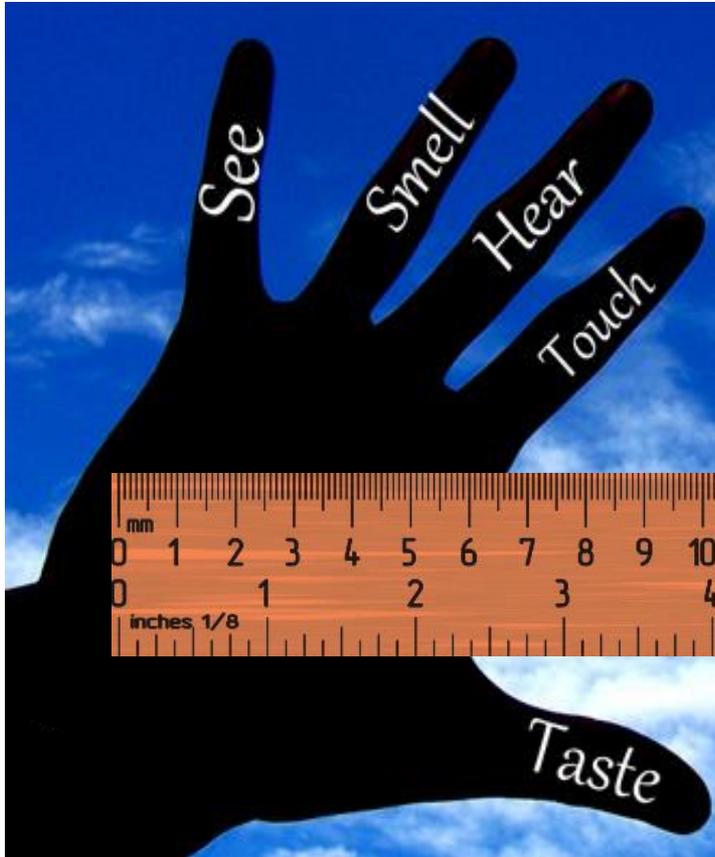
- **Observation** is describing an object or event using your five senses (*what you see, hear, smell, taste, touch*) or measurement (*numbers*).

- **Information gathered** during an observation is called **data** (sing. *datum*).

Observation **does not include opinion** (how you *feel* or what you *think*)!

Describe the Kitten

It weighs ~300 grams.

It has yellow-black-white fur.

It has blue eyes.

It is young.

It is very pretty and cute!

Qualitative vs Quantitative Data

QuaLitative (letters)

- **Descriptions** using **words**.

- Data which can be **observed** but **not measured**.

- What the object is *like*: colors, texture, smell, taste, appearance, etc.

- *Subjective, relative*

QuaNtitative (numbers)

- Specific **numbers**.

- Data which can be **measured**.

- Length, height, area, volume, weight, speed, time, temperature, humidity, sound levels, cost, age, etc.

- *Objective, specific*

Example: **Freshmen**

Qualitative data:

* quiet

* young people

* listen well

Quantitative data:

* 172 students in class

* 94 girls, 78 boys

* 68% wear glasses

DIY: Monarch Butterfly

common morph (form)

rare Hawaiian white morph

© Dan Petr

Make one **qualitative** observation about each picture above.
Explain why this is a qualitative observation.

Make one **quantitative** observation about each picture above.
Explain why this is a quantitative observation.

DIY:
Data from Text

Rafflesia arnoldii, the largest individual flower on earth, has a strong odor of decaying flesh - the latter point earning it the nickname of "corpse flower".

The flower grows to a diameter of around 3 feet and weighs up to 24 lb. It lives as a parasite on the *Tetrastigma* vine, which grows only in primary rainforests. Rafflesia lacks any leaves, stems or even roots, yet is still considered a vascular plant.

Hypothesis

- **Hypothesis** is a statement that tries to answer the scientific question. Hypothesis is based on initial observations. Must be *testable*.

- **Example:** you want to know the shortest walking route from your house to your school.

Hypothesis: it is the one across the soccer field ☺

DIY: **Hypothesis**

1. **You want to know what is the best place to plant sunflowers in your yard.**

Hypothesis: sunflowers grow best in full sun ☺

2. **You want to know how big your paper airplane should be for it to make across the room and maybe even the lawn…**

   Hypothesis: A larger paper airplane flies longer distance ☺

What do you need to do next?

Experiment

- **Experiment** is a "cause-effect" procedure to test the hypothesis. Must be *repeatable* and *reproducible*.

- **Experiment** is designed by a researcher (materials and instructions) and deals with variables (factors that change).

To find your fastest route home you would walk several different routes and time your trip – you would vary the route (cause) and measure time (effect).

What is important here?

Experiment variables

1. **Independent** (manipulating) **variable – factor that is *deliberately changed* by researcher. Good practice: one at a time!**

   Your *route* from house to school.

2. **Dependent** (responding) **variable – factor that is *measured or observed*.**

   ***Time* it takes you to walk.**

3. **Control variables** (constants) **– factors that are *kept the same*. Good practice: these should be *all other factors* that a researcher has control over!**

   You are walking *yourself* every time.

The Case of the Oviraptor
Egg-stealer or …?

DATA: First fossil of this dinosaur ever discovered was found *huddling over a nest filled* with dinosaur eggs. Its powerful beak was strong enough to crack open an egg.

HYPOTHESIS: assumed to be an egg-thief. The paleontologists thought that the Oviraptor was stealing eggs when it died…

NAME GIVEN: Oviraptor (125-100 mya) means **"egg thief"**.

The case of the oviraptor
…good parent!

Controlled **EXPERIMENT**: not possible!

MORE DATA: A recent study found an **oviraptor embryo** inside one of those eggs, so actually the oviraptor was by **its own nest!**

More expeditions have found **oviraptor skeletons on top of nests** — these devoted parents apparently died in sudden sandstorms while **guarding their nests**!

HYPOTHESIS DISPROVED but the **NAME STAYED**…