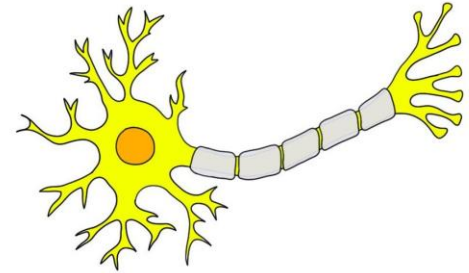


# “Doing” Science

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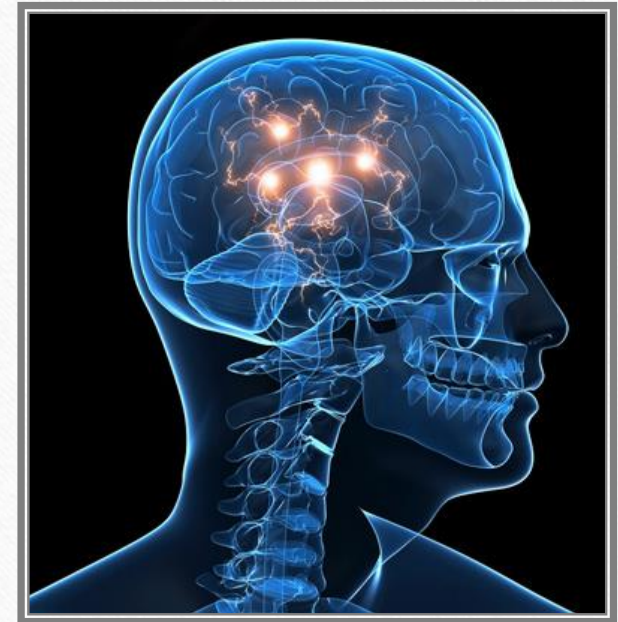
# What is learning?

- This is a nerve cell (aka neuron).
- Neurons carry information through the body.
- Information passes between neurons where they connect.
  - These points of connection are called synapses.



# Your Brain

- It has all the neurons it will ever have at birth.
  - That doesn't change unless you kill them.
- Growing your brain is like building muscle and training for a sport – it only grows and gets better if you **USE IT.**



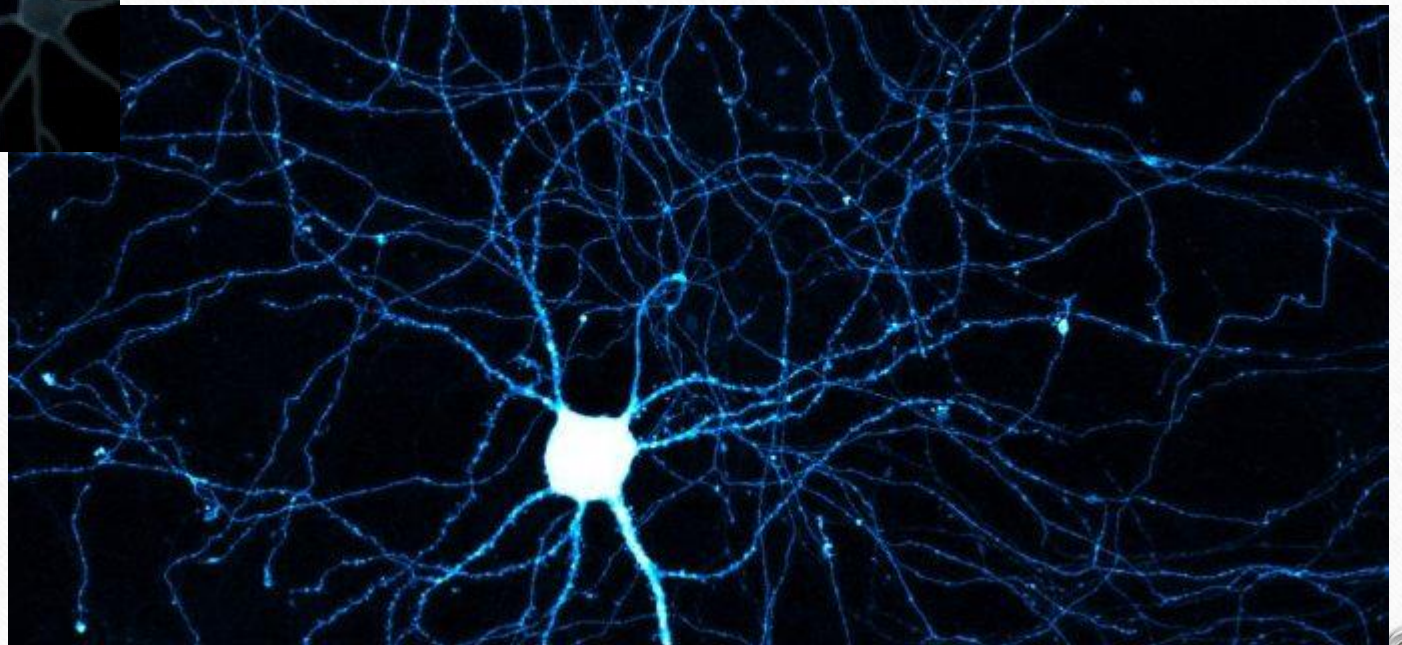
# Connections

- Using the brain causes new connections to grow.
- Learning occurs when these new connections grow.
- The more we think, the stronger and faster a connection gets.



**BECOMES...**

All those extra dendrites allow the neuron to make connections faster and with more neurons.



Using the brain (aka *thinking*) is the only way to get these changes to occur!

THESE...



DO NOT  
WORK!

# Science is...

- Everything we know about the natural universe – how things work and why.
  - Knowledge is based on evidence such as facts, data, and observations.
- The way we figure out all that stuff in the first place! (Science is a VERB)

Without observation there  
is no science!

---



# How would you define “observation”?

- An observation is something that is detected or measured directly with one of the five senses.
  - Sight, sound, smell, taste, feel
  - You “see” the measurement of something.
  - You “feel” the ridges on something.

# Examples of Observations

- *There are black clouds in the sky this morning.*
- *There are five flowers on the plant.*
- *The reaction produced a smell like rotten eggs.*
- *Loud sizzling occurred when sodium hit water.*
- *The table has three ridges on it.*

# Types of Observations

- Quantitative: description using numbers and/or measurements.
  - A *quantity* of something is a *number*.
  - Example: *She is 5'2" tall.*
- Qualitative: description using only words, no numbers.
  - Example: *She is short. She has brown hair.*

# Circle the observations that are quantitative.

- *There are black clouds in the sky this morning.*
- *There are five flowers on the plant.*
- *The reaction produced a smell like rotten eggs.*
- *Loud sizzling occurred when sodium hit water.*
- *The table has three ridges on it.*

# Qualitative vs. Quantitative

- Whenever possible, observations should be quantitative and not qualitative.
  - Why do you think this is?
  - Why do we even have qualitative observations then?

# Quantitative vs. Qualitative

- Quantitative observations can be reproduced by other scientists and give an exact amount.
  - “It’s heavy” vs. “It weighs 154.33 kg”
  - “There are a lot of them” vs. “There are 498”
- Qualitative observations are necessary because many characteristics cannot be measured or counted in science (such as color, texture, taste, etc.) and therefore words are needed to describe them.

# The Importance of Observations

- The ability to observe carefully and communicate clearly what you have observed is an essential skill and the foundation of scientific discovery.
- It requires patience and attention to details (more than you normally would in everyday life).

What if you had to find this...

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In THAT...could you do it?



# Improving Observation Skills

- Starts with noticing! Look carefully for details.
- Make a detailed record of what you notice so someone else could read what you wrote and visualize accurately what you observed.
  - Or...find that sunflower seed in the pile!

What are some observations about the sunflower seed?



Observations often lead to  
inferences.

---

Many observations are actually inferences.

# Inference

- An explanation of what you observed based on your past experiences or judgement.
- Inferences aren't bad – they are an important part of science. They just are not observations.

# Examples of Inferences

- *It's going to rain today because there are black clouds in the sky.*
- *The mug with steam coming off of it is hot.*
- *The person named Rian is a girl because the name is spelled with an "I".*

What are some inferences we can make about the sunflower seed?



# Let's test out those skills!!

Write down some observations about the piece of equipment your teacher is holding.

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Continue taking observations as things progress.

# Initial Observations



Highlight the observations in your original list that turned out to be an inference.

---

So now how would you describe an inference?

Why do you think it's important in science to distinguish between observations and inferences?

---

# Importance between the two...

- As you found out, inferences can sometimes be wrong!
- Inferences also require you to look beyond what you are observing to form a conclusion.
- Scientists may come to different conclusions from the same observations.

# The Art of Conversation

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# The Art of Conversation

- It's amazing how many people (adults and youth) do not know how to have a conversation.
- Learning to listen and talk is an extremely important skill in order to be successful in life.
- Being a good conversationalist is difficult!

# The Art of Conversation

- The best way to improve those skills is to practice having a conversation using specific guidelines.
- Making a point of having 1-2 minute conversations will help improve the anxiety everyone has when it comes to having a conversation.

# Good conversations include...

- Eye contact
- Listening and contributing
  - Remembering what you heard is important
- Respecting different viewpoints
- Building the conversation and moving it forward.

# Listening

- This is often the most difficult part of conversations.
- Most of the time when “listening” we are actually thinking of how we are going to respond when it’s our turn to talk.
- So how can we improve our listening skills.



# The Three “P’s” of Listening

- **Pause** – make sure you have really listened and remember what was said
- **Paraphrase** – using your own words, repeat what was said to you.
- **Probe** – ask relevant questions to dig deeper into what the person is saying

Let's practice this!

---

# Ask your elbow partner...

1. What was the last movie they saw.
2. Take the time to really listen (**Pause**). You may even ask them to repeat.
3. Acknowledge your partner by restating what they just said (**Paraphrase**) and then ask another question (**Probe**).

# Find your birthday partner...

- Ask them: What would be your superpower and why?
- **Pause** - Wait
- **Paraphrase** – repeat back to your partner what you heard but in your own words
- **Probe** – ask another question

# Find someone with the same color shirt...

- Ask them: If you could have dinner with any 3 people, dead or alive, who would they be and why?
- **Pause** - Wait
- **Paraphrase** – repeat back to your partner what you heard but in your own words
- **Probe** – ask another question

# Conversations as a Group

- This often gets more difficult because we are all concerned about sounding “stupid” and being made fun of.
- But science is collaborative so you will need to be able to work with your group.

But first...



- Group work is most productive (and fun) if we have some guidelines, aka NORMS, that everyone follows.

# Our Group Norms

- Everyone contributes; every contribution is valued.
- One voice at a time. Focus on listening, not what you will say next.
- Seek first to understand, then to be understood.
- Embrace thinking and learning, not necessarily “knowing.”
- Be attentive. Pay respectful attention to what others say.
- Challenge put-downs...how can you rephrase something so it's not hurtful?
  - Instead of saying “That's stupid” say “I disagree with that”



# Everyone contributes.

- Sometimes it's hard to facilitate this.
- Some people are very shy and don't want to put themselves out there.
- Some people feel the need to fill in the quiet with noise.
- The use of "Talking Sticks" helps with this process.

# Talking Sticks

1. Each person puts his/her pen on the table.
2. Take turns commenting. *When its your turn to comment you pick up your pen.* Others are silent and listening.
3. After commenting, keep your pen in your hand. *Once all group members have had a turn, then you can go again.*
4. Once everyone has commented\*, everyone puts their pens down and the process repeats itself.

**\*NOTE:** Everyone comments! If you have nothing new to add you may comment on what someone else has said.

# Everyone Comments.

- Everyone's ideas are needed.
- Sample comment starters:
  - I agree/disagree with Joe but would add/change...
  - Can you tell me more about...
  - I'm still confused about...
  - One thing I thought about is...
  - Does anyone know...
  - I didn't know that...

# Today's Activity

---

We will be practicing our Group Norms and using Taking Sticks during this activity.

# Data, Prior Knowledge & Beliefs, Inferences

- "When you think about it, the fossil record is like a series of photographs: frozen moments from what is really a moving, ongoing reality. Looking at the fossil record is like thumbing through a family photo album. You know that the album isn't complete. You know life happens in between, you only have the pictures. So you study them, and study them. And pretty soon, you begin to think of the album not as a series of moments, but as reality itself." (p. 192 of Michael Crichton's *The Lost World*).

- Today you will work with a set of “snapshots in time” and attempt to make sense of the events.
- The information available to you is incomplete (like the records of any historical event).
- With the observations from in the photos and your prior knowledge and beliefs about the stories, you should be able to make many inferences about what has occurred, even though the information is incomplete.

# Group Norms

- Everyone contributes.
- One voice at a time. When you're not talking, you're listening.
- Seek first to understand, then to be understood.
- It's not about "knowing" but about thinking and learning.
- Pay respectful attention to what others say.
- Challenge put-downs

# Groupwork Grading

- Each time we do group work assignments, every member of the group will be graded based on their participation.
- 0 = did not participate
- 5 = minimal participation
- 10 = full participation

Participation grades  
can also fall between  
these values



# Talking Sticks

- Everyone starts with their pen/pencil on the table.
- When it is your turn, pick up your pen/pencil.
  - When it is not your turn you are listening to your group.
- Keep your pen/pencil in hand until everyone has had a turn.
- Put the pens/pencils down on the table and repeat procedure.

# Your assignment

- Make sense of the pictures by placing them in order to “reconstruct the past.”
- Once you have them in order, place a caption on a sticky note below the picture so other groups can understand your story.
- You have 20 minutes to complete this.

# Exit Ticket

1. Describe one difference between your story and that of another group.
2. Why do you think they had a different interpretation of the storyline even though you all started with the same 'data'?
3. How would this be similar to how scientists operate when they are trying to figure out something from data?

Time to Reflect...

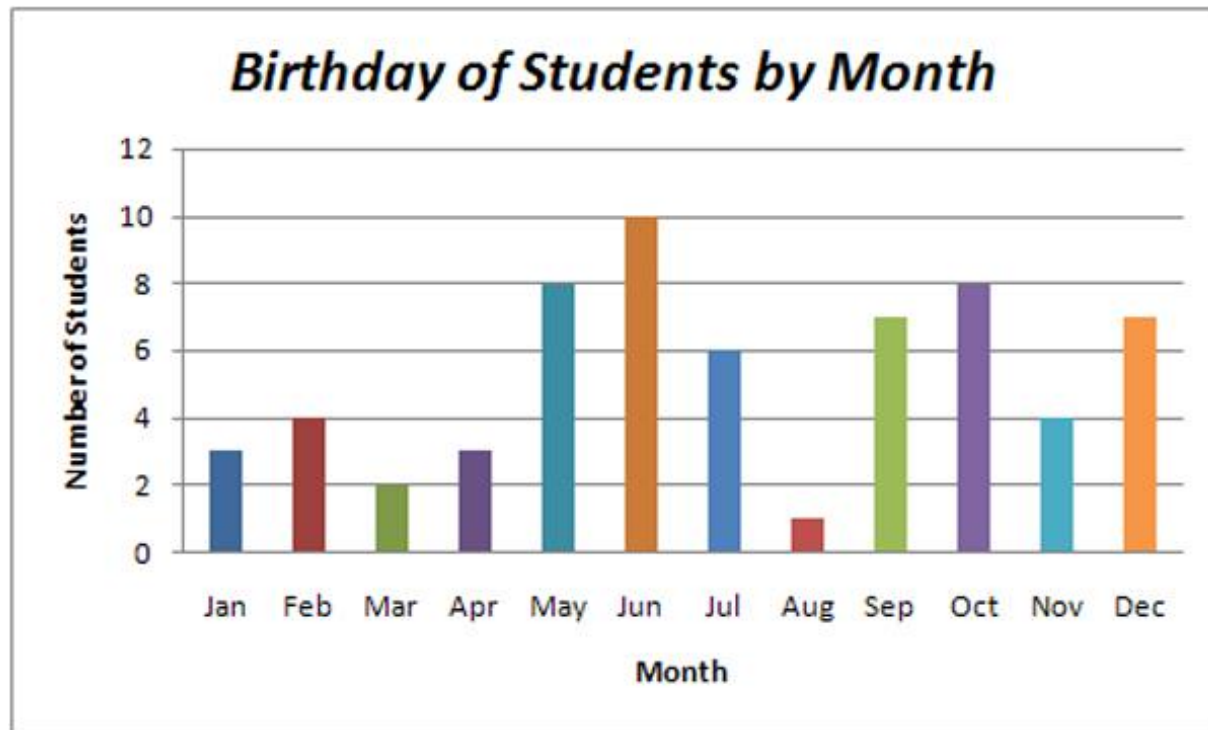
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# Graphing

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What are the  
different  
types of  
graphs?

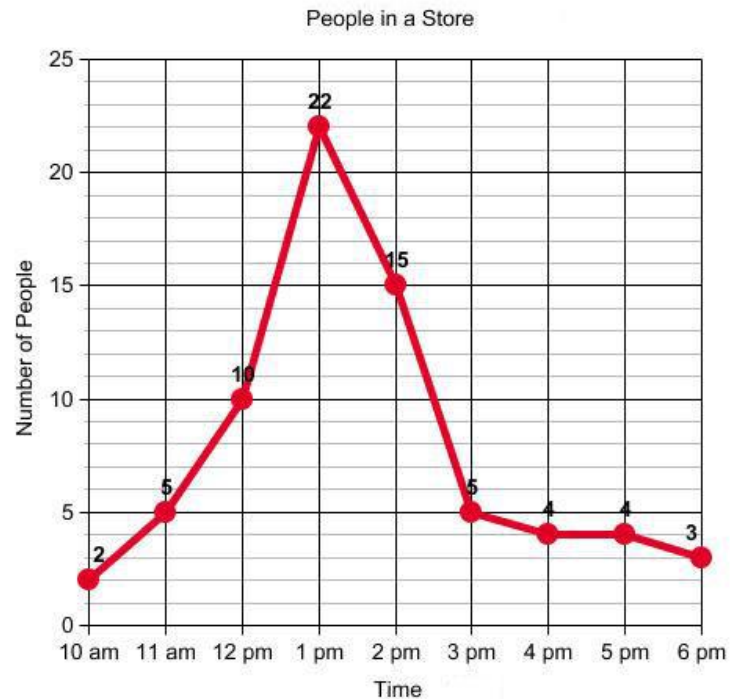
- Bar graph
- Line graph
- Pie graph (pie chart, circle graph)
- Scatter plot graph



# Bar Graphs

Use a bar graph  
when data are  
grouped by specific  
categories.

# Line Graphs

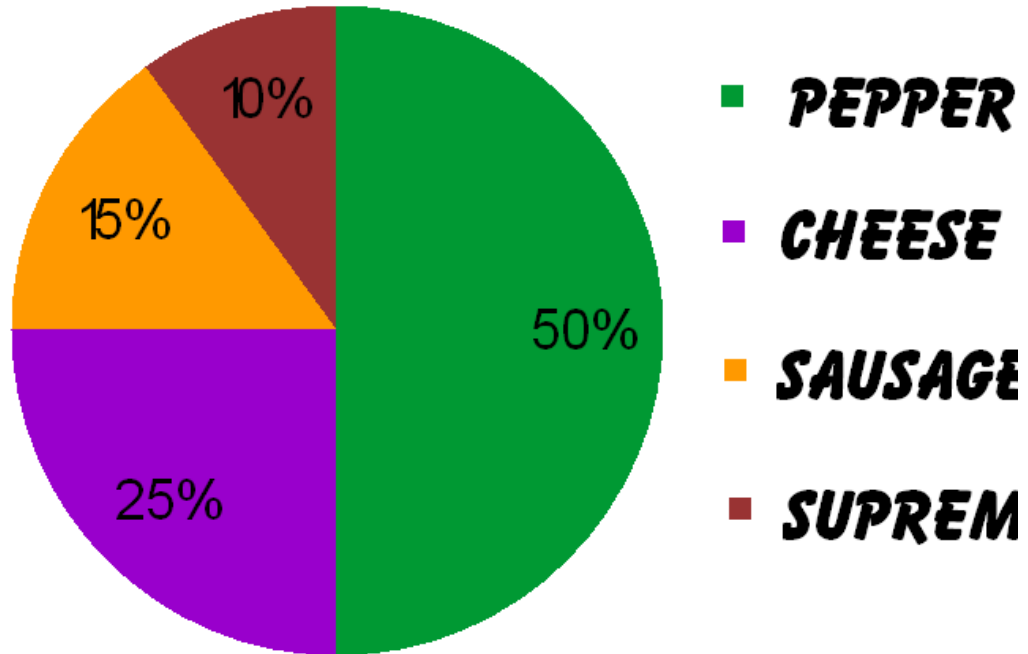


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- Line graphs are used to compare how one variable changes in response to a continuously changing variable.

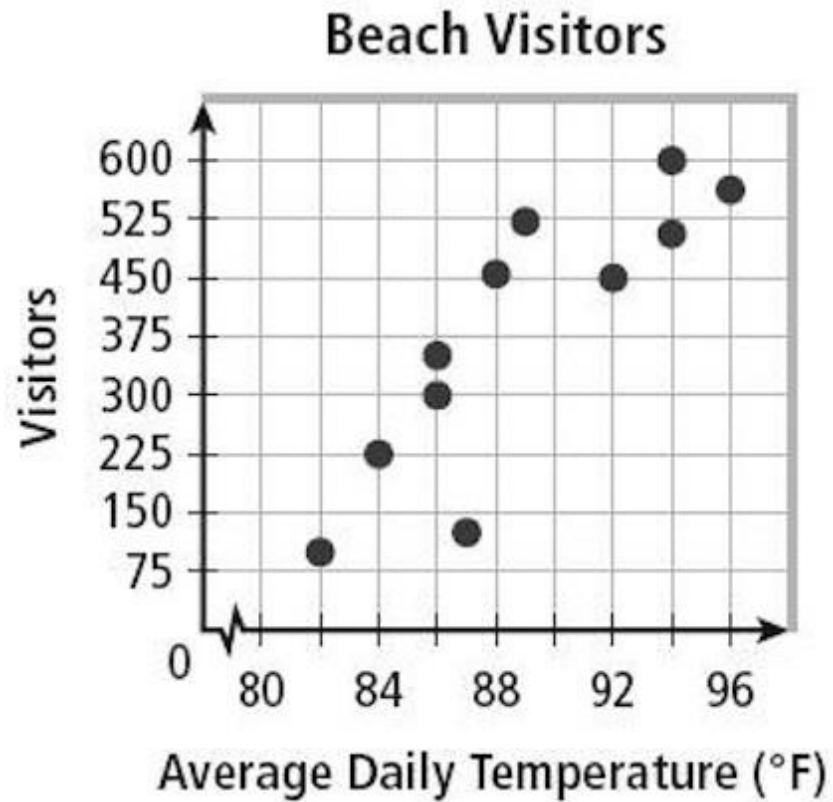


## ***FAVORITE PIZZA TOPPINGS***



# Pie Chart

- Also called circle graph and pie graph
- Pie charts are used to display data when the specific categories are parts of a whole.



## Scatter Plots

Scatter plots are used to compare a possible relationship between two variables.

# Components of a Good Graph

- Choose the best type of graph to tell the story of the data.
- Draw the axes or axis
- Decide the best intervals and label your axes with consistent increments.
- Plot the points
- Label the axes (always include the units!)
- Add a key if needed.
- Give your graph a descriptive title.

# Group Norms

- Everyone contributes.
- One voice at a time. When you're not talking, you're listening.
- Seek first to understand, then to be understood.
- It's not about "knowing" but about thinking and learning.
- Pay respectful attention to what others say.
- Challenge put-downs

# Groupwork Grading

- 0 = did not participate
- 5 = minimal participation
- 10 = full participation

# Talking Sticks

- Everyone starts with their pen/pencil on the table.
- When it is your turn, pick up your pen/pencil.
  - When it is not your turn you are listening to your group.
- Keep your pen/pencil in hand until everyone has had a turn.
- Put the pens/pencils down on the table and repeat procedure.

# What kind of graph?

- Spend 5 minutes quietly reading through the 4 data sets.
- On your handout, write down which type of graph you think would best fit the data.
- Use talking sticks to share which type of graph would be best for each set of data and why.
  - When finished, raise your hand and I will come over and assign your group the data set you will graph.
- Create a graph for your assigned data set on your paper.
  - You may want to use your tables and a dry erase marker for a rough draft.
- Be sure to use all of the components of a good graph.

Time to Reflect...

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# Group Norms

- Everyone contributes.
- One voice at a time. When you're not talking, you're listening.
- Seek first to understand, then to be understood.
- It's not about "knowing" but about thinking and learning.
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- Keep your pen/pencil in hand until everyone has had a turn.
- Put the pens/pencils down on the table and repeat procedure.

# Today's Activity

- Each box is numbered 1 – 5.
- Analyze the box to figure out the inside configuration.
- Draw a “report” for the box’s insides on your paper. Remember to label it!

# Today's Activity

- You will rotate as a group to the other tables in the room.
- You will have 5 minutes at each table to determine the inside configuration of each box. Make sure to stay on task.
- Make sure you have a “report” for each table’s box and that they are labeled.

# Revisions

- Back at your original table, using Talking Sticks establish consensus on what you feel the box interiors looks like.
- Place these drawings on your table with dry erase markers. Be sure to label the boxes!
- If you need to revisit a box, please raise your hand and the teacher will get it for you.

# Revisions

- Have a member of your group place the agreed upon drawing of your first box on the board.
- As a group analyze your drawings of the other boxes.
  - Look for similarities and differences.

You have just developed  
a model!

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# Models

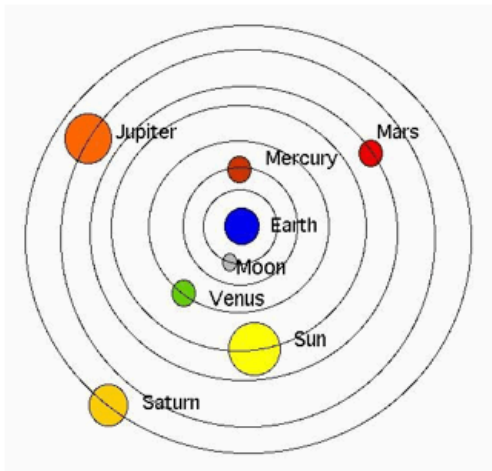
- Models are the basis of scientific understanding and explanations.
- We will develop and use models all year to help us understand and explain the important ideas of biology.

# Scientific Models

- These are a set of ideas that explain natural phenomena.
  - Phenomena: something that has been observed where the explanation of it is unsure
- **Example Phenomena: the sun appears to move across the sky each day.**
  - What model explains this?

# Early Model

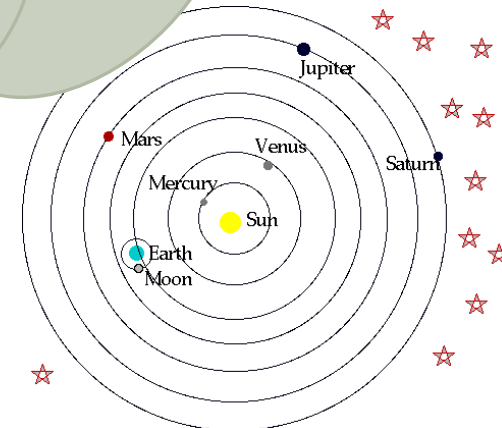
- Earth does not move.
- Sun orbits around the Earth once every 24 hours.



# Current Model

Earth stays in one place and the Sun orbits Earth. (Earth rotates on its axis once every 24 hrs)

*What do scientists do if valid evidence contradicts their model?*



# Scientific Models

- Are a set of ideas that explain natural phenomena.
- Valid models **MUST**...
  - Fit and explain all observations
  - Be realistic and follow all scientific laws
  - Enable us to make accurate predictions
  - **MUST** be changed if new evidence contradicts them.

# So whose model is correct?

- We will never know!
- How is this like real science?
- How is it different?

Time to Reflect...

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Lab

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Time to Reflect...

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