

Introduction to Biology



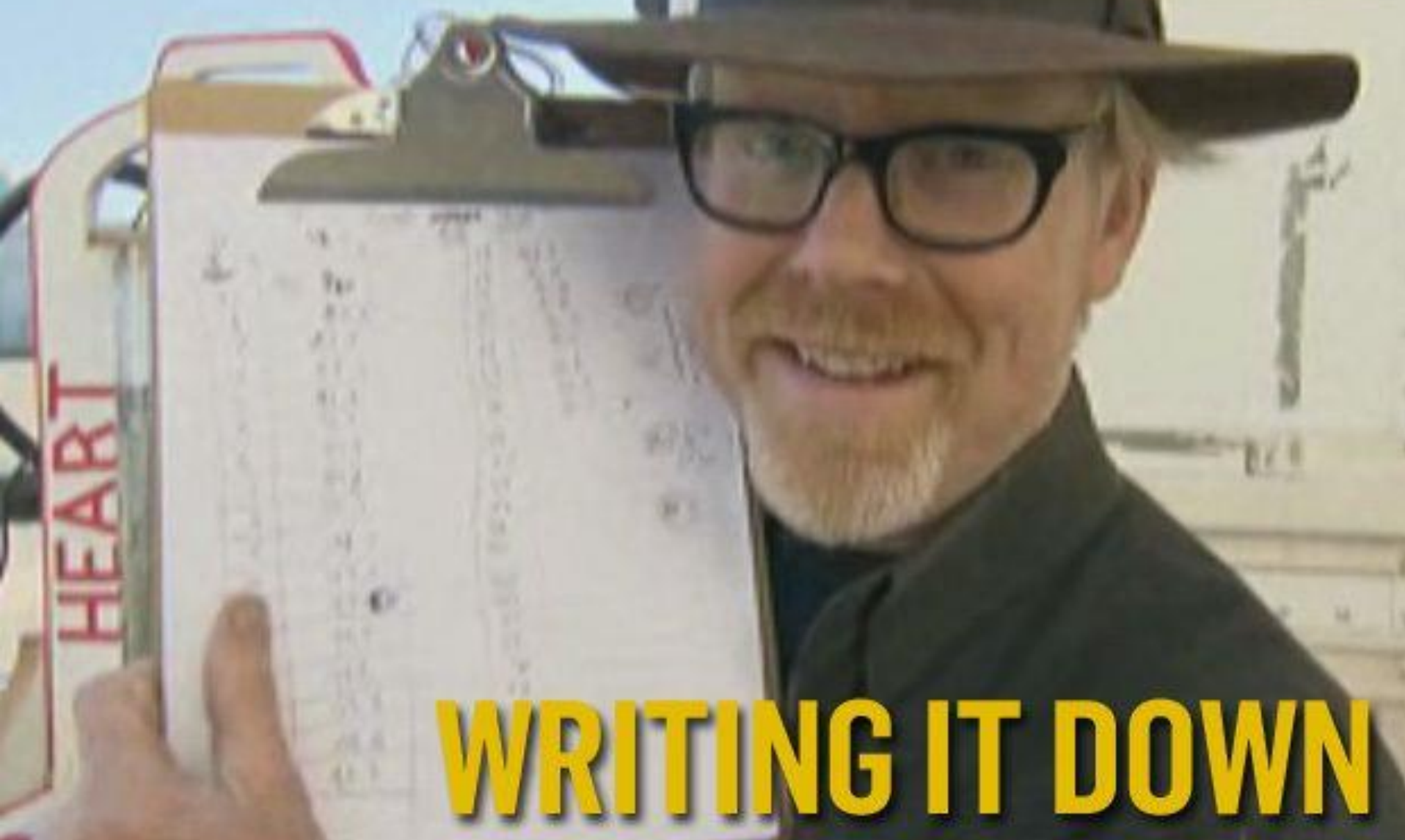
The Scientific Method 2:40

What is Science



What is Science 2:07

**REMEMBER, KIDS, THE ONLY DIFFERENCE BETWEEN
SCREWING AROUND AND SCIENCE IS**



WRITING IT DOWN

What is Science

Science is...

- a **Process**
 - It's about doing and experiencing things
 - It's a participatory sport
 - It's based on inquiry
 - It's observation and measurement based
- the Study of **Nature**
 - Not man-made stuff
 - Natural causes for natural phenomenon
 - Anything not man-made is natural
- uses **Repetitive** techniques
 - Experiments are done over and over
 - Lots of data is needed to draw useful conclusions

How Do We Do Science?

There are two main scientific approaches:

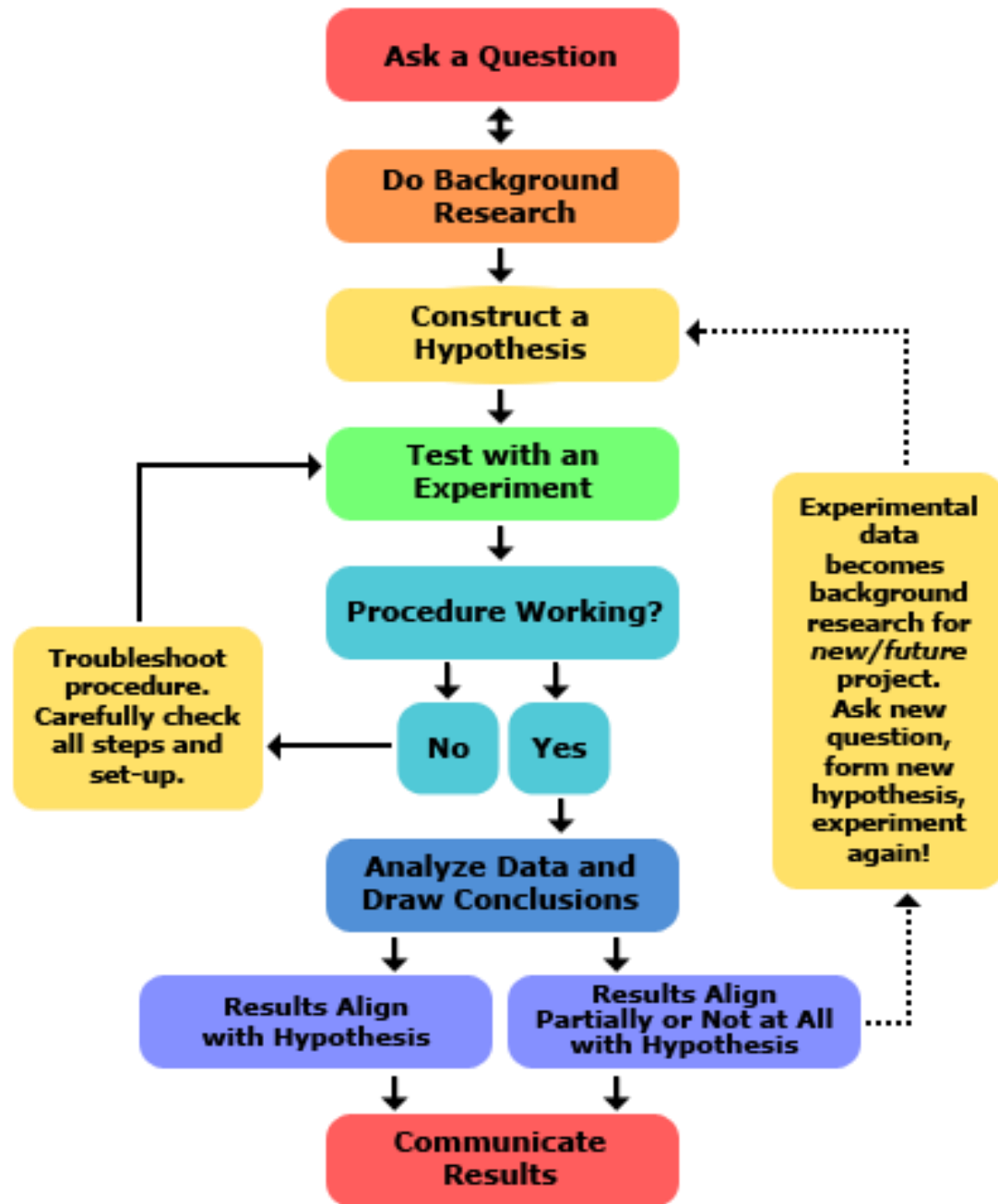
Discovery Science	Hypothesis-Driven Science
<ul style="list-style-type: none">• Traditional Science• Describing nature• Makes use of <u>Scientific Method</u>• Based on verifiable observations and measurements• Describe what you see• More structured	<ul style="list-style-type: none">• Modern Science• Explaining nature• Hypothesis – An explanation (NOT A GUESS) on trial• If...Then... logic• More flexible

STAND BACK



**I'M GOING TO TRY
SCIENCE**

Scientific Method



Nature **Conclusions** **Interpreting** **Variables** **Observing**
Questions **Experiments** **Hypothesis** **Change** **Calculating**
Data **Scale** **Predicting** **Evaluating** **Inferring**
Classifying **Communicating** **Measuring**
Models **Experiments** **Relationships** **Patterns**
Problem Solving **Systems**
Making Judgements **Tables & Graphs** **Applied Math**
Cause and Effect **Compare and Contrast** **Peer Review**

Matching Terms

Scientific Theory

Scientific Fact

Scientific Law

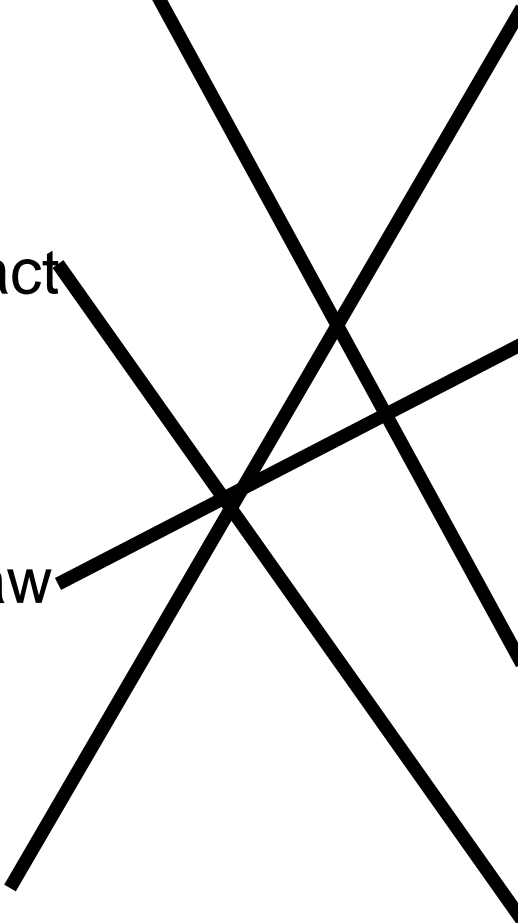
Hypothesis

A **tentative explanation** that is tested to determine if the explanation is valid

A **description** of what happens – often expressed using mathematics

a **well tested and widely accepted view** that **explains** certain observable facts

Accepted or measured **data or observation**



Hypothesis, Theories and Laws

Hypothesis	Theory	Law
Tentative	Well-accepted	
Cannot be proven		
Is testable and has some data supporting it	Is well-tested and has lots of data supporting it	
Does not become a theory	Does not become a Law	Stands on its own
Explains facts/observations		Describes facts/observations
If any part is disproven, it must be discarded or revised		

Culture of Science

- Culture of Science is based on **cooperation and competition**
 - Communicate results for verification and generate new ideas
- **Different** from other ways of explaining nature
 - **Observations and measurements** that can be verified
 - **Testable**
- **Different from technology**
 - Science uses technology
 - Technological advancements arise from scientific discoveries
 - Observations and measurements that can be verified
 - Testable
 - Technology seeks to make the world a better place for humans
 - **Not based on NATURE**

What Science is NOT

Science is not...

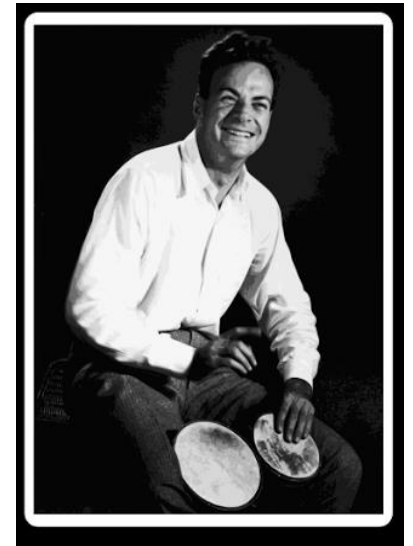
- A Collection of Facts
 - Textbook, Leaf Collection, Poster, Periodic Table
 - Does not involve a repeatable process
- Technology
 - Rocketry, Cooking, Medicine
 - Does not involve study nature
 - Applied Science
- Collecting
 - Museum, Aquarium, Library
 - Does not involve a process
- Pseudoscience
 - Astrology, ESP, Intelligent Design
 - Does not involve a repeatable process

Conclusions About Science

It is a process

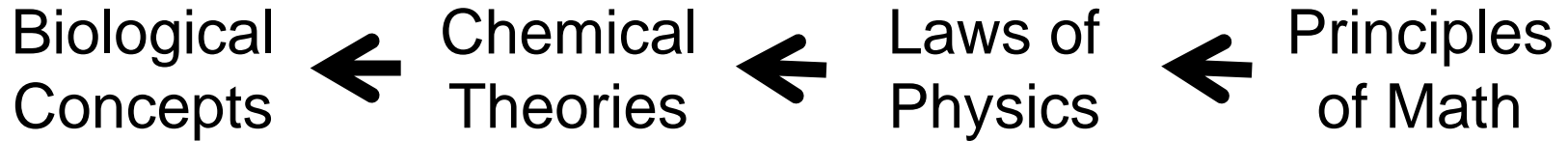
It must be experienced

It cannot be taught





What is Biology



- Biology is the study of living things and their vital processes.
- Very interdisciplinary and broad
- Broken down in hundreds of subdivisions
- Certain themes tie all of these subdivisions together



What is Biology 2:10

Five Unifying Themes of Biology

1. **Cells** are the smallest unit of life
2. **Genes** are how traits are passed from one generation to the next
3. Living things **change over time**
4. **Homeostasis** maintains internal environments of organisms
5. All living things **require energy** to survive



Characteristics of Living Things

Characteristics of Living Things

1. All living things are made up of **cells**
2. All living things **reproduce**
3. All living things are based on a **universal genetic code**
(contain DNA)
4. All living things **grow and develop**
5. All living things obtain and use **material and energy**
6. All living things **respond** to their environment
7. All living things maintain a stable internal environment
(**homeostasis**)
8. Taken as a species, all living things **evolve**



Are Viruses Alive?

This is a very interesting question which has instigated many heated debates in scientific circles. Why are viruses such a big deal? Well, viruses are interesting because they are neither inanimate nor living; a virus is "midway between brute matter and living organism" (Wolfhard Weidel). Because of this ambiguity, it is difficult to define and classify viruses. Although viruses are not composed of cells, they possess all the other characteristics of living things. They replicate, require energy (from living cells), adapt, respond to stimuli and display heredity. Because viruses satisfy six of the seven characteristics of living things, they are on the verge of being classified as a living organism. Perhaps the haziness surrounding our very definition of "living" is at fault for not including viruses as a form of life. As scientist Wolfhard Weidel once said, "nothing brings us so close to the riddle of Life - and to its solution - as viruses".

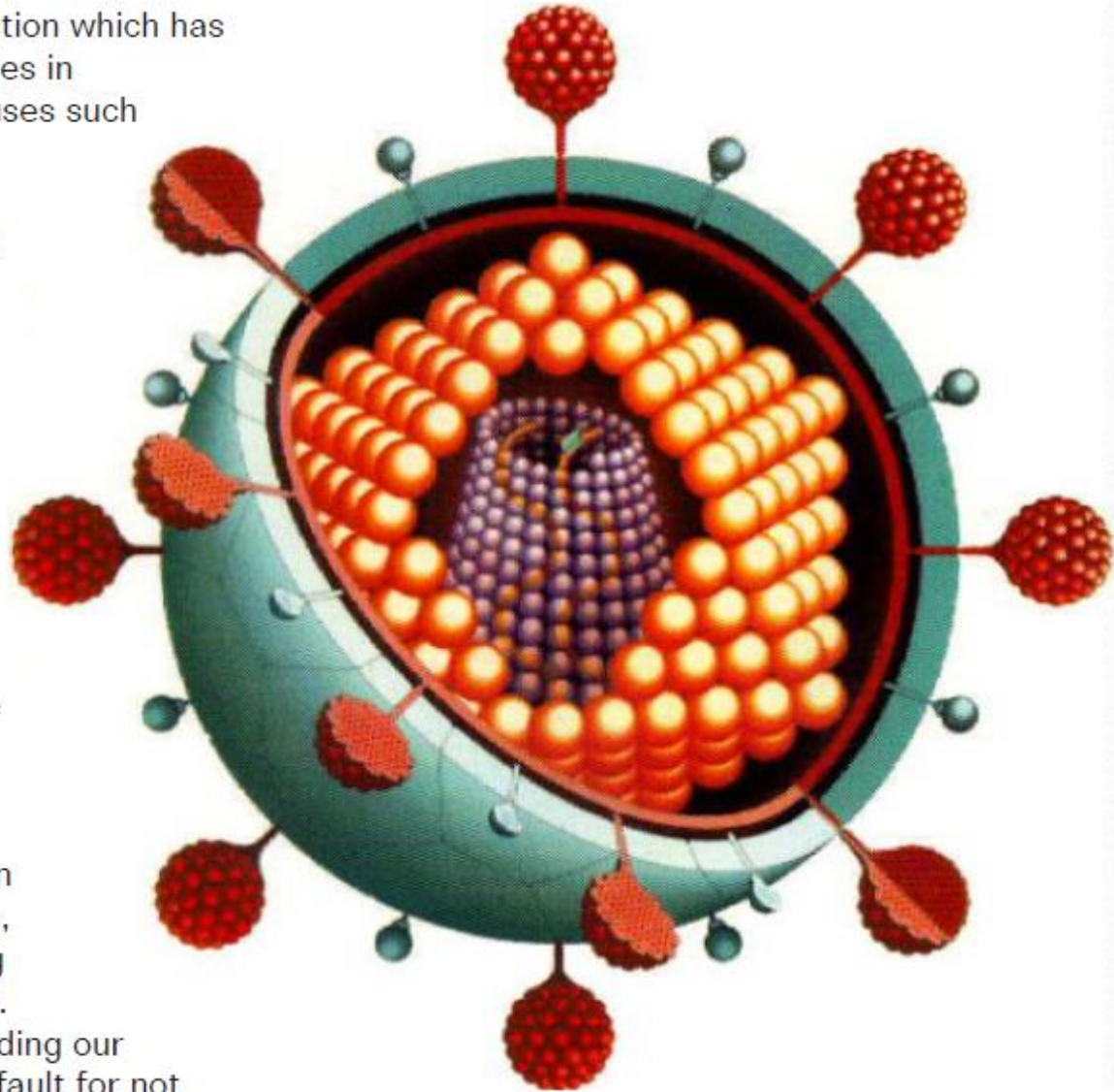


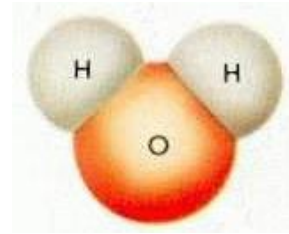
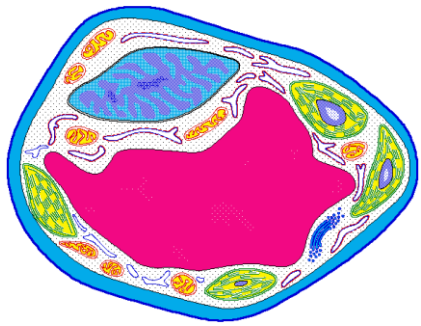
Image courtesy of AltaVista Images



Organization of

Living Things

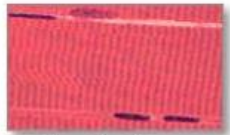
Sorting the Organization of Living Things



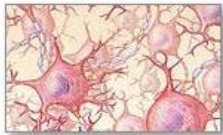
Connective tissue



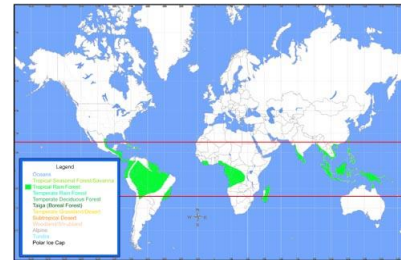
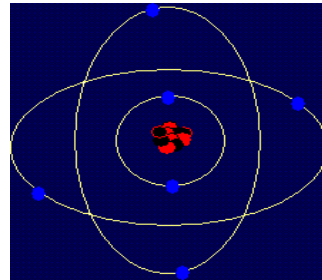
Epithelial tissue



Muscle tissue



Nervous tissue



Mitochondria Inner Structure

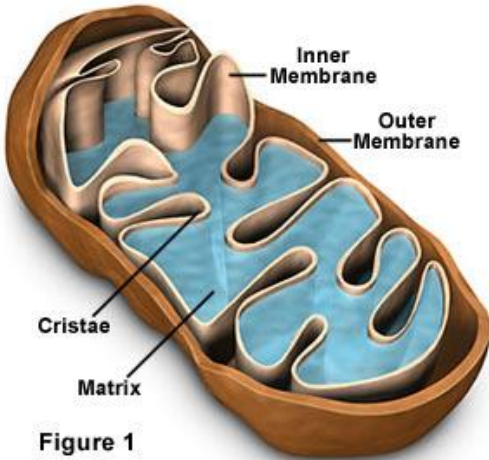
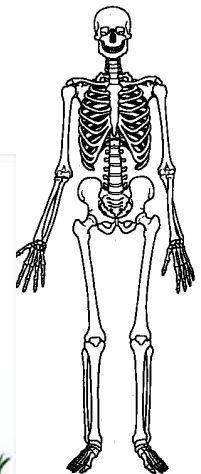
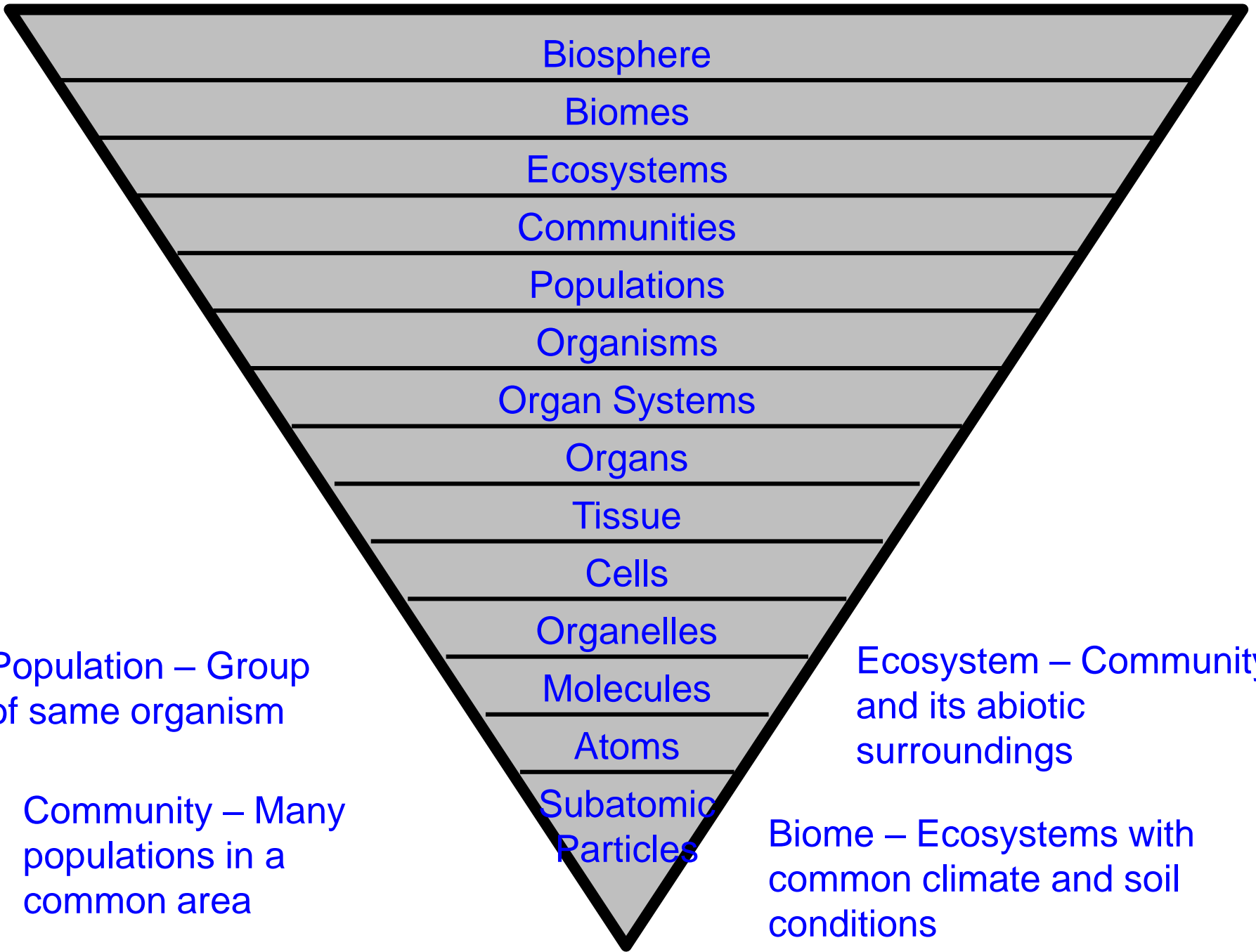


Figure 1





Biosphere

Biomes

Ecosystems

Communities

Populations

Organisms

Organ Systems

Organs

Tissue

Cells

Organelles

Molecules

Atoms

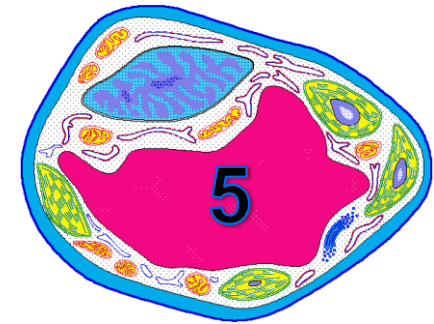
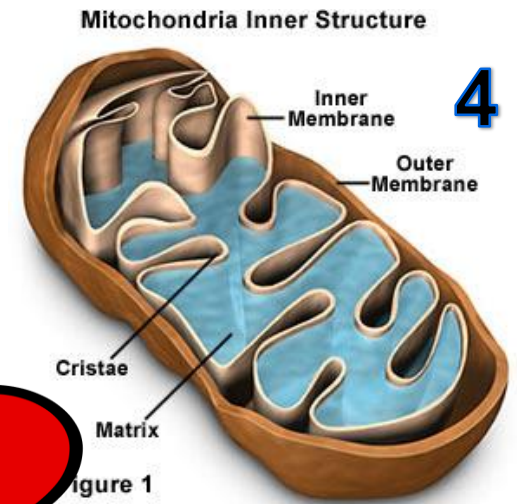
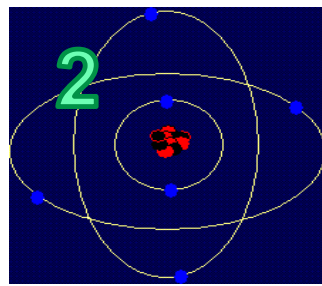
Subatomic
Particles

Population – Group
of same organism

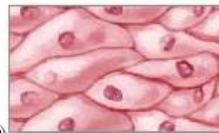
Community – Many
populations in a
common area

Ecosystem – Community
and its abiotic
surroundings

Biome – Ecosystems with
common climate and soil
conditions



Connective tissue

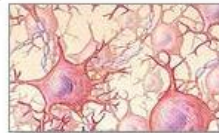


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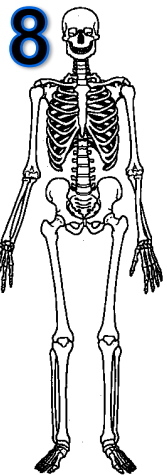
Epithelial tissue



Muscle tissue



Nervous tissue



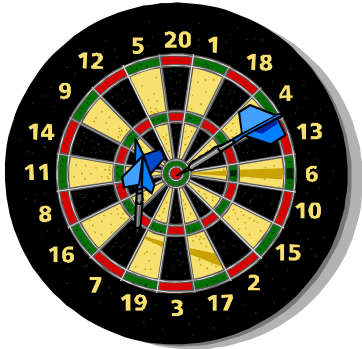
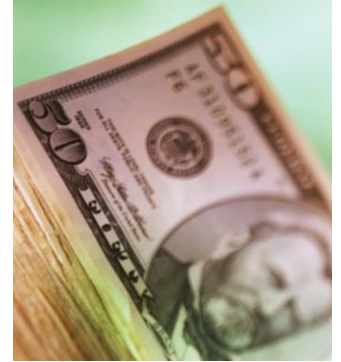
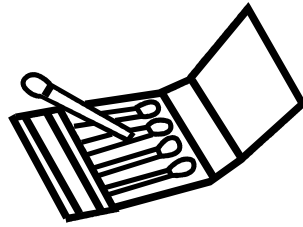


Unifying Themes

of

Science

Observations



Direct Observation Questions

1. How many airplanes were in the picture?
2. What number was at the top of the dart board?
3. What time did the clock say?
4. What denomination was the money?
5. What color was the boy's hair who was holding the globe?
6. What color was the fingernail polish?
7. What color was the baseball player's shirt?
8. How many matches were still in the book?
9. What number was on the side of the car?
10. What toy (not a ball) was touching the football?
11. Name three of the four colors on the dartboard.

Observations

Direct Observations – Those observations we make ourselves

Five ways to make direct observations...

i.e. Measurements using a ruler

i.e. Amount of snow that fell

Indirect Observations – Those observations that we infer or make from far away

Five ways to make direct observations...

i.e. Measurements using a ruler

i.e. Amount of snow that fell

Observing Milk Consumption

The cafeteria is considering getting rid of milk at lunch. First they need to know how many students drink milk each day.

List as many ways as you can to find out how many students drink milk each day.

Comparing Observations

Observation	Time	Cost	Accuracy
Direct	Lots	Expensive	High
Indirect	Little	Cheap	Low

Observations and Questions

A woman gets ready for bed one evening. She changes and turns out the light. She goes to sleep. When she wakes in the morning, she looks outside. She promptly jumps out the window and kills herself. Why?

Observations and Questions

A man lives on the 94th floor of a tall apartment building. Every day the man rides the elevator all the way to the ground floor to go to work. On rainy days the man rides the elevator back home. On sunny days the man only rides to the 44th floor and then walks up the steps for the remaining 50 floors. Explain this behavior.

Observations and Questions

A stranger needing a haircut walks into a town. The town has two barber shops. The man walks into the first barbershop and sees a messy dirty shop. The barber's clothes don't fit, are stained, and his hair is sloppy and uneven. The man walks into the second shop and finds it to be clean and well-kept. The barber is sharp looking and has a great hair cut. The stranger walks back to the first barbershop for his haircut. Why?

Nature is a System

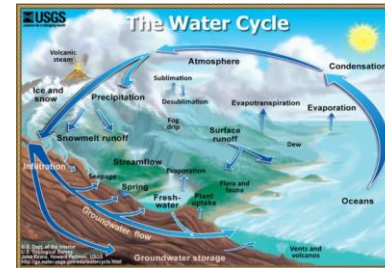
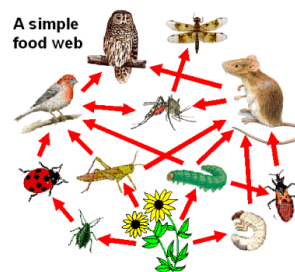
Natural Systems

System – Group of parts working together to complete a function

Changes in one part of a system will impact the other parts

Closed Systems – a system where nothing enters or leaves – it is self-contained

Open Systems – a system that requires resources to enter the system or waste to leave the system



Investigating Cycles

Earth's major cycles include the following:

- Water
- Carbon
- Nitrogen
- Phosphorus

Use the information provided to answer the following questions:

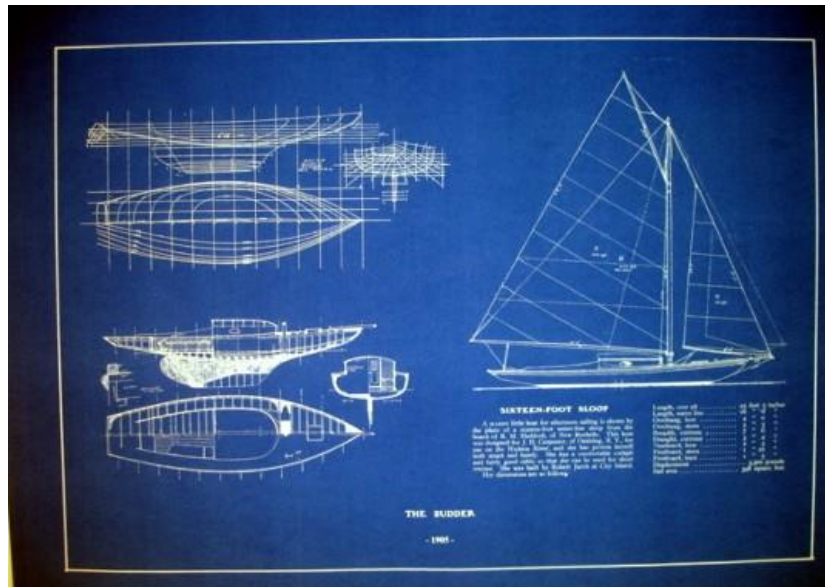
1. What elements are involved in each cycle
2. Which of Earth's spheres are involved in each cycle
3. Name three important needs for each element/compound
4. What ultimately powers these cycles
5. In what sphere is each of the elements most common
6. What happens to nutrients when living things die

Models

Definitions

Model - A scientific model is a simplified thing that helps us explain how something works.

Scale – mathematical relationship between a real-life object and a model of the object



Patterns



$\frac{1}{2}$

1

$1\frac{1}{2}$

2

$2\frac{1}{2}$

3

$3\frac{1}{2}$

—

—

Nature repeats itself in patterns

These patterns can be used to make predictions

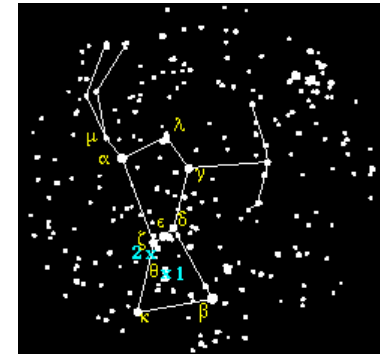
By understanding these patterns we are better able to understand the world we live on



Finding Patterns in Constellations

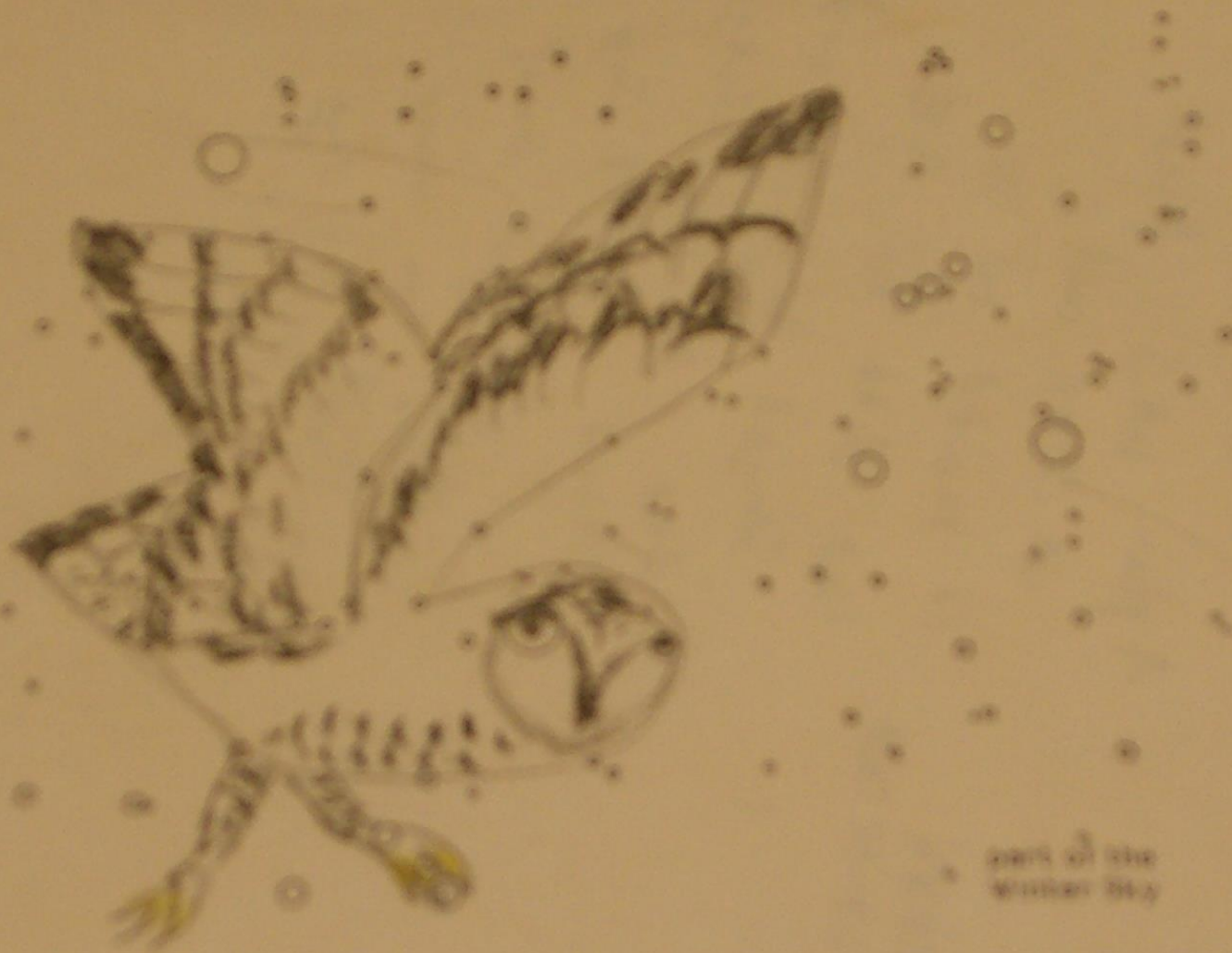
For thousands of years, humans have found patterns in the stars. These patterns, while not based on anything more than our own perspective from here on Earth, help us find our way around the sky, predict seasons, and navigate.

Many times, these constellations were based on the myths and legends of different cultures. Thus we have Orion the Hunter and Aries the Ram.

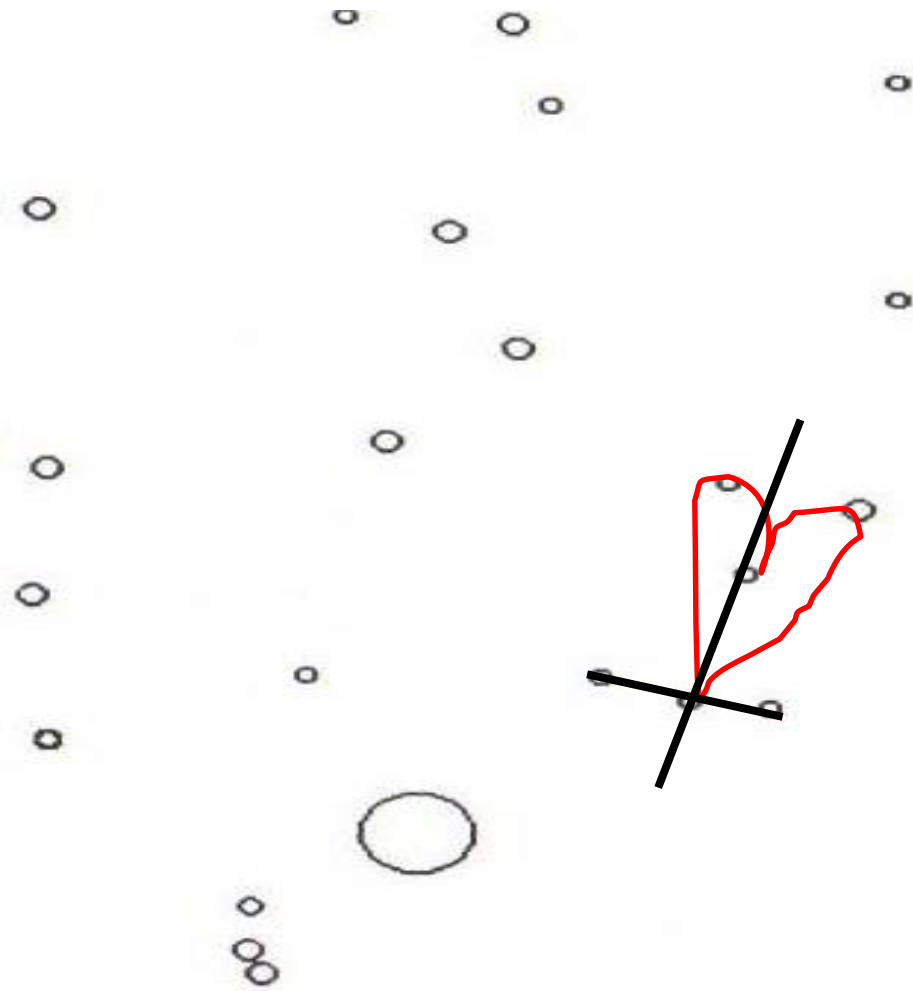


On the star sheet provided, find your own constellation. When you are done, write a myth about your constellation.

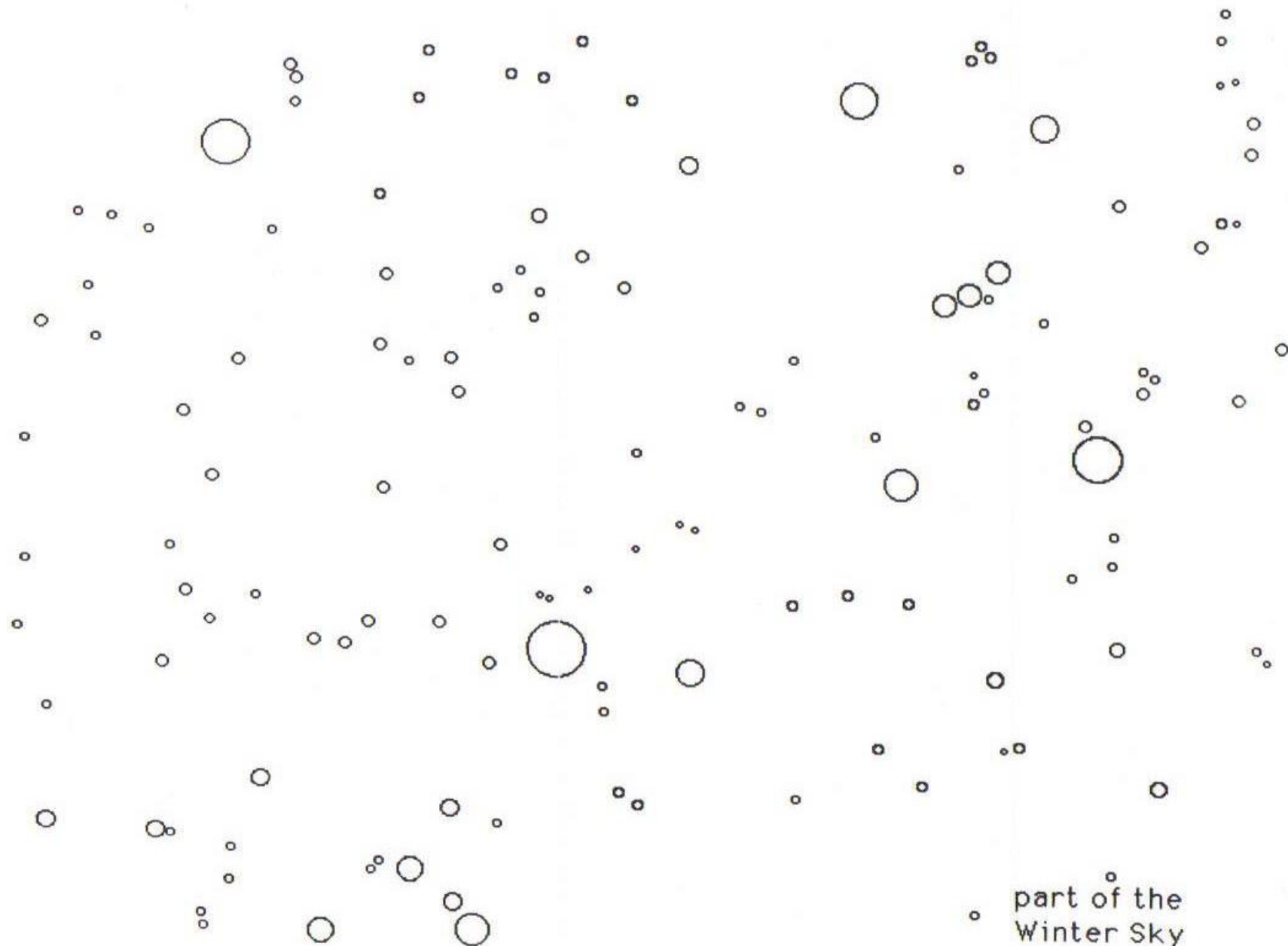
Pohotoni the White Owl



part of the
winter sky



Once upon a time there was a really nice teacher named Mr. R. Now Mr. R. had fallen deeply in love with Ms. T across the hall. However, when he expressed his love for her, she spurned his advances and broke his heart using a knife. To forever remind humans of the importance of love and friendship, the gods took Mr. R's heart and the knife and placed them in the heavens where they remind us to this day that men are nice and women are evil, conniving, uncaring...



part of the
Winter Sky

Classification

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10

$\frac{1}{2}$ 1 $1\frac{1}{2}$ 2 $2\frac{1}{2}$ 3 $3\frac{1}{2}$ 4 $4\frac{1}{2}$

0.25 $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$ 1 1.25 1.33

Apple

Orange

Tangerine

Broccoli

Banana

Tomato

Grapefruit

Pineapple

Pear

Kiwi

Carrot

Potato

- How do libraries organize fiction?
- How do libraries organize nonfiction?
- How do bookstores organize fiction?
- How do bookstores organize nonfiction?
- How does Main Street Jukebox organize its music?
- How does FYE organize its movies?

Classification provides scientists a way to sort and group specimens for easier study

There is NO right way to classify things

Does it make sense

Is it effective