Name ____ Score ________

Classification

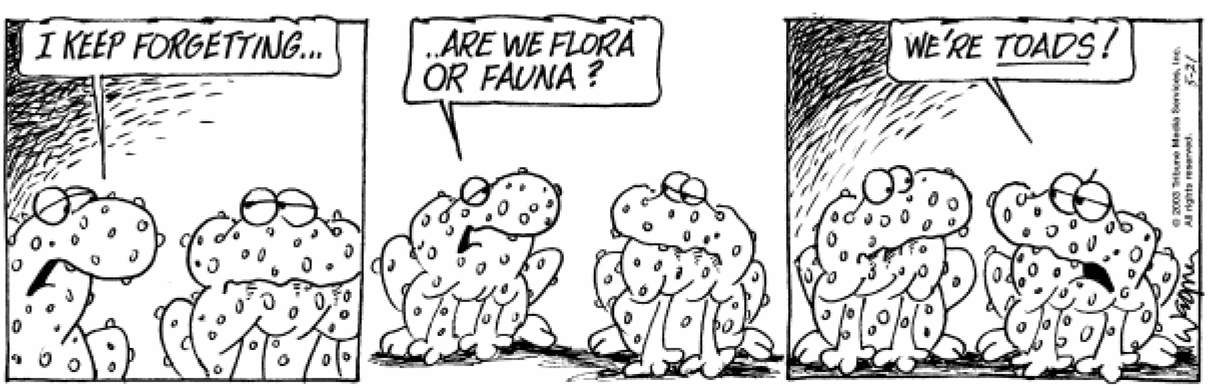
Worksheets and Readings

STANDARD V: Students will understand that structure is used to develop classification systems.

Objective 1: Classify based on observable properties.
a. Categorize nonliving objects based on external structures (e.g., hard, soft).
b. Compare living, once living, and nonliving things.
c. Defend the importance of observation in scientific classification.
d. Demonstrate that there are many ways to classify things.

Objective 2: Use and develop a simple classification system.
a. Using a provided classification scheme, classify things (e.g., shells, leaves, rocks, bones, fossils, weather, clouds, stars, planets).
b. Develop a classification system based on observed structural characteristics.
c. Generalize rules for classification.
d. Relate the importance of classification systems to the development of science knowledge.
e. Recognize that classification is a tool made by science to describe perceived patterns in nature.

Objective 3: Classify organisms using an orderly pattern based upon structure.
a. Identify types of organisms that are not classified as either plant or animal.
b. Arrange organisms according to kingdom (i.e., plant, animal, Monera, fungi, protist).
c. Use a classification key or field guide to identify organisms.
d. Report on changes in classification systems as a result of new information or technology.



Classification Notes

What is classification?

- To put things into groups of some kind.
- It is usually done based on some type of similarities.

Why do we classify things?

- Grouping things helps us to understand them better.
    - A phone book
    - A dictionary
    - A store

Carolus Linnaeus is responsible for developing the classification system we use today (taxonomy).

- Linnaeus developed classification hierarchy.
- **Kingdom – Highest level; most general**
    - There are five Kingdoms
        - Kingdom Monera
        - Over 10,000 species
            - Members – Bacteria and Cyanobacteria (blue-green algae)
    - Kingdom Protista
        - Members – Protozoans and unicellular/ multi-cellular algae
    - Kingdom Fungi
        - Over 100,000 species
        - Members – Include mushrooms and mold
    - Kingdom Plantae
        - Over 250,000 species
        - Members – Make own food through photosynthesis
    - Kingdom Fungi
        - Over 1,000,000 species
        - Members – Multi–cellular, no cell walls, don't make food through photosynthesis
- **Phylum (Division for Plants)** – Groups of classes with shared characteristics; members of a phylum share a common structure and organization; Chordate Phylum (animals with backbones).
- **Class** – Members share common structure; made up of several Orders; Class Mammalia (have mammary glands).

- **Order** – Share common structure and traits; made up of several Families; Order Primate (flexible hands and feet).
- **Family** – Share common characteristics; made up of several Genera; Family Homindae (bipedal – walks on two feet).
- **Genus** – Have common characteristics, structures, and organization; made up of several Species; Genus Homo (large brain).
- **Species** – Most basic; members resemble each other; can produce fertile offspring; sapiens (knowing, knowledge, thinking).
  - The scientific name for human beings is *Homo sapiens*.
    - *Homo* – Latin for "man."
    - *sapiens* – Latin for "wise; to be wise."
      - *Homo sapiens* – The Wise Man.

How can you remember each level of the classification hierarchy?

- **K**aty **p**lease **c**ome **o**ver **f**or **g**inger **s**naps.
- **K**ids **p**refer **c**heese **o**ver **f**ried **g**reen **s**pinach.
- **K**ing Phillip **c**alled **o**ut **f**or **g**ood **s**oup.
- **K**ing Philip **c**an **o**nly **f**arm **g**reen **s**pinach.
- **K**enneth, **p**lease **c**lose **o**ur **f**ront **g**ate **s**oon.
- **K**eep **p**lates **c**lean **o**r **f**amily **g**ets **s**ick.

- **Linnaeus gave species two names.**
  - The two names are the genus and species.
    - This is known as binomial nomenclature or the scientific name.
  - All names are given in Latin.
    - This is because Latin does not change.
  - All Names are unique for each species.
  - By using a scientific name, you know exactly which species you are talking about.

The scientific name also tells you which species are similar.

- Which of these three species are similar:
  - *Erithacus johnstoniae*
  - *Turdus migratorius*
  - *Erithacus rubecula*
- If you selected *Erithacus johnstoniae* and *Erithacus rubecula*, you are correct!
  - *Erithacus johnstoniae* and *Erithacus rubecula* share the same genus – *Erithacus*.

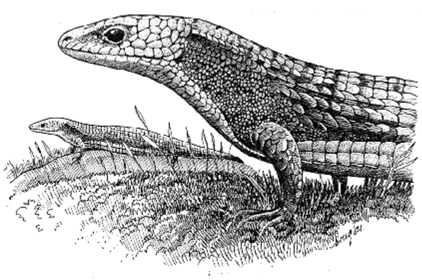
- While different species, these two birds still share some common characteristics.

How do we go about classifying things?

- Living things are classified based on "observable properties!"
    - ("Observable properties" are things you can see)
- Examples of observable properties:
    - Living, once living, non-living
    - External structure – hard or soft
    - Patterns – geometric shapes, symmetry, etc.

Rules you need to follow when classifying

- Know what is being classified.
- Make many observations about the things being classified.
- Classify things based on your observations.
- Group the most similar things together.
- When grouping living things, place the most similar organisms in the same species.
- The largest, or most general, group of living things is the kingdom.



How would you identify this lizard?

- Get a book, look at all the pictures, and select the one that most looks like the picture?
    - ***No!***
- You want to use a classification key (also called a dichotomous key).
- A classification key asks a question and gives you two answers.
- The answer you select takes you to another question until you finally identify the lizard.

Look at an example of a classification (dichotomous) key:

1a. This organism has an exoskeleton - go to question 2
1b. This organism has an endoskeleton or no skeleton - go to question 3

2a. This organism has thin black body and a red stripe on its abdomen - go to question 4a.
2b. This organism has a thick black body with large grey/brown abdomen - go to question 4b.

3a. Organism dwells on land - go to question 5
3b. Organism dwells in the ocean - go to question 6

4a. Organism is called *Latrodectus hasselti*
4b. Organism is called *Atrax infensus*

5a. Organism is totally covered in smooth scale-like skin - go to question 7
5b. Organism has a textured coat or covering - go to question 8

6a. Organism 8 thick legs or tentacles - go to question 9a.
6b. Has many string-like legs or tentacles - go to question 9b.

7a. Scale-like skin is patterned in horizontal stripes over the body - go to question 10a.
7b. Scale-like skin has one block color over most of its body - go to question 10b.

8a. Has fine fur-like covering - go to question 11
8b. Has feather-like covering over most of its body - go to question 12

9a. Organism is *Hapalochlaena lunulata*
9b. Organism is *Chironex flecken*

10a. Organism is *Psuedonaja texilis*
10b. Organism is *Pseudechis porphyricus*

11a. Has two opposing thumbs on the front paws - go to question 13a.
11b. Has no opposing thumb on the front paws - go to question 13b.

12a. Has large bone-like structure on a bald, blue-skinned head - got to question 14a.
12b. Has feather-like covering over head with no bone-like structure - go to question 14b.

13a. Organism is *Phascolatarctos cinerus*
13b. Organism is *Vombatus ursinus*

14a. Organism is *Casuarius casuarius*
14b. Organism is *Dromaius novaebollandiae*

- Isn't this much easier than looking through a book?

Characteristics of living things:

1. ***Living things are made of cells.***
2. ***Living things use energy***
3. ***Living things grow and develop.***
4. ***Living things respond to the environment.***
5. ***Living things reproduce.***

You are now ready to become classification gurus!

Classification Vocabulary

Bilateral Symmetry – If you divide something in half (have a left and right side), the sides are "mirror images." (Most animals have bilateral symmetry).

Classification – To put things into groups of some kind. It is usually done based on some type of similarities.

Classification Key – A device used to identify what group an organism or object is in. Most use a two choice system where you answer yes or no to each question to arrive at the correct group. (Also known as a dichotomous key.) *Dichotomous* comes from the Greek "dikhotomia" (cutting in two); from "dikho-" (apart, in two) + "temnein" (to cut).

Diversity – A variety of something; many different things.

Kingdom – The largest of the classification groupings. Currently scientists have identified five kingdoms: plant, animal, protist, yeast and Monera.

Organism – Any living thing.

Radial Symmetry – Can be divided into two identical halves when divided at any angle.

Species – The smallest of the classification groupings. Any group of organisms that share common genetic information. Members of a species are capable of breeding and producing offspring that can also reproduce. Species comes from the Latin "specere" (appearance, kind).

Words from Science – Classification

(Taken from *Words of Science and the History Behind Them,* by Dr. Isaac Asimov & *The Encarta Dictionary, 2006 Edition*)

Animal – comes from the Latin word "anima" (breath). It was originally believed that plants were not alive but animals were because they could move and breathe.

Bacteria – comes from the Greek "bakterion" (a little rod) since a number of them have the appearance of tiny rods.

Diversity – From the Latin "diversus" (separate).

Fungus (fungi) – comes from the Latin for mushroom, a fungus that can be seen with the naked eye.

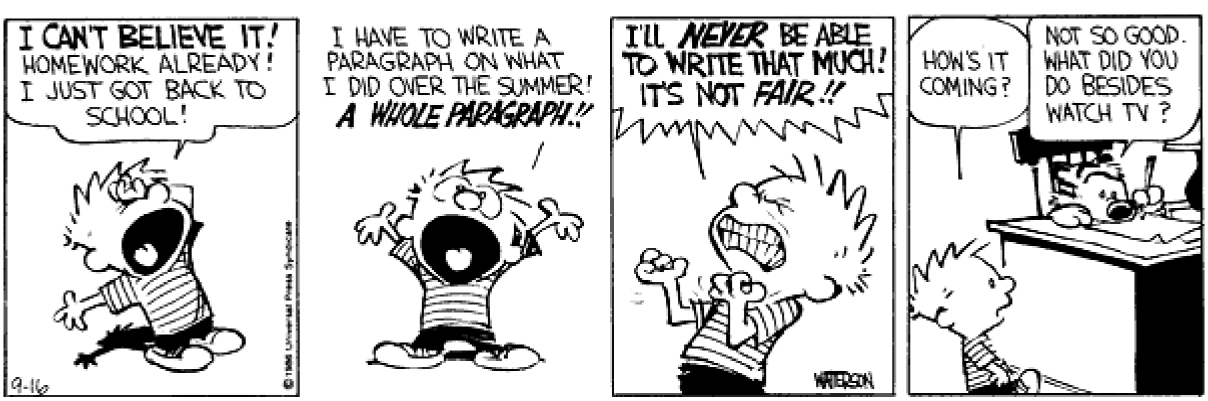
Genus – comes from the Latin "gener-" (birth, race, kind).

Homo sapiens – scientific name for human beings; comes from the Latin "homo" (man); and the Latin "sapiens" (wise). *Homo sapiens* – the wise man.

Phylum – comes from the Greek "phylon" (tribe). All the organisms included within a phylum have the same general body plan, varying only in detail.

Plant – comes from Latin "plantare" (to plant; to push in with the sole of the foot) and was formed from "planta" (sole of the foot).

Protozoan – comes from the Greek "protos" (first) and "zoon" (animal), which are single-celled animals and were the "first animals" to exist on Earth.



Classification Pre-Test

Match the letter of the word in the column on the right with the phrase. Not all letters will be used.

_____ A word that means "different kinds"
_____ The procedure for grouping organisms
_____ Who made the system of classification of grouping organisms?
_____ Classification is based upon _________.
_____ The smallest grouping that can interbreed.
_____ The term for a scientific name made up of two Latin names.
_____ An organisms name always begins with a ___.
_____ The largest grouping in classification.

Answers:

A. Species
B. Small letter
C. Linnaeus
D. Kingdom
E. Diversity
F. Darwin
G. Capital letter
H. Classification
I. Structure
J. Binomial nomenclature
K. Phylum

Number the following classification groups from the largest to the smallest (the largest group will be Number 1)

_____ Class
_____ Genus
_____ Kingdom
_____ Species
_____ Phylum
_____ Order
_____ Family

However many ways there may be of being alive, it is certain that there are vastly more ways of being dead.

- Richard Dawkins

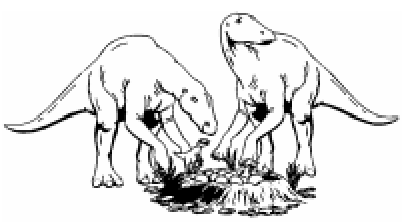
Classification[1].

Classification is a very important part of science (and everyday life). We use it to show differences between objects and ***organisms***[2]. We see how things are similar and different.

Why do we classify things? Imagine trying to look up a phone number in a phonebook with no organization. The Brigham City phonebook is 56 pages long. It has over 5,000 phone numbers. How would you like to have to look up a friend's phone number if there was no order? You'd have to look at every name, on every page, until you found it. It wouldn't be of much use to you.

This is why scientists classify. Classification helps make our world a bit easier to understand.

How Did We Get a Classification System?



Classification goes back to the beginning of time. Dinosaurs classified things. Really, they did! For example, plant-eaters classified things as "What can I eat?" and "What will eat me?" They classified their food – "What can I eat?" and "What can't I eat?"

This information is kind of important to having a good day. If you're eaten, that ruins your whole day. Eating something that makes you sick is not as ***bad*** as being eaten. Still, it's not too nice a thing to have happen.

Even meat-eaters like T-Rex classified. They needed to know "What can I get to eat that's easy" (dinosaur version of fast food!) and which animals were going to put up a fight. Whenever possible, meat-eaters preferred "fast food!"

---

[1] ***classification*** - To put things into groups of some kind. It is usually done based on some type of similarities.

[2] ***organism*** – any living thing.

Early man also classified things much the same way. It didn't take many members of your hunting party being eaten by a saber tooth tiger to know you wanted to stay away from the saber tooth and its cousins!

Who was the first person to classify things? That honor belongs to the Greek scientist Aristotle. He first classified living things around 330 A.D.

Aristotle classified living things as being either plant or animal. Next, he classified plants and animals.

- Plants
  - Herbs
  - Bushes
  - Trees
- Animals
  - Land
  - Air
  - Water

There were problems with his system. Where do we put the frog? It can live on both the land and the water. Where to place the frog?

Something had to be done to improve how we classify living things. That change came in the 1750's. A Swedish scientist, Carolus Linnaeus, developed the science of ***taxonomy***[3].

The first thing Linnaeus did was develop a ***hierarchy***[4] for living things. His hierarchy of living things was organized like this:

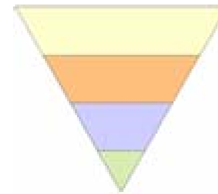
- ***Kingdom*** [*]– The highest level of classification. Kingdom is the most general level of classification and contains the most members.
- ***Phylum (Division in the Plant Kingdom)*** – Made up of several classes. Members of a phylum share a common design even though their actual body details may be different.
- ***Class*** – Made up of several orders.
- ***Order*** – Made up of several families.
- ***Family*** – Made up of several genera.

---

[3] ***taxonomy*** – the science of classifying living things.
[4] ***hierarchy*** – a formal system of classification based on different categories.
[*] See Attachment 1 for information about specific kingdoms.

- ***Genus*** – Made up of several species.
- ***Species*** – A distinct organism whose characteristics remain constant from year-to-year.

As we move down the classification hierarchy, members become more and more similar. The number of species slowly decrease until there is just one. It would look like an upside-down pyramid.



How can you remember each level? Here are some sayings that might help:

- **K**aty **p**lease **c**ome **o**ver **f**or **g**inger **s**naps.
- **K**ids **p**laying with **c**ars **o**n **f**reeways **g**et **s**quashed.
- **K**ids **p**refer **c**heese **o**ver **f**ried **g**reen **s**pinach.
- **K**ing Philip **c**ame **o**ver **f**or **g**ood **s**paghetti.
- **K**ings **p**lay **c**hess **o**n **f**unky **g**reen **s**tools.

And don't forget the every popular:

- **K**issing **p**eople **c**arries **o**ver **f**ungus, **g**erms & **s**pit.

Linnaeus also developed ***binomial nomenclature*** (also known as the ***scientific name***). Binomial nomenclature means "two names." He gave each species to names, a genus name and a species name. He used Latin to name species. He did this because Latin is a dead language. Words and meanings will not change.

Each species has a unique name. When you use the scientific name, everyone knows ***exactly*** which species you are talking about.

If two species share the same genus, you know they are very similar to each other. For example, the birds *Erithacus johnstoniae* (the Collared Bush Robin) and *Erithacus rubecula* (British Robin) are very similar to each other.

That's Great, But How Do We Actually Classify?

I know what you're thinking right now. That's all fine. But how do we ***really*** classify something? Good question. Let's look at the answer.

We classify things based on "observable properties." What that means is that we classify things based one what we can see. Here are some examples of observable properties:

- External structure
    - Hard
    - Soft
- Living, once living, non-living
- Patterns
    - Shape
    - ***Symmetrical***[5]
    - ***Asymmetrical***[6]

How do we determine if something is living or not? All living things have the same ***properties***[7]. These are the properties of living things:

- All living things are made of ***cells***[8].
- All living things use energy (food and water) to grow, move, and process information.
- All living things can maintain stable internal conditions (for example, your body maintains a temperature of about 98.6° F. no matter how cold or warm the weather is.)
- All living things can reproduce (produce young).
- All living things pass on traits to their young.
- All living things can adapt to their environment.

To be classified as living (or once living), what you are classifying must meet all six of the above conditions.

Rules of Classification

"I believe we've been spotted."

All games have rules. Classification is no different.

When you classify something, you ***don't*** just jump in and put things together however you want. There are some rules you need to follow.

First, you must know what is being classified. If you don't know what you're classifying, you can't classify it! Next, make as many observations as you can about

[5] ***symmetrical*** – balanced; both sides equal to each other.
[6] ***asymmetrical*** – unbalanced; neither side equal to each other.
[7] ***properties*** – trait, quality, or feature.
[8] ***cell*** – the smallest unit of life that can function on its own.

what it is you're classifying. You're not in a rush. You don't win awards by being first. ***Take your time!*** Look at the object very carefully and make sure you see everything you need to see.

Now, you classify what you've seen based on your observations. Take what you have classified, and put it together with similar things. The objects that are ***most identical*** are probably the same species. Things that share similar traits belong to the same kingdom.

Where Do I Go From Here?

Is this all there is to classification? Of course not! Now you know how to classify, you want to go out and use that information to identify things.

Have you ever seen a bird and wondered what type of bird it was? Classification gives you an important tool to use. This tool is called a ***classification key***[9] (also called a ***dichotomous key***).

Have you ever looked at a ***field guide***[10] about birds? If you have, you've seen a book that contains hundreds of pictures of birds. How would you like to look through that book, picture-by-picture, to find the bird you have just seen? Most people don't want to.

That is why we have classification keys. The classification key is a set of "yes-or-no" questions that help you identify what you are looking at. Let's look at an example:

You have money in a pile. You have some brown and silver coins as well as some paper money. You want to identify what you have. The classification key you might use may look something like this:

1 A. Is it made of metal? Go to 2
1 B. Is it made of paper? Go to 5

---

[9] ***classification key*** – A device used to identify what group an organism or object is in. Most use a two choice system where you answer yes or no to each question to arrive at the correct group. (Also known as a dichotomous key.)
[10] ***field guide*** – a handbook that has picture and information about things (birds, insects, rocks, plants, etc.)

2 A. It is brown (copper). It is a penny
2 B. It is silver. Go to 3

3 A. It has a smooth edge. It is a nickel.
3 B. It has ridges around the edge. Go to 4

4 A. It has a torch on the back. It is a dime
4 B. It has an eagle on its back. It is a quarter

5 A. It has the number 1 in the corners. It is a $1 bill
5 B. It has the number 2 in the corners. It is a $2 bill

If the answer to question #1A is yes, you go to question #2. If it is no, you go to question #5. At question #2, if the answer to #2A is yes, you know you have a penny. If it is no, you go to question #3. And so on until you identify all your money.

The classification key helps make the process of identifying and classifying things much easier.

Conclusion

During this unit, you have learned the basics of classification. You have learned why we classify. You have reviewed a brief history of classification. You have seen how things are classified as well as rules that help you classify. Finally, you have learned how to use characteristics to identify things using a classification key.

Remember, like other areas of science, classification systems may change as science develops new knowledge. The way things are classified will change in the future. With the basics you have learned, you will understand why and how the changes are made.

ALLEN'S Law – When all else fails, read the directions.

I am not sure how clouds get formed. But the clouds know how to do it, and that is the important thing.

-Unknown Student

When you breathe, you inspire. When you do not breathe, you expire.

-Unknown Student

Biological Classification Worksheet

Five-Kingdom System

Animal Kingdom – Invertebrates (without backbones) and vertebrates (with backbones), multicellular, no cell walls, obtain energy through respiration
Plant Kingdom – multicellular, have cell walls, obtain energy through photosynthesis. Ex. mosses, ferns, flowering and seed plants
Fungi Kingdom – cells with cell walls but not green and do not carry out photosynthesis, break down other organic materials to obtain food. Ex. mushrooms, molds, and yeasts
Protist Kingdom – come in a wide variety of forms, some are animal-like, such as amoeba, paramecium and protozoan. Some are plant-like such as algae and others are fungi-like. Many are single-celled and others are multicellular.
Monera Kingdom – some photosynthesize while others respire. The nucleus of Moneran cells are not bounded by nuclear membranes like cells in the other kingdoms. Ex. bacteria and blue-green algae.

The classification of humans – *Homo sapiens*

The two part naming system is called *Binomial nomenclature (consists of genus and species.).*

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Primata
Family: Hominadae
Genus: Homo
Species: sapiens (note: species is **not** capitalized.

Using the information above, answer the following questions.

1. What is the next smallest classification group after Order? _______________

2. What is the smallest classification group? _______________

3. Every living organism has what classification groups as its name? __________ and _________

4. The first letter of every genus name is ______________.

5. The first letter of every species name is _______________.

6. What is binomial nomenclature? ____.

7. Give one example of how you classification is used at school.

8. Why is the understanding of classification an important life skill?

Classification Practice – Animals

Part A

In the exercises that follow, arrange the items listed into different groups. Give each group a title indicating what the members of that group have in common.

1. German Shepherd, Great Dane, parrot, Irish setter, canary, husky, robin, pigeon

Title ________________________	Title ________________________
________________________	________________________
________________________	________________________
________________________	________________________
________________________	________________________

2. Apples, peas, orange, banana, carrot, lettuce, turnip, pear, grape, potato

Title ________________________	Title ________________________
________________________	________________________
________________________	________________________
________________________	________________________

_________________________ __________________________
_________________________ __________________________

3. Steak, football, sausage, chair, table, bacon, sofa, baseball bat, cleats, ham, bookcase

Title ____________________ Title_____________________ Title____________________

Part B Study the following list of living things:

Mare, trout, parrot, quarterhorse, woodpecker, spaniel, goldfish, Great Dane, eagle, bass, beagle, hawk, stallion, Dalmatian, shark

1. Classify them into two groups (give each group a name).

Group 1 ________________________ Group 2 _______________________

2. Using the same list of living things show how they could be classified into three groups.

Group 1 ________________
Group 2 _________________
Group 3 ________________

3. Using the same list, show how they could be classified into four groups.

Group 1 _________________
Group 2 _________________
Group 3 _________________
Group 4 _________________

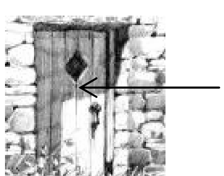
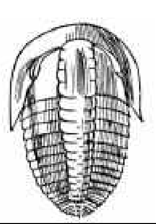
Touch a scientist and you touch a child.

-Ray Bradbury

Yes, But is it Alive?

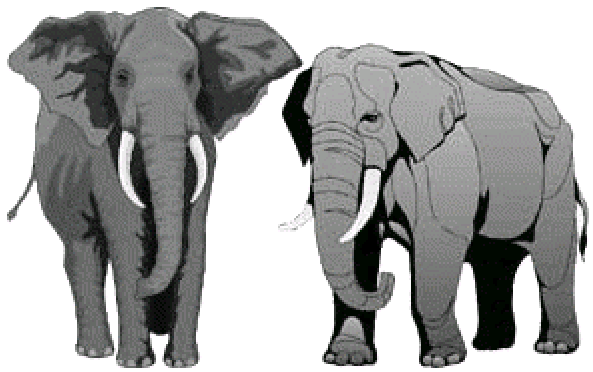
Scientists divide or classify things into three major groups. These groups are: living, nonliving, and once living. Living things are objects that can pass on genetic information through reproduction. The term once-living is a term that refers to things that were at one point part of a living thing.

See how well you understand this. Your goal will be to identify correctly the correct group for each of the following photographs.

Object	*Living (includes once living) or Non-Living*
	
	
	
	
	
	

A Tale of Two Elephants



1. What organisms are shown?

2. Do they look the same?

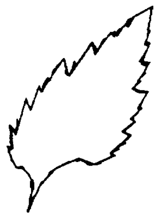
3. Do the pictures show the same species?

4. How are they elephants similar?

5. How are they different?

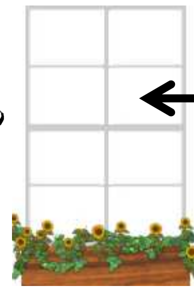
Is it Hard or Soft?

Scientists place things in categories based on their external structures. Determining how to group things is called classification. Below are photographs of some non-living things.



#1

#2



#3

#4

#5

#6

#7

#8

In the box below, identify which objects are hard and soft.

Soft Objects	***Hard Objects***

all species inventory

Introduction

Taxonomy is one of the oldest practices in biology—the science of classifying and naming living things according to how similar they are to other creatures. Now, a group of scientists and Silicon Valley entrepreneurs is trying to bring the musty field of taxonomy into the twenty-first century. You'll hear about their plan in this Science Update.

Transcript

Taking inventory of the earth. I'm Bob Hirshon and this is Science Update.

Scientists have identified about 1.7 million plants, animals, and microbes. It sounds like a lot, until you realize that's less than ten percent of all the species that actually exist on earth.

Kevin Kelly is co-founder and board chairman of the All Species Foundation in San Francisco. He says they're looking to discover, identify, and catalog every species on earth within the next 25 years. They're drawing on the help of professional biologists as well as trained amateurs.

Kelly:
Part of our goal is to actually increase the abilities of countries around the world to train more people, both professionals and the parataxonomists to go out and do this.

Biologist and board member Peter Warshall says that new technologies, like DNA analysis techniques, will help keep the effort on pace.

Warshall:
And it might be possible in five years, for instance, just to dip a root of a plant or a leg of a grasshopper into a small machine and come out with a temporary DNA definition of is it a new species or not.

Eventually, the group plans to make all the information publicly available—by giving every species its own website. For the American Association for the Advancement of Science, I'm Bob Hirshon.

Making Sense of the Research

A list of all the species on the planet is quite a big list. If the number of species Kelly's team expects to find is even close to being right, then just a list of the names, printed out in 12-point type on standard paper, one name per line, would take up over 370,000 pages.

So why go through all the trouble? Well, for starters, the number of species on earth is rapidly diminishing. It's thought that species are constantly disappearing from the planet that humans have never even identified. Knowing exactly what's here will give us a better idea of what we're losing—and how our actions as human beings really affect the creatures we share the planet with.

But the way scientists keep track of species now is like a big business that still keeps all its books in big handwritten ledgers. There's no centralized database of all the species that we know of. If someone thinks they've found a new species, they have to dig through taxonomy books to try and figure out if someone else has found it first. At the rate we're going, Kelly estimates that it will take between 600 and 1,000 years to catalog all the species we have. A comprehensive, Web-searchable database would let scientists and amateurs verify and record their new discoveries far more quickly and easily. Plus, all the pertinent information about a species—where it lives, what it eats, what its predators are, and so on—could be held in the same place.

Of course, there are problems. One of them is the cost: this project will require billions of dollars in investment from countries around the world. There also aren't nearly enough trained researchers to find all the new species, especially in developing countries, where the diversity of life is the richest. As Kelly points out, the All Species Foundation hopes to issue grants to help train new amateur taxonomists, but that alone is a big undertaking.

Finally, there's the complexity. In order to find all the species on earth, you've got to look everywhere on earth, and some places are a lot easier to get to than others. It's easy enough to search a meadow in Iowa, but what about the bottom of the Pacific Ocean? A cave in a remote part of South America? What about cataloguing all the bacteria inside the gut of a rare African termite? In order to pull this off, scientists are going to have to come up with an organized way to scour the planet for undocumented life forms.

Kelly says there are a number of possible strategies. One is to simply divide up the globe like a grid and move from one area to the next systematically. For now, though, the Foundation hopes to start by choosing small, manageable areas that people are already somewhat familiar with, and concentrating as much effort as possible on documenting every species within those areas. Once they see how many new species turn up there, they can use that experience to guide them through more uncharted territory.

Now answer these questions:

1. What reasons are there to take an All Species Inventory?

2. What are some of the obstacles to completing this project?

3. Scientists estimate that humans have identified only about 10% of the living species on earth. How do you suppose they arrived at this figure, without ever having seen these undiscovered species?

4. If a species hasn't been identified by humans yet, is it important to know it's there? How can we be affected by living things that we aren't aware of?

How Sharper Than a Shark's Tooth?

Only .5% of all living things leave a fossil behind. Unfortunately, we usually don't get a full set of fossils. In fact, sometimes we only get a tooth. Our paleontologists have been busy collecting shark teeth. You have been given a set of teeth to evaluate and classify your teeth.

How do you determine properties of the group? There are many ways. Here are some suggestions:

- Put all teeth that are similar in the same group.
- Measure the length of the tooth.
- Measure the width of the tooth.
- Measure the width of the tooth.
- Count the number of points.
- Describe the color.
- Use words like: sharp, rough, smooth, lines of the tooth, etc.

Remember, be ***very*** specific about your description and characteristics. If you are not sure how to describe something, ask Mr. Hill

Classify your teeth below, naming your group, listing its properties, drawing a picture of a sample tooth, and listing the number in each group. (You may not need to complete all the charts.)

Group Name	
Properties of Group	
Picture	
Number	

Group Name	
Properties of Group	
Picture	
Number	

Group Name	
Properties of Group	
Picture	
Number	

Group Name	
Properties of Group	
Picture	

Number	

Group Name	
Properties of Group	
Picture	
Number	

Paperbag Paleontology

Introduction

In this Science Update, hear about science reporter Bob Hirshon with teams of kids who are helping a scientist with a mastodon dig.

Transcript

Performing Paleontology by mail. I'm Bob Hirshon and this is Science Update.
After collecting more than four tons of dirt, fossils, and plant matter from around two mastodons, John Chiment looked for help sorting through it all. But the Cornell Paleontologist didn't send it off to a team of his colleagues. Instead, he offered five pound bags of the stuff to just about anyone interested in helping him.

Chiment:
"We've got children that are five, and people that are in their 80's doing it, and we've got Boy Scout troops and Brownie posts, and, a couple of people that are in prison. So, lots of interests from all sorts of different groups."

Dr. Chiment recently found the two mastodon skeletons in a bog in New York state. After he viewed other collections of mastodons, he decided that his would be different.

Chiment:
"What they had when they had collected large skeletons like that, was just the mammalian skeleton. They had never thought to collect all the other stuff that's between the toes, all the little insects, the pine needles, all the other kinds of fossils."

But Dr. Chiment has. And after getting some elementary school classes to help him pick through a few bags, he decided to offer it to other groups as well. With their help, he's building more than just another mastodon skeleton-- he's creating a more complete picture of the world in which they lived.

For the American Association for the Advancement of Science, I'm Bob Hirshon.

Now answer the following questions:

1. What did Paleontologist John Chiment collect from around the two mastodons? Why?

2. What did he do with the tons of dirt, fossils, and plant matter that he collected?

3. Who are the people who are helping Dr. Chiment sort through the material from his dig? What are they looking for?

Treasures of the Great Barrier Reef

Complete the chart as you identify your fish.

Picture #	Fish
1	
2	
3	
4	
5	
6	
7	
8	
9	

Identifying Norns

(from The Biology Corner – Worksheets and Lessons)

Norns belong to the **genus Norno** and can be divided into eight species that are generally located in specific regions of the world. Use the dichotomous key to identify the Norns below. Write their complete scientific name (genus + species) in the blank.

Dichotomous key

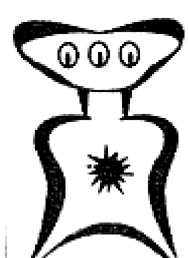
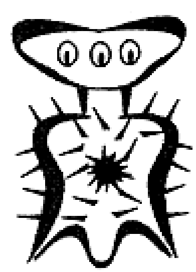
1. Has pointed ears .... go to 3
   Has rounded ears ....go to 2

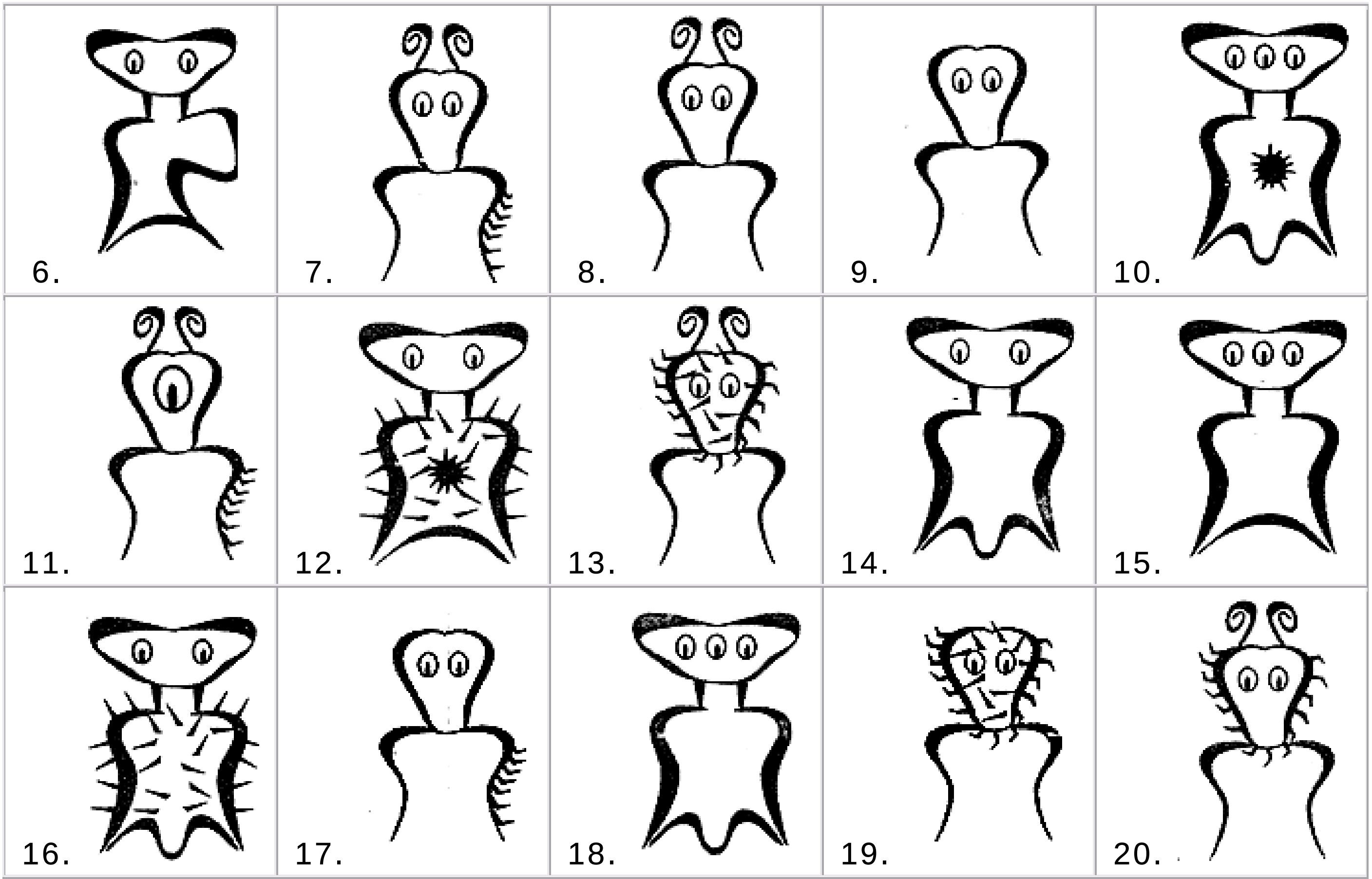
2. Has no tail .... Kentuckyus
   Has tail .... Dakotus
3. Ears point upward .... go to 5
   Ears point downward ....go to 4
4. Engages in waving behavior .... Dallus
   Has hairy tufts on ears ....Californius
5. Engages in waving behavior .... WalaWala
   Does not engage in waving behavior ....go to 6
6. Has hair on head .... Beverlus
   Has no hair on head (may have ear tufts) ....go to 7
7. Has a tail .... Yorkio
   Has no tail, aggressive .... Rajus

Pamishan Classification

(from The Biology Corner – Worksheets and Lessons)

Help! Scientists have discovered quite a few new creatures on planet Pamishan. They need your help to identify and classify them. Use the dichotomous key on the next page to identify these creatures.

1. 	2. 	3. 	4. 	5. 



1.

2.

3.

4.

5.

6.

7.

8.

11.

12.

13.

14.

15.

16.

17.

18.

9. 19.

10. 20.

Pamishan Creatures Dichotomous Key

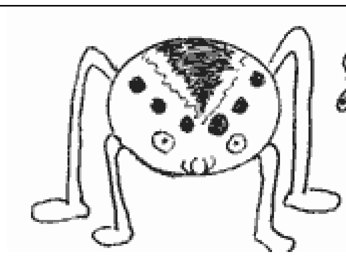
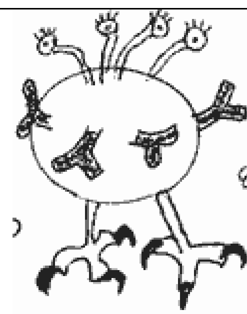
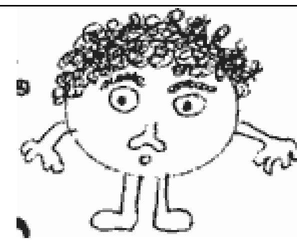
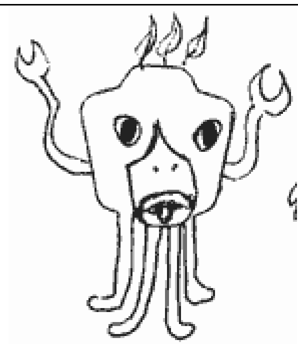
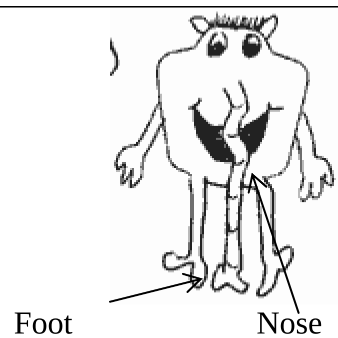
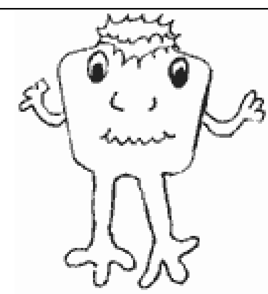
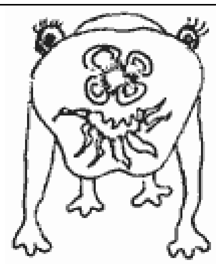
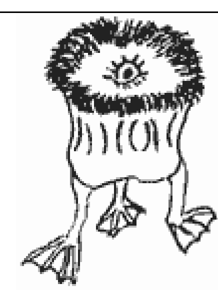
1. a. The creature has a large wide head............................go to 2
   b. The creature has a small narrow head..........................go to 11
2. a. It has 3 eyes ....go to 3
   b. It has 2 eyes ....go to 7
3. a. There is a star in the middle of its chest....................go to 4
   b. There is no star in the middle of its chest ....go to 6
4. a. The creature has hair spikes ....*Broadus hairus*
   b. The creature has no hair spikes...............................go to 5
5. a. The bottom of the creature is arch-shaped ....*Broadus archus*
   b. The bottom of the creature is M-shaped ....*Broadus emmus*
6. a. The creature has an arch-shaped bottom ....*Broadus plainus*
   b. The creature has an M-shaped bottom...........................*Broadus tritops*
7. a. The creature has hairy spikes ....go to 8
   b. The creature has no spikes....................................go to 10
8. a. There is a star in the middle of its body ....*Broadus hairystarus*
   b. The is no star in the middle of its body ....go to 9
9. a. The creature has an arch shaped bottom ....*Broadus hairyemmus*
   b. The creature has an M shaped bottum ....*Broadus kiferus*
10. a. The body is symmetrical ....*Broadus walter*
    b. The body is not symmetrical..................................*Broadus anderson*
11. a. The creatrue has no antennae ....go to 12
    b. The creature has antennae ....go to 14
12. a. There are spikes on the face ....*Narrowus wolfus*
    b. There are no spikes on the face ....go to 13
13. a. The creature has no spike anywhere ....*Narrowus blankus*
    b. There are spikes on the right leg ....*Narrowus starboardus*
14. a. The creature has 2 eyes......................................go to 15
    b. The creature has 1 eye.......................................*Narrowus cyclops*
15. a. The creature has a mouth.....................................go to 16
    b. The creature has no mouth....................................go to 17

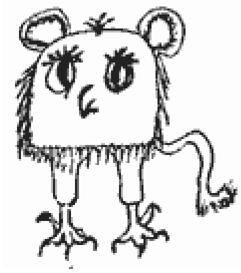
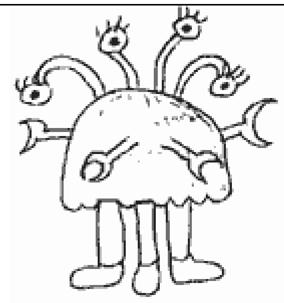
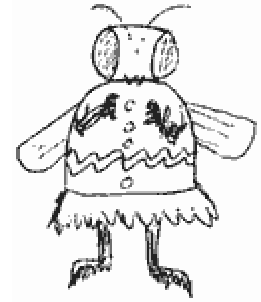
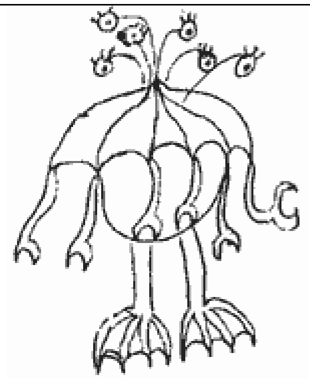
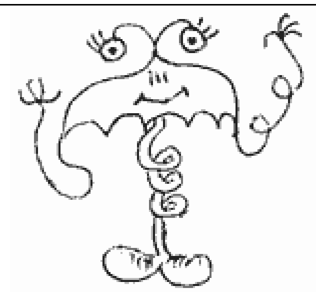
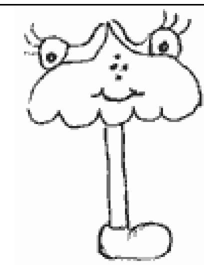
16. a. There are spikes on the left leg ....*Narrowus portus*
    b. There are no spikes at all ....*Narrowus plainus*
17. a. The creature has spikes ....go to 18
    b. The creature has no spikes ....*Narrowus georginia*
18. a. There are spikes on the head ....go to 19
    b. There are spikes on the right leg............................*Narrowus montanian*
19. a. There are spikes covering the face ....*Narrowus beardus*
    b. There are spikes only on the outside edge of head ....*Narrowus fuzzus*

Wacky People Dichotomous Key

(from a Lesson Plan by Vivian Johnson)

Using your dichotomous key, identify each "Wacky Person." Write the name below the "Person."

Wacky People Dichotomous Key

1a Two feet	Go to #2
1b Some other number of feet	Go to #3
2a Does not look human	Go to #4
2b Looks like a human	Go to #5
3a One Leg	Go to #6
3b Three or four legs	Go to #7
4a Fly-like	Mos Cara
4b Not fly-like	Go to #8
5a Seems to be a girl	Rita Nita
5b Not a girl	Go to #9
6a Leg is curled, two feet	Ru-ela Brella
6b Leg is straight, one foot	Giggles

7a Three legs	Go to #10
7b Four legs	Go to #11
8a Has webbed feet	Hex Oculate
8b Clawed feet	Go to #12
9a Curly hair, no toes	Lugio Wirum
9b Wiggly looking mouth, three toes on feet	C. Nile
10a Very long nose, open mouth	Elle E. Funk
10b Some other appearance	Go to #13
11a Has duck bill, two pinchers	Tri D. Duckt
11b Has no arms or pinchers	Go to #14
12a Has ears, tail, and beak	Grif Leon
12b Four eyes on stalks	Eggur Ondy
13a One eye, webbed feet	Cue Kide
13b Four stalked eyes, four pinchers	Quadrumenox
14a Three toed feet, nose like a flower	Tunia petalos
14b Spider-like, has spots	Patterned mulywumpus

Harry Potter and the Organized Beans

"'… Now, enough questions. Is suggest you make a start on these sweets. Ah! Bertie Bott's Every Flavor Bean! I was unfortunate enough in my youth to come across a vomit-flavored one, and since then I'm afraid I've rather lost my liking for them – but I think I'll be safe with a nice toffee, don't you?'

"He smiled and popped the golden-brown bean into his mouth. Then he choked and said, 'Alas! Ear wax!'"

-Harry Potter and the Sorcerer's Stone

You have a box of Bertie Bott's All Flavor Beans. Your assignment is to identify what "flavor" each bean is and help Dumbledore find one he will enjoy. Once you have identified each, bean, you need to develop a dichotomous key so Dumbledore will always be able to select the right type of bean.

"Humans have a knack for choosing precisely the things that are worst for them."

- Albus Dumbledore

Fin-Addict Identification

1. How many of the fins show a nick or set of notches?

2. How many of the fins show scars?

3. You placed your whales into two groups. What characteristic did you use?

4. How many sets of two statements were needed to identify all of the whales.

5. Turn in your completed classification key.

"In those days spirits were brave, the stakes were high, men were real men, women were real women, and small furry creatures from Alpha Centauri were real small furry creatures from Alpha Centauri. "

-Hitchhikers Guide to the Galaxy

Podcast Title: ____

1. What was this podcast about?

2. List two facts presented in the podcast.

    a.

    b.

3. List three new things you learned while listening to this podcast.

    a.

    b.

    c.

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    b.

    c.