Everything in Its Place: Science Classification

Grade Level or Special Area: Fifth Grade
Written by: Cyndie Stanley, Jefferson Academy, Broomfield, Colorado
Length of Unit: Sixteen lessons (nine weeks at four days a week for 40 minutes a day including the preparation for and completing the Culminating Activity)

I. ABSTRACT

The focus of this unit is for students to develop an understanding of the system of classification for living things used by scientists. Students will experiment with the five kingdoms: monerans, protists, fungi, plants, and animals. The students will learn about the similarities and differences in characteristics of each of these kingdoms and know specific examples from each kingdom.

II. OVERVIEW

A. Concept Objectives
   1. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigation. (Colorado Science State Standard 1)
   2. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment. (Colorado Science State Standard 3)

B. Content from the *Core Knowledge Sequence*
   1. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal and Plant. (page 126)
   2. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus, Species, (Variety). (page 126)
   3. When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin), which help scientists around the world understand each other and ensure that they are using the same names for the same living things. (page 126)
   4. Different classes of vertebrates and major characteristics: fish, amphibians, reptiles, birds, mammals (page 126)
   5. Non vascular plants (page 127)
   6. Vascular plants have tube like structures that allow water and dissolved nutrients to move through the plant. (page 127)
   7. Parts and functions of vascular plants: roots, stems, and bud, leaves (page 127)
   8. Photosynthesis (page 127)
   9. Plant reproduction (page 127)
   10. All living things reproduce themselves. Reproduction may be asexual or sexual. (page 128)
   11. Examples of asexual reproduction: fission (splitting) of bacteria, spores from mildews, molds, and mushrooms, budding of yeast cells, regeneration and cloning (page 128)
   12. Sexual reproduction requires the joining of special male and female cells to form a fertilized egg. (page 128)
   13. Development of the embryo: egg, zygote, embryo, new animal (page 128)

C. Skill Objectives
   1. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
   2. Students will explain why a classification system is needed for living things.

3. Students will create a classification system that can be used to place common items into proper groups.
4. Students will recognize that scientific knowledge is subject to modifications as new information is discovered.
5. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
6. Students will identify organisms that belong in each kingdom. For example, bacteria are monerans, ameba is protists, mushrooms are fungus, flowers are plants and dogs are animals.
7. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species.
8. Students will list the parts of a virus.
9. Students will describe how a virus reproduces and causes disease.
10. Students will name and describe the parts of a moneran.
11. Students will compare autotrophic and heterotrophic monerans.
12. Students will list ways in which monerans can be harmful and helpful.
13. Students will describe general characteristics of the protists.
14. Students will define autotrophs and heterotrophs.
15. Students will list the three groups of protists.
16. Students will list the four main groups of animal like protists.
17. Students will distinguish structural features of animal like protists.
18. Students will describe the methods of movement and feeding used by animal like protists.
19. Students will identify characteristics of plantlike protists.
20. Students will name three types of plantlike protists.
21. Students will identify characteristics of funguslike protists.
22. Students will distinguish slime molds from other types of protists.
23. Students will describe the major characteristics of fungi.
24. Students will compare the three types of fungi.
25. Students will describe ways in which fungi interact with other living things.
26. Students will name the two groups of plants.
27. Students will describe the general characteristics of plants.
28. Students will list reasons why plants are important.
29. Students will define vascular and nonvascular plants.
30. Students will list the characteristics of mosses and liverworts.
31. Students will describe the characteristics of ferns.
32. Students will explain how ferns are different form other kinds of plants without seeds.
33. Students will list the function of roots, stems, and leaves.
34. Students will compare the xylem and phloem.
35. Students will compare herbaceous and woody stems.
36. Students will describe the process of photosynthesis.
37. Students will identify the structure of a seed.
38. Students will explain the life cycle of seed plants.
39. Students will identify the structures and their functions of a flower.

40. Students will explain the plant terms annual, biennial, and perennial.
41. Students will review the different classes of vertebrates and their characteristics.
42. Students will review the different classes of invertebrates and their characteristics.

III. BACKGROUND KNOWLEDGE

A. For Teachers
1. Maton, A. *Parade of Life: Monerans, Protists, Fungi, and Plants*. Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6.
2. Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.

B. For Students
1. Classification system for rocks (Grade 4, page 105)
2. Classes of animals according to characteristics they share (Grade 3, page 81)
3. Introduction to classification of animals (Grade 3, page 81)
4. Familiarity with examples of animals in each class and basic characteristics of each class (Grade 3, page 81)
5. Insects as a group in the classification of animals (Grade 2, page 59)
6. Life cycles in plants and animals (Grade 2, page 59)
7. Special classifications of animals (Grade 1, page 37)
8. Fungi living underground (Grade 1, page 37)
9. Plants: nutrients, water, soil, air, sunlight (Grade 1, page 37)
10. Classification of magnetic materials (Kindergarten, page 20)
11. Animals and their needs (Kindergarten, page 19)
12. Plants and plant growth (Kindergarten, page 19)

IV. RESOURCES

A. Maton, A. *Parade of Life: Monerans, Protists, Fungi, and Plants*. Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6. (all lessons)

B. Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4. (all lessons)

C. Teacher's Video Company *Classification* Video Quiz P.O. Box 4455, Scottsdale, AZ. 85261 (1-800-262-8837) (40 minutes) (Lesson Five)

D. *Photosynthesis*, Schlessinger Science Library, Schlessinger Media. Wynnewood, PA. 2000. ISBN 1-57225-317-7 Phone: 1-800-843-3620 (23 minutes) (Lesson Eleven)

E. *All About Plant Pollination: Fruit, Flowers, and Seeds*, Schlessinger Science Library, Schlessinger Media, Wynnewood, PA, 2000. ISBN 1-57225-314-2. (23 minutes) (Lesson Thirteen)

V. LESSONS

Lesson One: History of Classification

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigation.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin words), which help

scientists around the world understand each other and ensure that they are using the same names for the same living things.

3. Skill Objective(s)
    a. Students will explain why a classification system is needed for living things.
    b. Students will create a classification system that can be used to place common items into proper groups.
    c. Students will recognize that scientific knowledge is subject to modifications as new information is discovered.

B. *Materials*
1. Appendix A (1) – one copy for each student
2. Appendix A (2) – teacher copy of History of Classification
3. Appendix B – one copy for each student
4. Appendix C (1) – one copy for each student
5. Pencils – one for each student
6. Highlighters – one for each student

C. *Key Vocabulary*
1. Classification – the grouping of things according to similar characteristics
2. Organism – any living thing
3. Taxonomy – the science of classification
4. Genus – a number of similar, closely related species
5. Species - individuals that are quite similar in appearance and behavior and that can produce off spring
6. Carolus Linnaeus – the eighteenth century Swedish scientist who developed the two-name classification system we use today
7. Binomial Nomenclature – classification system from Linnaeus giving each organism two names, a genus and species name

D. *Procedures/Activities*
1. As you pass out Appendix B to each student, discuss that people sort objects into categories, or classify them, in order to organize them in a sensible, useful way. Tell students that there is no single correct response to this activity. You may classify a particular set of things quite differently from your teacher or classmates. Give students about 10 – 15 minutes to complete this activity.
2. As students are working, walk around the room to see if anyone has a unique way of classifying the categories on the sheet.
3. When time is up, have students share their ways of classifying the items from the worksheet. See how many different ways students chose to classify them.
4. Make sure that when students share their responses, they explain why they put things in a particular group or class. (For example, the letters of the alphabet might have been vowels and consonants.)
5. Ask students if they can think of any other things that people organize into groups. Make a list of these discussed items on the board for students to visualize the many areas in life where people classify items. (Examples, record store, library, etc.)
6. Tell students that they just performed an activity of classification. Explain that scientists also do classifying when grouping all living things.
7. Hand out Appendix A (1) to each student.
8. Have students take turns reading out loud the information on classification. Using highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix A (2).
9. Discuss what was covered in the reading with the following questions:

a. Describe ways you use classification in your everyday life? (Students might respond that their album, CD, or tape collection is in a particular order.)
b. What is taxonomy? (The science of classification.)
c. What is binomial nomenclature and how is it used? (classification system from Linnaeus giving each organism two names, a genus and species name making each animal has its own (one) scientific name)

10. When you have finished this discussion, have students complete Appendix C (1) for assessment and evaluation purposes. Take this as a grade on the history of classification. This assignment can also be homework for this lesson.

E. *Assessment/Evaluation*

1. Appendix C (1) serves as assessment and evaluation for this lesson. It is a worksheet.

Lesson Two: Classification Today

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigation.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: moneran, protist, fungus, animal and plant.
   b. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus, Species, (Variety).
   c. When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin word), which help scientists around the world understand each other and ensure that they are using the same names for the same living things.
3. Skill Objective(s)
   a. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
   b. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
   c. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species.
   d. Students will define autotrophs and heterotrophs.

B. *Materials*

1. Appendix C (2) – History of Classification answer key
2. Appendix D (1) – one copy for each student
3. Appendix D (2) – teacher copy of Classification Today

4. Appendix D (3) – one copy for each student
5. Science Journal – one for each student (this can be a spiral notebook or loose leaf paper stapled between a colored construction paper cover labeled classification)
6. Highlighter – one for each student
7. Pencil – one for each student

C. *Key Vocabulary*

1. Moneran – are simple, singled celled organisms that lack a nucleus and other cell structures
2. Protist – are complex, single celled organisms that contain a nucleus
3. Fungi – are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and them absorbs the digested food
4. Autotrophs – organisms that can make their own food
5. Heterotrophs – organisms that cannot make their own food

D. *Procedures/Activities*

1. Go over the vocabulary from Lesson One by having the students write it in their science journal, after you have asked if anyone can remember what the words mean, one by one.
2. Review with students the answers to Appendix C (1) by reading aloud from the teacher copy {Appendix C (2)}. You can have students share the answers that they had.
3. Hand out a copy of Appendix D (1) to each student. Read this out loud together calling on students, and having them highlight the main ideas, with your guidance using teacher copy of Classification Today {Appendix D (2)}.
4. After reading Appendix D (1), discuss with students what they read with the following questions:
    a. How many kingdoms are included in today's classification system? (five)
    b. Name the kingdoms used in today's classification system. (plants, animals, protists, monerans, and fungi)
    c. How many groups are all living things classified into? (seven)
    d. Name the seven groups that all living things are classified into. (kingdom, phylum, class, order, family, genus, species)
    e. What is the biggest group of living things? (kingdom)
    f. Which is the smallest? (species)
    g. What is the difference between an autotroph and a heterotroph? (autotrophs make their own food and heterotrophs cannot)
    h. What is the difference between a moneran and a protist? (monerans lack a nucleus and protists have one)
5. Review form Lesson One that all living things have one scientific name. Ask who remembers what two names for the organism do we use? (genus and species) Who was the man who came up with this system of classification? (Linneaus)
6. Have students get out their Science Journals and write down the key vocabulary words from this lesson.
7. Hand out a copy of Appendix D (3) to each student for completion. This will serve as Assessment and Evaluation of Classification Today, so take a grade. This assignment can also be homework for this lesson.

E. *Assessment/Evaluation*

1. Appendix D (3) serves as assessment and evaluation for this lesson. It is a worksheet.

Lesson Three: Classification Fun

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal and Plant.
   b. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus and Species (Variety).
3. Skill Objective(s)
   a. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
   b. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
   c. Students will create a classification system that can be used to place common items into proper groups.
   d. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species.

B. *Materials*

1. Appendix D (3) – one copy for teacher to read from
2. Appendix D (4) – Classification Today answer key
3. Copy of the music "Battle Hymn of the Republic"
4. Overhead projector
5. Overhead transparency of Appendix E- Classification Songs
6. Students' Science Journals
7. Student's shoes

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*

1. Review with the students the answers to Appendix D (3) by reading aloud the answers from Appendix D (4) after reading the question from Appendix D (3).
2. Have students get out their Science Journals.
3. Using the overhead transparency of Appendix E, have students write down the words to the first song.
4. After students have had some time to do this, tell them that you are going to teach them the songs and then practice together. Also, stress that they will have time at the end of class to finish writing down the songs if they didn't get a chance to finish. For the Kingdom Phylum song, I usually dress up in overalls, a straw hat, put pig tails in my hair, and using mascara put freckles on my face and

black out a front tooth. Then when I teach it to the students I grab hold of my suspenders and go crazy with a good ole fashioned country twang.

5. After you demonstrate, have the students practice with you. Have them grab hold of their imaginary suspenders and have fun.
6. After you practice a few times, it is time to go over the second song. Have students write down the words to this song from the overhead transparency of Appendix E. While they are doing this, I like to play the music to "Battle Hymn of the Republic" so they get familiar with the tune that they will be singing to.
7. Have the students now practice with you a few times.
8. After you have practiced the song, divide the students into groups (six in each group works best but adjust to your class size), on your direction have the students remove their right shoe and place it in the center of their workspace.
9. As a group, think of a characteristic that will divide all six shoes into two kingdoms. For example, you may first divide the shoes by the characteristic of color into the brown shoe kingdom and the non-brown shoe kingdom.
10. Place the shoes into two separate piles based on the characteristics your group has selected.
11. Working only with those shoes in one kingdom, divide that kingdom into two groups based on a new characteristic. The brown shoe kingdom, for example may be divided into shoes with rubber soles and shoes without rubber shoes.
12. Further divide these groups into subgroups. For example, the shoes in the rubber-soled group may be divided into those with shoelaces and a non-shoelace group.
13. Continue to divide the shoes by choosing new characteristics until you have only one shoe left in each group. Identify the person who owns this shoe.
14. Repeat this process (steps 11 – 13) with the other kingdom group you started with. (non-brown shoes in the example).
15. Tell students to draw a diagram in their Science Journals to represent their classification system.
16. Leave about five minutes for the students who need the time to finish writing down the songs to do so. Play the music in the background so the ones that are finished can do a whisper sing.

E. *Assessment/Evaluation*

1. Check student Science Journals to see that students have written down the songs and a diagram describing their group's classification system activity will be the assessment for this lesson.

Lesson Four: Organizing Junk (Item Classification)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal and Plant.
   b. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus and Species (Variety).

3. Skill Objective(s)
    a. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
    b. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
    c. Students will create a classification system that can be used to place common items into proper groups.
    d. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species

B. *Materials*
1. Copy of the music "Battle Hymn of the Republic"
2. Overhead projector
3. Overhead transparency of Appendix E- Classification Songs
4. Students' Science Journals
5. Four 9" x 12" envelopes (one per group); I usually have the envelopes filled with the items 6 – 21; this way I only give each group an envelope already filled with it's contents
6. Four nails (one in each envelope)
7. Four screws (one in each envelope)
8. Four rolls of tape (one in each envelope)
9. Four pieces of string (one in each envelope)
10. Four paper clips (one in each envelope)
11. Four pieces of lined notebook paper (one in each envelope)
12. Four pieces of unlined paper (one in each envelope)
13. Four pieces of colored paper (one in each envelope)
14. Four pencils (one in each envelope)
15. Four ballpoint pens (one in each envelope)
16. Four erasers (one in each envelope)
17. Four lined index cards (one in each envelope)
18. Four pictures of a screwdriver (laminated) – one in each envelope
19. Four pictures of a pair of scissors (laminated) – one in each envelope
20. Four thumbtacks (one in each envelope)
21. Four rubber bands (one in each envelope)
22. Appendix F (1) – one copy for each student

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*
1. Practice the two songs from Lesson Three with the students either using the overhead transparency of Appendix E or students can look at their Science Journals. Don't forget to play the music.
2. Divide students into four groups. (This may vary depending on your class size.)
3. Hand each group an envelope and instruct them not to look inside yet.

4. Tell students that they will be working in these groups to classify the items inside their envelopes. They will then write down their system in their Science Journals.
5. Also, tell students that you will tell them the steps they need to do with their group and then give them time to discuss with their group and write down their findings in their Science Journals.
6. Have the students empty the contents of their envelope onto a desk or a table.
7. Allow the students time to look over what was in the envelope (about 2-3 minutes). Then ask them: In what ways are these items similar? Accept all logical answers. (Possible answers: They are useful in some way; they are all small enough to hold in your hand; they can be found in most homes.)
8. Tell them to suppose that they wanted to divide these items into two groups based on similar characteristics. What characteristics might you choose? Accept all logical answers and write them on the board or overhead. (Possible answers: paper and nonpaper; metal and nonmetal; fasteners and items used for other purposes; writing implements and items used for other purposes; sharp items and blunt items.)
9. Tell them that they need to choose one of the characteristics that you listed on the board or overhead as a group. Then they need to use this characteristic to divide the items into two groups. Have them write a heading for each group in their science journals and then list the items that you would place in each group under its proper heading. Give students time to write their group's decision down (about 2-3 minutes).
10. Tell students to skip two lines in their Science Journals and rewrite the headings from above. Then examine the items in each group. Think of a characteristic that you can use to divide each group into two subgroups. Put the title of each subgroup under its appropriate heading and leave spaces between heading one with its subgroups and heading two with its subgroups so you can list the items that you placed in each subgroup. Classification systems will vary. One possible answer follows: heading 1 – Items related to writing and under it Subgroup A (paper items) and Subgroup B (nonpaper items); under heading 2 – Items not related to writing and under it Subgroup A (fasteners) and Subgroup B (not fasteners). Students would have to write the individual items under these subgroups. Give students about 7-10 minutes to write down their group's decision.
11. Tell students to skip two lines in their Science Journal and rewrite the headings with each subgroup under each heading. They are to then write a number 1 and a number 2 category under each subgroup title because they are going to classify each subgroup into two new categories based on a new characteristic. Remind students to leave spaces under each new category so they can list the items that will be placed in each category. Classification systems will vary. Going off the above possible answer: Heading 1-Items related to writing Subgroup A – paper items 1^{st} category – Lined: index card, notebook paper 2^{nd} category – Nonpaper items 1^{st} category – writing instruments: pencil, ballpoint pen 2^{nd} category – not writing instruments: eraser Heading 2- Items not related to writing Subgroup A – fasteners 1^{st} category – metal: nail, screw, thumbtack, paperclip 2^{nd} category – nonmetal: string, rubber band, tape Subgroup B – items used for other purposes 1^{st} category – sharp: scissors 2^{nd} category – not sharp: screwdriver
12. Discuss with students what problems they had in classifying these items. Ask groups to share how their system looks with the rest of the class.

13. Hand out Appendix F (1) to each student as homework, instructing them that they will have two days to complete it because they will be watching a movie tomorrow.

E. *Assessment/Evaluation*

1. The activity written in the students' Science Journals will serve as assessment and evaluation for this lesson.

Lesson Five: Classification Video

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
   b. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus, Species, (Variety).
   c. When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin), which help scientists around the world understand each other and ensure that they are using the same names for the same living things.
3. Skill Objective(s)
   a. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
   b. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
   c. Students will explain why a classification system is needed.
   d. Students will create a classification system that can be used to place common items into proper groups.
   e. Students will recognize that scientific knowledge is subject to modifications as new information is discovered.
   f. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species.

B. *Materials*

1. Teacher's Video Company *Classification* Video
2. Television
3. VCR
4. Copy of the music "Battle Hymn of the Republic"
5. Overhead projector
6. Overhead transparency of Appendix E- Classification Songs

7. Students' Science Journals

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*

1. Practice the two songs from Lesson Three with the students either using the overhead transparency of Appendix E or students can look at their Science Journals. Don't forget to play the music.
2. Tell the students that they will be watching a classification video today. This particular video has places where it will stop and ask the students questions about what they just heard.
3. Direct students that when the video stops, you will stop the video, so they have a chance to write down their answers to the questions in their Science Journals.
4. Play the movie for the students.
5. If time permits after the video, have students work on completing their Classification Study Guide. (Remind them it is due tomorrow.)

E. *Assessment/Evaluation*

1. The student's responses to the video's questions will be the assessment and evaluation for this lesson.

Lesson Six: Review for Test on Classification

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
   b. Each kingdom is divided into smaller groupings as follows: Kingdom, Phylum, Class, Order, Family, Genus, Species, (Variety).
   c. When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin), which help scientists around the world understand each other and ensure that they are using the same names for the same living things.
3. Skill Objective(s)
   a. Students will list the five kingdoms of living things, which are moneran, protist, fungus, plant, and animal.
   b. Students will describe the characteristics of each kingdom and compare them briefly. For example, monerans are simple, single celled organisms that lack a nucleus and other cell structures; protist are complex, single celled organisms that contain a nucleus; fungi are usually a multicellular organism, that releases chemicals that digest the substance on which it is growing and then absorbs the digested food; plants are mostly multicellular autotrophs; and animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. They are heterotrophs.
   c. Students will explain why a classification system is needed.
   d. Students will create a classification system that can be used to place common items into proper groups.

e. Students will recognize that scientific knowledge is subject to modifications as new information is discovered.
f. Students will list the groupings of kingdoms in order form largest to smallest, which is kingdom, phylum, class, order, family, genus, and species.

B. *Materials*
1. Appendix F (1) – one copy for each student (their own)
2. Appendix F (2) – one copy for the teacher
3. Copy of the music "Battle Hymn of the Republic"
4. Overhead projector
5. Overhead transparency of Appendix E
6. Students' Science Journals

C. *Key Vocabulary*
No new vocabulary

D. *Procedures/Activities*
1. Before going over the study guide, Appendix F (1), practice the two songs from Lesson Three with the students either using the overhead transparency of Appendix E or students can look at their Science Journals.
2. Have each student look at their own copy of Appendix F (1) to make sure they have the correct answers.
3. Go over the study guide, reading each question and letting students share the answers. Make sure to correct any wrong answers.
4. Assign students Appendix F (1) to study for the test.

E. *Assessment/Evaluation*
1. Appendix G (1) – the test on classification will be the assessment and evaluation for this lesson.

Lesson Seven: Viruses (Special Monerans)

A. *Daily Objectives*
1. Concept Objective(s)
a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
b. All living things reproduce themselves. Reproduction may be asexual or sexual.
c. Examples of asexual reproduction: fission (splitting) of bacteria, spores from mildews, molds, and mushrooms, budding of yeast cells, regeneration and cloning
3. Skill Objective(s)
a. Students will list the parts of a virus.
b. Students will describe how a virus reproduces and causes disease.

B. *Materials*
1. Appendix H (1) – one copy for each student
2. Appendix H (2) – copy for teacher
3. Appendix H (3) – one copy for each student
4. Students' Science Journals

5. Pencils – one for each student
6. Highlighter – one for each student
7. Five different kinds of empty cold medicine remedy containers

C. *Key Vocabulary*
1. Virus – are tiny particles that can invade living cells
2. Hosts –a living thing that provides a home and/or food for a parasite
3. Parasite – is an organism that survives by living on or in a host organisms, thus harming it
4. Vaccine – substance that helps the body to produce antibodies
5. Antibodies – substances that prevent infection

D. *Procedures/Activities*
1. Show students the different cold remedies. Ask students what are all these products? (Lead students to respond that they are all cold remedies.)
2. Ask, "Which product does the best job of curing a cold?" (Expect any number of responses based on products that students use.)
3. Ask, "How does a product for colds "cure" a cold?" (The products claim to reduce fever and aches and pains, as well as relieve congestion and general stuffiness.)
4. Ask students, "When your cold symptoms start to disappear, is this a sign that you are cured?" (Students may tend to suggest yes; however, the correct answer is no.)
5. Point out that these medications provide relief form symptoms, not a cure. A sure would have to kill the cold virus, and none of these products can eliminate the virus. Mention that we basically "survive" a cold until we develop antibodies. Remedies simply try to make us more comfortable.
6. Go over the key vocabulary words, having students write them down in their Science Journals.
7. Tell the students that they just finished learning about how and why scientists classify organisms. Ask if anyone can remember what the five kingdoms were that today's classification systems was broken into. (Moneran, Protist, Fungi, Plant and Animal)
8. Tell the students that they will be studying the kingdoms of living things in more depth now. The first one we will study is the monerans.
9. Explain to students that the activity they just did started them thinking about viruses. Viruses are a special kind of monerans. Scientists have some confusion as to whether they are actually living things.
10. Hand out Appendix H (1) to each student.
11. Have students take turns reading out loud the information on viruses. Using highlighters, have students highlight the main ideas as it is read, with your guidance, using Appendix H (2).
12. Discuss what was covered in the reading with the following questions:
    a. What is a virus? (tiny particles that can invade living cells)
    b. What is a host? (living things that provide a home for the virus)
    c. What is a parasite? (an organism that survives by living on or in a host cell)
    d. How does a virus reproduce? (injects its hereditary material into a host cell, causing the host cell to ignore its functions and produce more virus particles instead; the virus particles leave the host cell to infect other cells)
    e. Describe the structure of a virus. (two parts – a core of hereditary material surrounded by a protein coat)

f. How does a vaccine work? (helps the body to produce antibodies)
g. What is an antibody? (substance that prevents infection)

13. When you have finished this discussion, have students complete Appendix H (3) for homework on this lesson.

E. *Assessment/Evaluation*

1. Appendix H (3) serves as assessment and evaluation for this lesson. It is a worksheet.

Lesson Eight: Bacteria (Monerans)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
   b. All living things reproduce themselves. Reproduction may be asexual of sexual.
   c. Fission (splitting) of bacteria
3. Skill Objective(s)
   a. Students will identify organisms that belong in each kingdom. For example, bacteria are monerans, ameba is protists, mushrooms are fungus, flowers are plants, and dogs are animals.
   b. Students will name and describe the parts of a moneran.
   c. Students will compare autotrophic and heterotrophic monerans.
   d. Students will list ways in which monerans can be harmful and helpful.

B. *Materials*

1. Appendix I (1) – one copy for each student
2. Appendix I (2) – teacher copy of Monerans
3. Students' Science Journals
4. Highlighter – one for each student
5. Pencil – one for each student
6. Five prepared slides of bacteria (one for each bacteria shape)
7. Five microscopes (I use one for each prepared slide but you may have to adjust due to supplies available; this helps to not waste time switching slides)
8. Five clean glass slides and cover slips
9. One tablespoon of buttermilk
10. Two medicine droppers
11. Bottle of methylene blue stain (CAREFUL WITH THIS STAINS CLOTHES AND HANDS)

C. *Key Vocabulary*

1. Monerans - are simple, singled celled organisms that lack a nucleus and other cell structures
2. Heterotrophs – organisms that cannot make their own food
3. Autotrophs – organisms that can make their own food
4. Decomposers – break down dead organisms into simpler substances
5. Flagellum – a long, thin, whip like structure that propels a bacteria cell through its environment

D. *Procedures/Activities*

1. TEACHER NOTE – I HAVE THE MICROSCOPES SET UP BEFORE STUDENTS COME WITH THE PREPARED SLIDES.
2. Go over the vocabulary for this lesson and have students write it down in their Science Journals. Remind them that the first three are review from an earlier lesson. Ask if anyone can remember them before giving them the definition.
3. Tell the students that they are going to be looking at various slides today. Even though the slides may look different they all represent the same kind of organisms. They just have different shapes.
4. Have students number in their Science Journals to number five leaving space to draw what each of the prepared slides look like basically.
5. Give students 10 – 15 minutes to complete this activity.
6. Divide the students into five groups (one for each microscope). Give each group a glass slide and cover slip.
7. Call on two students from each group to come forward to prepare their slide. I usually keep the supplies by me so I can help if any problems arise.
8. Have students use a medicine dropper to place a drop of buttermilk on the glass slide.
9. Use another dropper to add a drop of methylene blue to the slide. CAUTION: Be careful when using methylene blue; it can stain your skin or clothing. (I usually add this to the slides.)
10. Carefully place the cover slip over the slide. Place the slide under the microscope.
11. Observe the slide under the microscope and have students draw what they see in their Science Journals.
12. As students in the groups finish have each group clean up to your lab specifications.
13. When finished ask students what similarity did they see in the prepared slides and the one that they made? (same shape as one of the prepared slides)
14. Tell the students that what they just saw is an example of bacteria. Bacteria are another name for monerans.
15. Hand out Appendix I (1) to each student.
16. Have students take turns reading out loud the information on monerans. Using highlighters, have students highlight the main ideas as it is read, with your guidance, using Appendix I (2).
17. After reading, discuss with students what was covered in the reading with the following questions:
    a. Name several ways in which bacteria are beneficial to humans. (Responses might include many dairy products are produced with the help of bacteria and bacteria replenish the soil, which helps crops.)
    b. Name several ways in which bacteria are harmful to food. (Students might suggest that bacteria can cause food to spoil and can spoil water supplies, which in turn spoil crops grown with that water.)
18. Have students re-read the description of a bacteria cell and in their Science Journals so they can draw, label and color a bacterial cell. The students can also draw one of the prepared slides again this time with color and detail.

E. *Assessment/Evaluation*

1. This drawing of a bacteria cell in students' Science Journals serves as assessment and evaluation of this lesson

Lesson Nine: Protists

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
    b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
    a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
    b. All living things reproduce themselves. Reproduction may be asexual or sexual.
    c. Molds have spores
3. Skill Objective(s)
    a. Students will identify organisms that belong in each kingdom. For example, bacteria are monerans, ameba is protists, mushrooms are fungus, flowers are plants and dogs are animals.
    b. Students will describe general characteristics of the protists.
    c. Students will list the three groups of protists.
    d. Students will list the four main groups of animal like protists.
    e. Students will distinguish structural features of animal like protists.
    f. Students will describe the methods of movement and feeding used by animal like protists.
    g. Students will identify characteristics of plantlike protists.
    h. Students will name three types of plantlike protists.
    i. Students will identify characteristics of funguslike protists.
    j. Students will distinguish slime molds from other types of protists

B. *Materials*

1. Appendix J (1) – one copy for each student
2. Appendix J (2) – teacher copy of protists
3. Students' Science Journals
4. Highlighters – one for each student
5. Pencils –one for each student
6. Overhead projector
7. Bottle of clove oil (available at the pharmacy)
8. Blue food coloring
9. Water (small amount)
10. Clear glass dish
11. Tablespoon of rubbing alcohol
12. Two eye droppers (one for the clove oil and one for the rubbing alcohol)
13. Paraffin (cut into 2mm pieces)
14. Toothpick (cut into 2mm pieces)

C. *Key Vocabulary*

1. Protist – a single-celled organism that contains a nucleus
2. Sarcodine – animal like protist characterized by extensions of the cell membrane and cytoplasm known as pseudopods
3. Pseudopod – foot like extensions used to capture food particles or for movement
4. Ciliates – an animal like protist that has small hair like projections on the outside of their cells at some point in their life

5. Zooflagellates- an animal like protist that possesses one to eight flagella, depending on the species
6. Sporozoans – a parasite animal like protist that has a complex life cycle involving more than one kind of host cell and produces cells called spores in order to pass from one host to the next
7. Euglena – plantlike protist with a reddish eyespot and a pouch that holds tow flagella
8. Diatom – plantlike protist that has a beautiful two part glassy shell
9. Dinoflagellate – plantlike protist that typically has cell walls that look like plates of armor and possesses two flagella, one at the end like a tail and one about the middle like a belt
10. Slime mold – a fungus like protist that is a cell at one stage of its life cycle and a large, moist, flat, shapeless blob at another stage which reproduce with fruiting bodies containing spores
11. Spores – a cell, usually surrounded by a protective wall, that is specialized either for reproduction or for a resting stage

D. *Procedures/Activities*

1. Fill the clear glass dish with a small amount of water (just so the bottom is covered).
2. Put in a few drops of blue food coloring to change the color of the water slightly blue.
3. Put a drop of clove oil about the size of a nickel into the dish.
4. Place the dish on the overhead projector.
5. Ask students, "How could we tell if this thing is alive or not?" (Lead students to suggest criteria such as movement, food ingestion, breathing, and reacting to stimuli.)
6. Tell students that you can test for response to stimulus by putting a couple of drops of liquid next to the blob. With an eyedropper, place about five drops of rubbing alcohol at one edge of the oil. Do not name the liquid. After students have time for observation, ask this question: How would you describe what you observed? (Try to get at least ten different descriptions.)
7. Tell students that they will be studying a type of protist, amebas, which look like this when they move.
8. To test for eating, place "food," pieces of paraffin and a toothpick about 2mm long at the edge of, but not touching the blob. Add a few more drops of alcohol on the opposite side.
9. Ask students what information this gives us about whether or not this thing can eat? (Students should see the blob surround the "food" in small bubbles.) Say that many protists enclose their food in a bubble, or food vacuole, when they take it into their bodies.
10. Ask students do you think this blob is alive or not? (Answers will vary. Ask students for reasons to support their opinions.) Then after this discussion, identify the chemicals you used. Explain that chemicals can be used to imitate some, but not all, of the very complex behavior of protists.
11. Hand out Appendix J (1) to each student.
12. Have students take turns reading out loud the information on protists. Using highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix J (2).
13. Discuss what was covered in the reading with the following questions: List two characteristics of protist. (unicellular and have a nucleus) How are protists different from monerans? (have nucleus) Review questions:

a. What is an autotroph? (organism that makes own food)
b. What is a heterotroph? (organism that cannot make own food)
c. What does colony mean? (group of individuals that live together)
d. Why are colonies of protists not multicellular organisms? (they do not function as a unit only individuals living together)
e. What are sarcodines? (organisms characterized by extensions called pseudopods)
f. What are ciliates? (organisms with hair like projections on the outside of their cell)
g. What are plantlike protists characteristics? (autotrophs and unicellular, have nucleus)
h. What are the three groups of plant like protists? (euglenas, diatoms, and dinoflagellates)
i. What do they use diatom shells for? (abrasive cleaners, toothpaste, car polish)
j. What is a slime mold? (flat, moist, shapeless blobs that ooze over dead trees, leaves and compost piles)

14. Go over key vocabulary words for this lesson, having students write them in their Science Journals.
15. Write on the board the following question : Name the group of protists that is most closely linked with each of the following:
    a. chalk (sarcodines)
    b. toothpaste (diatoms)
    c. red tides (dinoflagellates)
    d. African sleeping sickness (zooflagellates)
    e. two kinds of nuclei (ciliates)
    f. fruiting bodies (slime molds)
    g. pseudopods (sarcodines)
    h. two part glassy shell (diatoms)
    i. crop destruction (fungus like protists)
    j. digesting wood (zooflagellates)
16. Have students write this activity in their Science Journals.

E. *Assessment/Evaluation*
1. The activity from the board in the students' Science Journals will serve as assessment and evaluation for this lesson.

Lesson Ten: Fungus

A. *Daily Objectives*
1. Concept Objective(s)
    a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
    b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
    a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
    b. All living things reproduce. Reproduction may be asexual or sexual.
    c. Spores form mildews, molds, and mushrooms, budding of yeast cells

3. Skill Objective(s)
    a. Students will identify organisms that belong in each kingdom. For example, bacteria are monerans, ameba is protists, mushrooms are fungus, flowers are plants and dogs are animals.
    b. Students will describe the major characteristics of fungi.
    c. Students will compare the three types of fungi.
    d. Students will describe ways in which fungi interact with other living things.

B. *Materials*
1. Appendix K (1) – one copy for each student
2. Appendix K (2) – teacher copy of Fungus
3. Appendix K (3) – one copy for each student
4. Package of dry yeast
5. Five mL of corn syrup
6. Five-hundred mL of warm tap water
7. Five microscope slides with cover slips
8. Five microscopes (this can vary due to class size and available materials)
9. Bowl
10. Aluminum Foil
11. Spoon that fits in the bowl
12. Bottle of methylene blue stain (CAUTION THIS WILL STAIN SKIN AND CLOTHES)
13. Students' Science Journals
14. Highlighters – one for each student
15. Pencils – one for each student
16. PREPARE BEOFRE THE LESSON STARTING AT PROCEDURE STEP 12
    a. Round balloon
    b. Craft pom poms 1/8 inch
    c. Tape
    d. Stick or ruler about 30cm long
    e. Modeling clay
    f. A pin

C. *Key Vocabulary*
1. Fungus – a heterotroph, usually multicellular, that releases chemicals that digest the substance on which it is growing, are made up of hyphae and reproduce by means of spores
2. Hypha – one of the branching threadlike tubes that makes up the body of a multicellular fungus
3. Spore – a cell, usually surrounded by a protective wall that is specialized for reproduction or for a resting stage (review from earlier lesson)
4. Mushroom – a multicellular fungus shaped like an umbrella
5. Yeast – a unicellular fungus
6. Mold – a fuzzy, shapeless, fairly flat multicellular fungus

D. *Procedures/Activities*
1. Show the class a package of dry yeast. Point out that if conditions for growth and reproduction become unfavorable, yeasts form spores within their cells and become inactive. The yeast in this package is inactive.
2. Ask, "What do we need to do to cause the yeast to become active?" (Most students will be aware that adding water to the package contents can activate the yeast.)

3. Point out that in addition to moisture, yeasts also need something else. Clue students on what else besides water do they need to survive? (source of food)
4. Ask students what source of food energy do they think yeasts need? (the source for most yeasts is sugar)
5. Prepare a culture of yeast cells by providing the conditions needed to activate the package of yeast.
6. Mix about 5 mL of corn syrup and 500 mL of warm tap water in a bowl.
7. Then add one-half of the dry yeast package to the mixture. Stir the mixture.
8. Cover the top loosely with aluminum foil, and allow to stand for about 30 minutes in a warm place. (I usually use the heater in the room.) While waiting, continue with the lesson.
9. Ask students why we added the corn syrup? (contains the sugar needed for food)
10. Hand out Appendix K (1) to each student.
11. Have students take turns reading out loud the information on Fungus. Using highlighters, have students highlight the main ideas as it is read, with your guidance, using Appendix K (2). TEACHER NOTE ON YOUR APPENDIX TO SHOW SPREADING SPORES
12. Stretch the balloon so that it inflates easily. Do not tie off the end of the balloon.
13. Insert the craft pom poms through the opening in the neck of the balloon. Continue putting the pom poms into the balloon until the balloon is almost full.
14. Inflate the balloon and tie a knot in its neck to keep the air inside.
15. Tape the knotted end of the balloon to the top of the stick.
16. Put the bottom of the stick into the modeling clay. Shape the modeling clay so that the stick stands upright. Stick the balloon with the pin to demonstrate how spores spread.
17. After reading, divide students into five groups. (This can vary depending on the number of students and available microscopes.)
18. Have students prepare a slide of the yeast cells for their group. One drop of yeast cells and one drop of methylene blue stain. (This is the part I put on.)
19. Have students then place the cover slip on the slide.
20. Direct students to look for cells with buds under the microscope. Then ask what do these buds represent? (yeast cells reproduce with buds, these buds will be new yeast cells)
21. Have students clean up according to your lab procedures
22. Go over key vocabulary words for this lesson and have students write them down in their Science Journals.
23. Hand out Appendix K (3) to each student for a homework assignment.

E. *Assessment/Evaluation*
1. Appendix K (3) will serve as assessment and evaluation for this lesson. It is a worksheet.

Lesson Eleven: Plants Without Seeds

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.

2. Lesson Content
    a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
    b. Non- vascular plants
    c. Vascular plants have tube like structures that allow water and dissolved nutrients to move through the plant.
    d. Parts and functions or vascular plants: roots, stems, and buds, leaves
    e. Photosynthesis
    f. Plant reproduction
    g. Asexual reproduction
    h. Sexual reproduction by spore-bearing plants
    i. Photosynthesis is an important life process that occurs in plant cells, but not animal cells (photo = light; synthesis = putting together). Unlike animals, plants make their own food, through the process of photosynthesis.
    j. Role in photosynthesis of: energy form sunlight, chlorophyll, carbon dioxide and water, xylem and phloem, stomata, oxygen, sugar (glucose)
    k. Sexual reproduction requires the joining of special male and female cells to form a fertilized egg.
    l. All living things reproduce. Reproduction may be asexual or sexual.
3. Skill Objective(s)
    a. Students will name the two groups of plants.
    b. Students will describe the general characteristics of plants.
    c. Students will list reasons why plants are important.
    d. Students will define vascular and nonvascular plants.
    e. Students will list the characteristics of mosses and liverworts.
    f. Students will describe the process of photosynthesis.
    g. Students will describe the characteristics of ferns.
    h. Students will explain how ferns are different form other kinds of plants without seeds.

B. *Materials*
1. Appendix L (1) – one copy for each student
2. Appendix L (2) – one copy for teacher
3. Appendix L (3) – one copy for each student
4. VCR and TV
5. Video *Photosynthesis* (Schlessinger Science Library)
6. Students' Science Journals
7. Pencils – one for each student
8. Highlighters – one for each student

C. *Key Vocabulary*
1. Nonvascular – a plant that lack structures for transporting water
2. Vascular – a plant that has structures for transporting water
3. Photosynthesis – the process by which plants cells use sunlight energy to make food from water and carbon dioxide
4. Chlorophyll – green substance in plant cells that absorbs sunlight energy
5. Algae – any simple plantlike autotroph, that can be brown, red, or green, which uses sunlight to produce its food
6. Fronds – the leaf of a fern
7. Fertilization – the joining of egg and sperm
8. Asexual reproduction – the process of reproducing without two cells
9. Sexual reproduction – the joining of two cells to produce offspring

D. *Procedures/Activities*

1. Take students on a guided tour of the exterior of the school building.
2. Explain to them that you will be looking for the many places that land plants grow.
3. Direct students to some of the obvious places first – the lawn, or garden or in the pits surrounding planted trees.
4. Then look in some of the less obvious places – in pavement cracks, on the shady sides of the building or walls, on rocks, on trees, or near a source of standing water.
5. Examine each plant and have students note the following:
    a. Does it have leaves?
    b. Does it have veins on its leaves?
    c. Where was the plant growing?
    d. What is the approximate size of the plant?
    e. Is the plant moss like or does it have a stem?
6. Have students write these down in their Science Journals.
7. Use your discretion in removing some of the plant samples for closer observations in the classroom.
8. After returning to the classroom, ask students which kinds of plants are more numerous? (plants with stems) Where are moss-like plants found? (in shady locations, cracks in pavement, places where water collects) Did all the plants have leaves? (Students should see that only those plants with stems had leaves.)
9. As you hand out Appendix L (1), tell students that they will be studying the fourth kingdom of living things, plants.
10. Have students take turns reading out loud the information on plants. Using highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix L (2).
11. Discuss what was covered in the reading with the following questions:
    a. Why is plant photosynthesis important to you? (plants provide you with the oxygen you need to breath)
    b. What two gases do plants need to grow? (oxygen and carbon dioxide)
    c. What are the five characteristics of plants? (have chlorophyll in cells, many celled, specialized cells, cells have cell walls, and cannot move from place to place)
12. When you have finished this discussion, have students copy down the key vocabulary words for this lesson by writing them down in their Science Journals.
13. Have students watch the video *Photosynthesis* (Schlessinger Science Library)
14. Hand out Appendix L (3) to each student. Allow students time to work or assign as homework depending on time remaining.

E. *Assessment/Evaluation*

1. Appendix L (3) will serve as assessment and evaluation for this lesson. It is a worksheet.

Lesson Twelve: Structure of Seed Plants

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
    b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.

2. Lesson Content
    a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
    b. Vascular plants have tube like structures that allow water and dissolved nutrients to move through the plant.
    c. Parts and functions of vascular plants: roots, stems, and buds, leaves
    d. Photosynthesis is an important life process that occurs in plant cells, but not animal cells (photo = light; synthesis = putting together). Unlike animals, plants make their own food, through the process of photosynthesis.
    e. Role in photosynthesis of: energy form sunlight, chlorophyll, carbon dioxide and water, xylem and phloem, stomata, oxygen, sugar (glucose)
3. Skill Objective(s)
    a. Students will list the function of roots, stems, and leaves.
    b. Students will compare the xylem and phloem.
    c. Students will compare herbaceous and woody stems.
    d. Students will describe the process of photosynthesis.
    e. Students will identify the structure of a seed.

B. *Materials*
1. Appendix M (1) – one copy for each student
2. Appendix M (2) – one copy for teacher
3. Appendix M (3) – overhead transparency
4. Students' Science Journals
5. Highlighters – one for each student
6. Pencils – one for each student
7. Overhead projector
8. Glass jar
9. Spoon
10. Knife
11. Red food coloring
12. Water
13. Celery Stalk

C. *Key Vocabulary*
1. Xylem – a special tissue in roots and stems that carries water up the plant
2. Phloem – a special tissue in roots and stems that carries food down the plant
3. Root – a structure in vascular plants whose main functions are typically absorption and anchorage
4. Root hairs – tiny hair-like structures on roots that absorb water into the plant
5. Fibrous roots – many small, thin roots
6. Taproot – one thick root
7. Stem – a structure in vascular plants whose main functions are typically to carry materials between the roots and leaves and to support the plant
8. Herbaceous stems – green, soft stems
9. Woody stems – hard, brown stems, including tree trunks
10. Leaf – a structure in vascular plants whose main function is making food
11. Stomata – tiny pores on leaves that allow gases in and out of the leaves
12. Blade – the broad flat part of a leaf
13. Petiole – a thin rib that connects the leaf to the plant
14. Plant embryo – the early, undeveloped state of a new plant
15. Seed plant – vascular plants that produce seeds
16. Seed – a protective covering for the first stage of a tiny new plant

D. *Procedures/Activities*

1. TEACHER NOTE: THIS NEEDS TO BE DONE THE DAY BEFORE YOU START THIS LESSON (STEPS 2 – 5)
2. Fill a glass jar one-fourth full of water.
3. Add a few drops of food coloring to the water and stir.
4. Place a stalk of celery in the jar so that its leaves are at the top. Only the base should be submerged in the colored water.
5. Place the jar where it will not be disturbed for 24 hours.
6. After 24 hours, examine your stalk of celery. Ask students what they observe. (leaves should be changing to red)
7. Remove the stalk of celery from the jar. Using a knife, cut off the portion of the stalk that was under water. Discard this portion.
8. Pass the celery around so that students can look at the base of the stalk. After everyone has an opportunity to view the stalk, ask students what they observed? (Should answer that they see tubes in the base.)
9. Next ask why does this occur? (Accept students answers, but lead to the tubes carrying the water up to the leaves if no student responds this way.)
10. Hand out Appendix M (1) to each student.
11. Have students take turns reading out loud the information on plants. Using highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix M (2).
12. Discuss what was covered in the reading with the following questions:
    a. Why can't roots carry out photosynthesis? (you need light and they are underground)
    b. What plant organ is carrot cake made from? (the root)
    c. What kind of tissue carries food down a plant? (phloem)
    d. What kind of tissue carries water and minerals up a plant? (xylem)
    e. Which plant organ contains most of the plant's chlorophyll? (Leaves)
13. When you have finished this discussion, have students write down the key vocabulary words in their Science Journals.
14. When you have finished going over the vocabulary, have students open their Science Journals to copy down a song dealing with the whole process of photosynthesis. Use the overhead transparency of Appendix M (3) to have students practice the song with you. I usually have students write it down stanza by stanza while practicing in between each stanza.
15. Have students practice the whole song, and then give students a chance to finish copying down the song. Have them turn this in.

E. *Assessment/Evaluation*

1. Student's Science Journals with the photosynthesis song and vocabulary serve as evaluation and assessment for this unit.

Lesson Thirteen: Reproduction in Seed Plants

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
    b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.

2. Lesson Content
    a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
    b. Vascular plants
    c. Sexual reproduction of non-flowering seed plants: conifers, male and female cones, wind pollination
    d. Seed germination and plant growth: seed coat, embryo and endosperm, germination (sprouting of new plant), monocots, and dicots
    e. Vegetative reproduction: runners (for example, strawberries) and bulbs (for example, onions), growing plants from eyes, buds, leaves, roots, and stems
    f. All living things reproduce themselves. Reproduction may be asexual or sexual.
    g. Sexual reproduction requires the joining of special male and female cells to form a fertilized egg.
3. Skill Objective(s)
    a. Students will explain the life cycle of seed plants.

B. *Materials*
1. Appendix N (1) – one copy for each student
2. Appendix N (2) – copy for teacher
3. Appendix N (3) – copy for teacher
4. VCR and TV
5. Video *All About Plant Pollination: Fruit, Flowers, and Seeds* (Schlessinger Science Library)
6. Students' Science Journals
7. Highlighters – one for each student
8. Pencils – one for each student

C. *Key Vocabulary*
1. Germination – the process by which a plant embryo (earlier vocabulary) develops and breaks out of the seed
2. Pollination – the process by which pollen reaches an egg
3. Fertilization – the joining of sperm and egg cells (review from earlier lesson)
4. Seed dispersal – the scattering of seeds
5. Ovules – structures that hold egg
6. Pollen – yellow grain that holds sperm

D. *Procedures/Activities*
1. Hand out Appendix N (1) to each student.
2. Have students take turns reading the information on the plant's life cycle. Using highlighters, have students highlight the main ideas as it is read, with your guidance, using Appendix N (2).
3. After reading, have students write down the key vocabulary for this lesson in their Science Journals.
4. When students have finished this, using Appendix N (3), teach students the movements to remember the life cycle.
5. Tell them that they just finished reading about the life cycle of a plant but that now you are going to show them a way to remember the cycle (for the test).
6. Proceed with teaching the movements and then repeating the words for each action.
7. Practice with the students, starting slow and getting faster. Do this several times.
8. Watch the Video *All About Plant Pollination: Fruit, Flowers, and Seeds*.

E. *Assessment/Evaluation*
   1. Pulling each student aside and having them repeat the life cycle movements to you serves as assessment and evaluation for this lesson.

Lesson Fourteen: Parts of a Flower

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
      b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
   2. Lesson Content
      a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
      b. Vascular plants
      c. Functions of sepals and petals, stamen (male), anther, pistil (female), ovary (or ovule)
   3. Skill Objective(s)
      a. Students will identify the structures and functions of a flower.
      b. Students will explain the plant terms annual, biennial, and perennial.

B. *Materials*
   1. Appendix O (1) – one for each student
   2. Appendix O (2) – one for teacher
   3. Model of a Flower-3D (I made mine out of fun foam but Science catalogs have one available)
   4. Appendix O (3) – one for each student
   5. Students' Science Journals
   6. Highlighters – one for each student
   7. Pencils – one for each student

C. *Key Vocabulary*
   1. Petals – the parts of a flower that are often brightly colored
   2. Pistil – the female part of the flower
   3. Plant ovary – the flower part, at the bottom of the pistil, where the egg cells are formed
   4. Sepals – the green leaf like parts of a flower that support the petals
   5. Stamens – the male parts of the flower
   6. Filament – the stalk like part of the stamen
   7. Anther – the knoblike part of the stamen where pollen is produced
   8. Annuals – plants that complete their life cycle within one growing season
   9. Biennials – plants that complete their life cycle in two years
   10. Perennials – plants that live for many years

D. *Procedures/Activities*
   1. Show students the model of the flower. Ask if anyone knows what it is? (Take any response at first, then lead students with the following clues if no one has guessed it.) It belongs in one of the five kingdoms? (Let students say all the kingdoms if necessary until you reach plant.) It attracts bees? (Flower) Hopefully no other clues are needed.
   2. Tell students that they will be studying the structure of the flower.
   3. Hand out Appendix O (1) to each student.

4. Have students take turns reading out loud the information on parts of the flower. Using their highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix O (2).
5. After reading, have students write down the key vocabulary words for this lesson in their Science Journals.
6. Then test student knowledge over what they read and just wrote down by having them close their Science Journals and have them guess the parts of the flower model as you point to them.
7. Practice this a few times calling on different students.
8. Hand out Appendix O (3) to each student for homework.

E. *Assessment/Evaluation*
1. Appendix O (3) will serve as assessment and evaluation for this lesson. It is a worksheet.

Lesson Fifteen: Animal Kingdom (Invertebrates)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
   b. All living things reproduce themselves. Reproduction may be asexual or sexual.
3. Skill Objective(s)
   a. Students will review the different classes of invertebrates and their characteristics.

B. *Materials*
1. Appendix P (1) – one copy for each student
2. Appendix P (2) – teacher copy
3. Appendix P (3) – one copy for each student
4. Highlighters – one for each student
5. Pencils – one for each student
6. Students' Science Journals
7. Various pictures of invertebrates (I have mine mounted on colored construction paper and then laminated)

C. *Key Vocabulary*
1. Invertebrates – animals without backbones
2. Abdomen – in invertebrates, the rear segment of a body
3. Appendages – movable parts that extend out from the body, such as arms, legs, wings, and claws
4. Arachnids – arthropods with four pairs of legs, such as spiders or scorpions
5. Arthropods – animals with exoskeletons, segmented bodies, and jointed appendages, such as insects and arachnids
6. Crustaceans – a group of arthropods, such as crabs and lobsters, that generally live in water
7. Exoskeleton – a tough, stiff covering around the body of an organism

8. Mollusks – animals with soft bodies that are not divided into segments, such as snails, oysters, and clams. Most mollusks have hard shells.
9. Thorax – the middle segment of a body
10. Vertebrates – animals with backbones

D. *Procedures/Activities*
1. Show students all sorts of pictures of invertebrates. Ask students if they know what all these pictures have in common. (Students might say animals.) If so, tell them this is the kingdom that they all belong to but lead them to invertebrates.
2. Tell them these animals are different from them in one special way. (no backbone)
3. Hand out Appendix P (1) to each student.
4. Have students take turns reading out loud the information on invertebrates. Using highlighters, have the students highlight the main ideas as it is read, with your guidance, using Appendix P (2).
5. After reading Appendix P (1) discuss with students what they read using the following questions:
   a. What is the difference between vertebrates and invertebrates? (vertebrates have backbones and invertebrate do not)
   b. What is an exoskeleton? (a hard covering over the body)
   c. How many groups are worms divided into? (three)
   d. What are they? (flat, round and segmented worms)
   e. Which is the most advanced? (segmented worms)
   f. Give an example of a mollusk. (except any that fit)
   g. Give an example of a hollow-bodied animal. (Any that fit)
6. Go over the key vocabulary words for this lesson by having students write them down in their Science Journals.
7. Hand out Appendix P (3) to each student. If time allows, have them work on this assignment or assign as homework.

E. *Assessment/Evaluation*
1. Appendix P (3) serves as assessment and evaluation for this lesson. It is a concept mapping activity.

Lesson Sixteen: Animal Kingdom (Vertebrates)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students understand the characteristics and structures of living things, the processes of life, and how living things interact with each other and their environment.
2. Lesson Content
   a. Scientists have divided living things into five large groups called kingdoms, as follows: Moneran, Protist, Fungus, Animal, and Plant.
   b. Different classes of vertebrates and major characteristics: fish, amphibians, reptiles, birds, and mammals
   c. All living things reproduce themselves. Reproduction may be asexual or sexual.
   d. Sexual reproduction requires the joining of special male and female cells to form a fertilized egg.
   e. Development of the embryo: egg, zygote, embryo, new animal

3. Skill Objective(s)
    a. Students will review the different classes of vertebrates and their characteristics.

B. *Materials*
1. Appendix Q (1) – one copy for each student
2. Appendix Q (2) – teacher copy
3. Appendix Q (3) – one copy for each student
4. Students' Science Journals
5. Highlighters – one for each student
6. Pencils – one for each student
7. Various pictures of vertebrates – I have mine on colored construction paper and then laminated.

C. *Key Vocabulary*
1. Cold-blooded – do not have a constant body temperature, they take on the temperature of their environment
2. Warm-blooded – have a constant body temperature that must be maintained
3. Amphibians – cold-blooded vertebrates that live part of their lives in water and part on land, hatch from eggs, have smooth, moist skin, have four appendages, and breathe through gills as well as lungs
4. Fish – cold-blooded animals that hatch from eggs, live in water, breathe through gills, and have scales on their bodies
5. Reptiles – cold-blooded animals that hatch from eggs, live on land, have scales or bony plates on their bodies, breathe through lungs and can have four short appendages or none at all
6. Birds – warm-blooded animals that hatch from eggs, have feathers covering their bodies, two legs and two wings, hollow bones, and breathe with lungs
7. Mammals – warm-blooded animals that give live births, get milk from mother's body, fur or hair covers their bodies, have four appendages, and breathe through lungs

D. *Procedures/Activities*
1. Show students the various pictures of vertebrates. Ask what makes these animals different than the ones in the previous lesson. (Students should say backbones.)
2. Ask if anyone knows how to group these animals into certain categories? (Students should pull from their previous knowledge of third grade core to get reptiles, amphibians, fish, birds and mammals.)
3. Hand out Appendix Q (1) to each student.
4. Have students take turns reading out loud the information on vertebrates. Using highlighters, have the students highlight the main ideas as it is read, with your guidance using Appendix Q (2).
5. Discuss what was covered in the reading.
6. Have students write down the key vocabulary words for this lesson in their Science Journals.
7. Hand out Appendix Q (3) to each student. If time allows, let students begin working on the concept mapping activity or assign as homework.

E. *Assessment/Evaluation*
1. Appendix Q (3) serves as assessment and evaluation for this lesson. It is a concept mapping exercise.

VI. CULMINATING ACTIVITY

A. Kingdom Day – Students in groups about four or five depending on your class size dress as examples from the five kingdoms. Making costumes and title boards for their group.

Students must all have speaking parts and describe their kingdom and who they are as examples, giving information on themselves as to how they fit in their kingdom and how they reproduce. I give the students a week or two to prepare their groups presentations. I use class time for the speeches part and they work on costumes at home. I grade group presentations using Appendix S. I also dress as Carolus Linneaus and introduce the kingdoms to the audience, and explain why scientists needed a classification system. We perform for other classes in the building and for the parents.

VII. HANDOUTS/WORKSHEETS

A.	Appendix A (1):	History of Classification (Lesson One)
B.	Appendix A (2):	History of Classification Teacher Copy (Lesson One)
C.	Appendix B:	Sorting It Out (Lesson One)
D.	Appendix C (1):	History of Classification Worksheet (Lesson One)
E.	Appendix C (2):	History of Classification Answer Key (Lesson Two)
F.	Appendix D (1):	Classification Today (Lesson Two)
G.	Appendix D (2):	Classification Today Teacher Copy (Lesson Two)
H.	Appendix D (3):	Classification Today Worksheet (Lesson Two)
I.	Appendix D (4):	Classification Today Answer Key (Lesson Three)
J.	Appendix E:	Classification Songs (Lessons Three, Four, Five, and Six)
K.	Appendix F (1):	Classification Study Guide (Lessons Four, Five, and Six)
L.	Appendix F (2):	Classification Study Guide Answer Key (Lesson Six)
M.	Appendix G (1):	Classification Test (after Lesson Six)
N.	Appendix G (2):	Classification Test Answer Key (after Lesson Six)
O.	Appendix H (1):	Viruses – Special Monerans (Lesson Seven)
P.	Appendix H (2):	Viruses – Special Monerans Teacher Copy (Lesson Seven)
Q.	Appendix H (3):	Viruses Worksheet (Lesson Seven)
R.	Appendix H (4):	Viruses Worksheet Answer Key (after Lesson Seven)
S.	Appendix I (1):	Bacteria – Monerans (Lesson Eight)
T.	Appendix I (2):	Bacteria – Monerans Teacher Copy (Lesson Eight)
U.	Appendix J (1):	Protists (Lesson Nine)
V.	Appendix J (2):	Protists Teacher Copy (Lesson Nine)
W.	Appendix K (1):	Fungus (Lesson Ten)
X.	Appendix K (2):	Fungus Teacher Copy (Lesson Ten)
Y.	Appendix K (3):	Fungus Worksheet (Lesson Ten)
Z.	Appendix K (4):	Fungus Worksheet Answer Key (after Lesson Ten)
AA.	Appendix L (1):	Study of Plants Without Seeds (Lesson Eleven)
BB.	Appendix L (2):	Study of Plants Without Seeds Teacher Copy (Lesson Eleven)
CC.	Appendix L (3):	Study of Plants Worksheet (Lesson Eleven)
DD.	Appendix L (4):	Study of Plants Answer Key (after Lesson Eleven)
EE.	Appendix M (1):	Structure of Seed Plants (Lesson Twelve)
FF.	Appendix M (2):	Structure of Seed Plants Teacher Copy (Lesson Twelve)
GG.	Appendix M (3):	Photosynthesis Song (Lesson Twelve)
HH.	Appendix N (1):	Life Cycle of a Plant (Lesson Thirteen)
II.	Appendix N (2):	Life Cycle of a Plant Teacher Copy (Lesson Thirteen)
JJ.	Appendix N (3):	Life Cycle of a Plant Movement Sheet (Lesson Thirteen)
KK.	Appendix O (1):	Parts of a Flower (Lesson Fourteen)
LL.	Appendix O (2):	Parts of a Flower Teacher Copy (Lesson Fourteen)
MM.	Appendix O (3):	Parts of a Flower Worksheet (Lesson Fourteen)
NN.	Appendix O (4):	Parts of a Flower Answer Key (after Lesson Fourteen)
OO.	Appendix P (1):	Invertebrates (Lesson Fifteen)
PP.	Appendix P (2):	Invertebrates Teacher Copy (Lesson Fifteen)

QQ. Appendix P (3): Invertebrate Concept Map (Lesson Fifteen)
RR. Appendix P (4): Invertebrate Concept Map Answer Key (after Lesson Fifteen)
SS. Appendix Q (1): Vertebrates (Lesson Sixteen)
TT. Appendix Q (2): Vertebrates Teacher Copy (Lesson Sixteen)
UU. Appendix Q (3): Vertebrates Concept Map (Lesson Sixteen)
VV. Appendix Q (4): Vertebrates Concept Map Answer Key (after Lesson Sixteen)
WW. Appendix R (1): Five Kingdom Test (after unit is completed)
XX. Appendix R (2): Five Kingdom Test Answer Key (after unit test is given)
YY. Appendix S: Grading Sheet for Kingdom Day (use with Culminating Activity)

VIII. BIBLIOGRAPHY

A. Maton, A. *Parade of Life: Monerans, Protists, Fungi, and Plants*. Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6. (all lessons)

B. Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4. (all lessons)

C. Teacher's Video Company *Classification* Video Quiz P.O. Box 4455, Scottsdale, AZ. 85261 (1-800-262-8837) (40 minutes) (Lesson Five)

D. *Photosynthesis*, Schlessinger Science Library, Schlessinger Media. Wynnewood, PA. 2000. ISBN 1-57225-317-7 Phone: 1-800-843-3620 (23 minutes) (Lesson Eleven)

E. *All About Plant Pollination: Fruit, Flowers, and Seeds*, Schlessinger Science Library, Schlessinger Media, Wynnewood, PA, 2000. ISBN 1-57225-314-2. (23 minutes) (Lesson Thirteen)

APPENDIX A (1)

History of Classification

Thousands of years ago, as people made observations about the world around them, they began to recognize that there were different groups of living things. There were animals and there were plants. In the animal group, some roamed the land, some swam in the water, and others flew in the air. Plants too, showed a wide range of differences. They varied in shape, size, and color.

What these early people were doing is something you often do in your daily life. They were giving order to the world around them by putting things in groups or categories based on certain characteristics. In other words, they were developing simple systems of classification. Classification is the grouping of things according to similar characteristics.

Stop and think for a moment about the ways in which you classify things everyday. Perhaps you group your clothing by season or perhaps by type. What are some other things that you sort in a meaningful way?

Classification is important to all fields of science, not just to the subject of biology you are now studying. For example, the geologist classifies rocks, soil, and fossils. Meteorologists (people who study the weather) classify clouds, winds, and types of storms. All of the 109 known chemical elements are classified into a system that helps chemists understand their behavior.

Classification is important in subjects other than science. In English, parts of speech are categorized as nouns, verbs, adjectives, and adverbs, to name a few. In mathematics, you work with odd numbers and even numbers, circles, rectangles, and triangles. In history, you group people and events according to time periods or geographic locations. You know that music can be rock-and-roll, rhythm and blues, country and western, or classical.

These are but a few examples of the important role that classification plays in all phases of life. For the people living thousands of years ago, classifying livings things according to observable characteristics often helped them to survive. For you, classifying objects probably makes life easier and more meaningful. For scientists, classification systems provide a means of learning more about life on Earth and of discovering the special relationships that exist between different kings of living things.

Biological classification systems name and organize living things in a logical and meaningful way. Scientists have identified more than 2.5 million different types of living things and they are not even close to being finished. In order to bring some order to this great diversity of living things, biologists have developed systems of classification.

The science of classification is a branch of biology known as taxonomy. Scientists who work in this field are called taxonomists. Taxonomy has a long history, during which many classification systems were developed, changed to fit new facts and theories, and even rejected and replaced with better systems. This should not surprise you if you remember that science is an ongoing process.

In the fourth century B.C., the Greek philosopher Aristotle proposed a system to classify living things. He divided organisms into two groups: plants and animals. He also placed animals into three groups according to the way they moved. One group included all animals that flew, another group included all those that swam, and a third group included all those that walked.

This system was useful, but it had its problems. Aristotle ignored the ways in which animals are similar and different in form. According to his system, both a bird and a bat would be in the same group of flying animals. Yet in basic ways birds and bats are different. Birds have feathers and bats are covered with hair.

Aristotle's system would not satisfy today's scientists but it was a start in classifying living things. In fact Aristotle's system was used for almost 2000 years.

By the seventeenth century, biologists had started to classify organisms according to similarities in form and structure. They examined the internal anatomy as well as its outward appearance. This helped them to place animals and other organisms into groups that were more meaningful than those Aristotle had created.

The classification system we use today is based on the work of the eighteenth century Swedish scientist Carolus Linnaeus. Linnaeus built upon Aristotle's work to develop his classification system. Linnaeus spent most of his life using his classification system to describe all known plants and animals.

Linnaeus also developed a simple system for naming organisms. His system is such a logical and easy way of naming that it is still used today. Linnaeus decided to give all living things two names, like people have, a first and last name. The naming system he developed is called binomial nomenclature. In this system, each organism is given two names. The two names are a genus name and a species name. The genus name would be like your last name and the species name would be your first name. The genus name is capitalized, but the species name begins with a small letter. Here is an example of the genus and species name for people: Homo sapiens. {Homo (genus) and sapiens (species)} Just like you have only one name for knowing you, each organism has only one scientific name. And no two organisms can have the same scientific name.

(adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi, and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6.)

APPENDIX A (2)

History of Classification

Thousands of years ago, as people made observations about the world around them, they began to recognize that there were different groups of living things. There were animals and there were plants. In the animal group, some roamed the land, some swam in the water, and others flew in the air. Plants too, showed a wide range of differences. They varied in shape, size, and color.

What these early people were doing is something you often do in your daily life. They were giving order to the world around them by putting things in groups or categories based on certain characteristics. In other words, they were developing simple systems of classification. Classification is the grouping of things according to similar characteristics.

Stop and think for a moment about the ways in which you classify things everyday. Perhaps you group your clothing by season or perhaps by type. What are some other things that you sort in a meaningful way?

Classification is important to all fields of science, not just to the subject of biology you are now studying. For example, the geologist classifies rocks, soil, and fossils. Meteorologists (people who study the weather) classify clouds, winds, and types of storms. All of the 109 known chemical elements are classified into a system that helps chemists understand their behavior.

Classification is important in subjects other than science. In English, parts of speech are categorized as nouns, verbs, adjectives, and adverbs, to name a few. In mathematics, you work with odd numbers and even numbers, circles, rectangles, and triangles. In history, you group people and events according to time periods or geographic locations. You know that music can be rock-and-roll, rhythm and blues, country and western, or classical.

These are but a few examples of the important role that classification plays in all phases of life. For the people living thousands of years ago, classifying livings things according to observable characteristics often helped them to survive. For you, classifying objects probably makes life easier and more meaningful. For scientists, classification systems provide a means of learning more about life on Earth and of discovering the special relationships that exist between different kings of living things.

Biological classification systems name and organize living things in a logical and meaningful way. Scientists have identified more than 2.5 million different types of living things and they are not even close to being finished. In order to bring some order to this great diversity of living things, biologists have developed systems of classification.

The science of classification is a branch of biology known as taxonomy. Scientists who work in this field are called taxonomists. Taxonomy has a long history, during which many classification systems were developed, changed to fit new facts and theories, and even rejected and replaced with better systems. This should not surprise you if you remember that science is an ongoing process.

In the fourth century B.C., the Greek philosopher Aristotle proposed a system to classify living things. He divided organisms into two groups: plants and animals. He also placed animals into three groups according to the way they moved. One group included all animals that flew, another group included all those that swam, and a third group included all those that walked.

This system was useful, but it had its problems. Aristotle ignored the ways in which animals are similar and different in form. According to his system, both a bird and a bat would be in the same group of flying animals. Yet in basic ways birds and bats are different. Birds have feathers and bats are covered with hair.

Aristotle's system would not satisfy today's scientists but it was a start in classifying living things. In fact Aristotle's system was used for almost 2000 years.

By the seventeenth century, biologists had started to classify organisms according to similarities in form and structure. They examined the internal anatomy as well as its outward appearance. This helped them to place animals and other organisms into groups that were more meaningful than those Aristotle had created.

The classification system we use today is based on the work of the eighteenth century Swedish scientist Carolus Linnaeus. Linnaeus built upon Aristotle's work to develop his classification system. Linnaeus spent most of his life using his classification system to describe all known plants and animals.

Linnaeus also developed a simple system for naming organisms. His system is such a logical and easy way of naming that it is still used today. Linnaeus decided to give all living things two names, like people have, a first and last name. The naming system he developed is called binomial nomenclature. In this system, each organism is given two names. The two names are a genus name and a species name. The genus name would be like your last name and the species name would be your first name. The genus name is capitalized, but the species name begins with a small letter. Here is an example of the genus and species name for people: Homo sapiens. {Homo (genus) and sapiens (species)} Just like you have only one name for knowing you, each organism has only one scientific name. And no two organisms can have the same scientific name.

(adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi, and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6.)

APPENDIX B

Name_____Date_____

Sorting It Out

Draw a diagram to show how you might classify your clothes.

Draw a diagram to show how you might classify the letters of the alphabet.

Draw a diagram to show how you might classify the numbers 0 through 20.

APPENDIX C (1)

Name_____ Date_____

History of Classification

What does binomial nomenclature mean?

What part of your own name corresponds to the genus name of an organism?

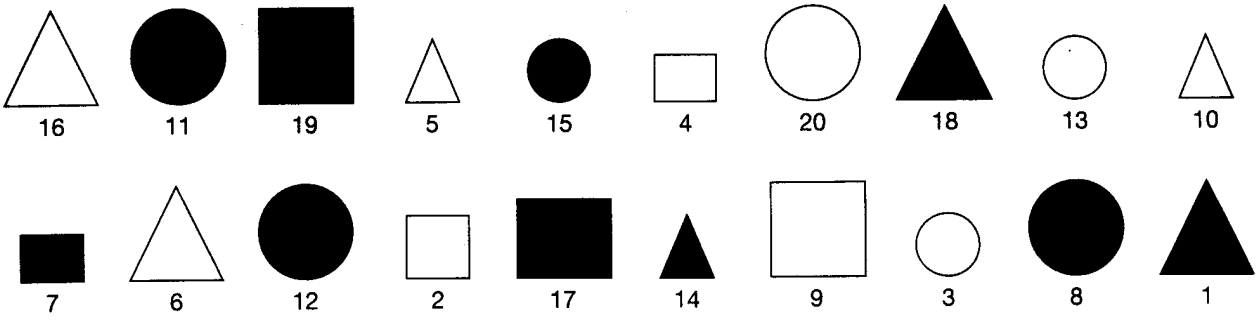
What part of your own name corresponds to the species name of an organism?

What is the difference about the order of names in Genus species and the way you usually write your signature in English?

Where might you find your name written in Genus species form?

APPENDIX C (1), page 2

Devise a classification system to put the objects below into two categories. List the numbers of the figures you selected in the space provided.



What figures did you put in Category #1? _____

What figures did you put in Category #2? _____

What was the basis of your classification system?_____

Perform the same activity putting your figures into three categories.

What figures did you place in Category #1? _____

What figures did you place in Category #2? _____

What figures did you place in Category #3? _____

If you compared your system with those of your classmates, would they all be the same?_____

Have all biological classification systems been the same? _____

What conclusions can you draw form this information? _____

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: PrenticeHall, 1997. ISBN 0-13-423252-6)

APPENDIX C (2)

Name_____Key (Teacher Copy)_____ Date_____

History of Classification

What does binomial nomenclature mean? (having two names, a genus and species)

What part of your own name corresponds to the genus name of an organism? (last name)

What part of your own name corresponds to the species name of an organism? (first name)

What is the difference about the order of names in Genus species and the way you usually write your signature in English? (we usually write our first name then our last)

Where might you find your name written in Genus species form? (phone book, class roster, etc. Any thing where last name comes before the first.)

APPENDIX C (2), page 2

Devise a classification system to put the objects below into two categories. List the numbers of the figures you selected in the space provided. **TEACHER NOTE: ANSWERS WILL VARY CHECK STUDENTS REASONING BEHIND THE GROUPS**

What figures did you put in Category #1? _____

What figures did you put in Category #2? _____

What was the basis of your classification system?_____

Perform the same activity putting your figures into three categories.

What figures did you place in Category #1? _____

What figures did you place in Category #2? _____

What figures did you place in Category #3? _____

If you compared your system with those of your classmates, would they all be the same?__NO__

Have all biological classification systems been the same? _____*NO*_____

What conclusions can you draw form this information? THAT SCIENCE CHANGES WHEN INFORMATION CHANGES

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants*. Upper Saddle River, New Jersey: PrenticeHall,1997. ISBN 0-13-423252-6)

APPENDIX D (1)

Classification Today

In the 200 years since Linnaeus developed his classification and naming systems, knowledge of the living world has grown enormously. And as the understanding of organisms improved, it became necessary to adjust the system of biological classification. Now scientists consider many factors when classifying organisms. Of course, they still look at the internal and external structures, but also rely on other observations. The invention of the microscope has allowed scientists to examine tiny structures hidden within the cells of the organisms. These advances are important tools that help scientists group and name organisms.

If you just glanced at the modem classification system it may seem complicated to you. It really is quite simple. The system used today serves two purposes. First, it gives each organism a unique name that all scientists can use and understand. Second, it groups organisms according to basic characteristics that reflect their evolutionary relationships.

All living things are classified into seven major groups: kingdom, phylum, class, order, family, genus, and species. The largest and most general group is kingdom. For example plants belong to the plant kingdom. The second largest group is the phylum. A phylum includes a large number of very different organisms that share some important characteristics. A species is the smallest and most specific group in the classification system. Members in this group share many characteristics and are similar in appearance and behavior. Also, members in the same species can interbreed and produce offspring.

You can think of the classification system as boxes within boxes. You might open a huge kingdom box to discover several large phyla boxes, each containing a number of smaller boxes. If you opened the smallest species box, you would find a number of individuals all of the same type.

The Five Kingdoms

With all of the discoveries of new living things and the changing ideas about the most effective way to classify have resulted in the five-kingdom classification system we use now. Today, the most generally used classification system contains five kingdoms: monerans, protists, fungi, plants, and animals.

Monerans are organisms consisting of only one cell. A monerans cell does not have a nucleus. In addition to a nucleus a moneran lacks other structures found in cells. Like other organisms, monerans can be placed into two groups based on how they obtain energy. Organisms that obtain energy by making their own food are called autotrophs. Organisms that cannot make their own food are called heterotrophs.

Protists are unicellular organisms that have a nucleus. A number of protists are capable of movement and are autotrophs or heterotrophs.

Fungi are generally multicellular organisms with a unique cell wall. They were once classified with the plants but they are quite different in structure. Fungi are heterotrophs.

Plants are mostly multicellular autotrophs. This is one of the kingdoms you should already be quite familiar with.

Animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. Unlike plants, animals are heterotrophs.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX D (2)

Classification Today

In the 200 years since Linnaeus developed his classification and naming systems, knowledge of the living world has grown enormously. And as the understanding of organisms improved, it became necessary to adjust the system of biological classification. Now scientists consider many factors when classifying organisms. Of course, they still look at the internal and external structures, but also rely on other observations. The invention of the microscope has allowed scientists to examine tiny structures hidden within the cells of the organisms. These advances are important tools that help scientists group and name organisms.

If you just glanced at the modem classification system it may seem complicated to you. It really is quite simple. The system used today serves two purposes. First, it gives each organism a unique name that all scientists can use and understand. Second, it groups organisms according to basic characteristics that reflect their evolutionary relationships.

All living things are classified into seven major groups: kingdom, phylum, class, order, family, genus, and species. The largest and most general group is kingdom. For example plants belong to the plant kingdom. The second largest group is the phylum. A phylum includes a large number of very different organisms that share some important characteristics. A species is the smallest and most specific group in the classification system. Members in this group share many characteristics and are similar in appearance and behavior. Also, members in the same species can interbreed and produce offspring.

You can think of the classification system as boxes within boxes. You might open a huge kingdom box to discover several large phyla boxes, each containing a number of smaller boxes. If you opened the smallest species box, you would find a number of individuals all of the same type.

The Five Kingdoms

With all of the discoveries of new living things and the changing ideas about the most effective way to classify have resulted in the five-kingdom classification system we use now. Today, the most generally used classification system contains five kingdoms: monerans, protists, fungi, plants, and animals.

Monerans are organisms consisting of only one cell. A moneran cell does not have a nucleus. In addition to a nucleus a moneran lacks other structures found in cells. Like other organisms, monerans can be placed into two groups based on how they obtain energy. Organisms that obtain energy by making their own food are called autotrophs. Organisms that cannot make their own food are called heterotrophs.

Protists are unicellular organisms that have a nucleus. A number of protists are capable of movement and are autotrophs or heterotrophs.

Fungi are generally multicellular organisms with a unique cell wall. They were once classified with the plants but they are quite different in structure. Fungi are heterotrophs.

Plants are mostly multicellular autotrophs. This is one of the kingdoms you should already be quite familiar with.

Animals are multicellular organisms that have specialized tissues, and most have organs and organ systems. Unlike plants, animals are heterotrophs.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX E

Classification Songs

Kingdom Phylum

Kingdom, Phylum, Class, Order, Family, Genus, Species
Kingdom, Phylum, Class, Order, Family, Genus, Species
Kingdom, Phylum, Class, Order, Family, Genus, Species

Five Kingdom Song

There are five kingdoms of living things and animals are the first.
Some swim, some walk, some talk, and they all have one nucleus.
One phylum all has backbones and they're called the vertebrates.
Animals are living things.

There are five kingdoms of living things and plants are number two.
Plants make their food with chloroplasts they also use the sun.
They're planted in one spot and the nucleus number's one.
All plants are living things.

There are five kingdoms of living things and protists are the third.
Protists are very small, you see, they're made of just one cell.
Most move through the water and have a nucleus as well.
Protists are living things.

There are five kingdoms of living things and monerans are the fourth.
They have no nucleus, and most don't move around at all.
These are called bacteria and they have one cell that's all.
Monerans are living things.

There are five kingdoms of living things and fungi are last.
They don't make food like plants; they absorb it from the ground.
Many fungi reproduce by spreading spores around.
A fungus is a living thing.

(Taken from Tamie Berg, 5th grade, Liberty Common School, Fort Collins, Colorado)

APPENDIX F (1)

Classification Study Guide

Name: _____

The Greek philosopher Aristotle classified animals according to the way they _____.

The largest classification grouping is a _____.

According to Aristotle's classification system a bird would be grouped with a _____.

The cells of monerans do not contain a _____.

Mushrooms and molds belong to the kingdom _____.

In which language are most scientific names? _____

The smallest classification group is a (an) _____.

An organism that cannot make its own food is called a (an) _____.

The scientist who developed a system for naming organisms was _____.

A family is divided into _____.

Organisms that can make their own food from simple substances are called _____.

Fungi are _____.

An order is divided into _____.

A dog is a member of the kingdom _____.

Carolus Linnaeus developed a system for naming organisms known as _____.

A rose is a member of the kingdom _____.

The term species refers to _____.

The science of classification is called _____.

In binomial nomenclature, the name of any organism is made up of its _____.

Unicellular organisms with a nucleus are usually placed in which kingdom? _____.

Determine whether each statement is true or false.

_____ Aristotle classified organisms according to the way they moved.

_____ The cells of moneran do not contain a nucleus.

_____ All living things are classified into seven major groups.

_____ Classification is the grouping of living things according to similar characteristics.

_____ Aristotle devised the simple naming system of binomial nomenclature.

_____ Each genus of organisms is divided into one or more classes.

_____ No two organisms can have the same scientific name.

The science of classification is called _____.

The cells of monerans do not contain a (an) _____.

A group of organisms that are able to produce offspring is a (an) _____.

In classification the two-word naming system is known as _____.

Animals that cannot make their own food are called _____.

The grouping of living things according to similar characteristics is known as _____.

Because plants can make their own food they are called _____.

The smallest classification group is the _____.

Today, most scientists use a system of classification that includes _____ kingdoms.

The scientist who devised the system of binomial nomenclature was _____.

Living things are classified using _____ major classification groups.

The largest classification group is the _____.

The Greek philosopher _____ was one of the first people to develop a system of classification.

Describe the system of binomial nomenclature.

Why did scientists need a system for naming organisms?

APPENDIX F (2)

Classification Study Guide

Name: _____KEY_____

The Greek philosopher Aristotle classified animals according to the way they ___MOVED_____.

The largest classification grouping is a ___KINGDOM_____.

According to Aristotle's classification system a bird would be grouped with a ___BAT_____.

The cells of monerans do not contain a ____NUCLEUS_____.

Mushrooms and molds belong to the kingdom ____FUNGUS_____.

In which language are most scientific names? _____LATIN_____

The smallest classification group is a (an) ___SPECIES_____.

An organism that cannot make its own food is called a (an) ____HETERTROPH_____.

The scientist who developed a system for naming organisms was __CAROLUS LINNAEUS_____.

A family is divided into __GENUS_____.

Organisms that can make their own food from simple substances are called ___AUTOTROPHS_____.

Fungi are __HETEROTROPHS_____.

An order is divided into __FAMILIES_____.

A dog is a member of the kingdom ___ANIMAL_____.

Carolus Linnaeus developed a system for naming organisms known as BINOMIAL NOMENCLATURE.

A rose is a member of the kingdom ___PLANT_____.

The term species refers to *A GROUP OF ORGANISMS THAT IS ABLE TO PRODUCE YOUNG_*.

The science of classification is called *TAXONOMY*_____.

In binomial nomenclature, the name of any organism is made up of its *GENUS AND SPECIES_*.

Unicellular organisms with a nucleus are usually placed in which kingdom? *PROTIST*_____.

APPENDIX F (2), page 2

Determine whether each statement is true or false.

__T___ Aristotle classified organisms according to the way they moved.

__T___ The cells of moneran do not contain a nucleus.

___T__ All living things are classified into seven major groups.

__T___ Classification is the grouping of living things according to similar characteristics.

__F___ Aristotle devised the simple naming system of binomial nomenclature.

__F___ Each genus of organisms is divided into one or more classes.

__T___ No two organisms can have the same scientific name.

The science of classification is called ___TAXONOMY_____.

The cells of monerans do not contain a (an) ___NUCLEUS_____.

A group of organisms that are able to produce offspring is a (an) ____SPECIES_____.

In classification the two-word naming system is known as BINOMIAL NOMENCLATURE_____.

Animals that cannot make their own food are called ___HETEROTROPHS_____.

The grouping of living things according to similar characteristics is known as __CLASSIFICATION___.

Because plants can make their own food they are called ___AUTOTROPHS_____.

The smallest classification group is the ___SPECIES_____.

Today, most scientists use a system of classification that includes __FIVE_____ kingdoms.

The scientist who devised the system of binomial nomenclature was ___LINNAEUS_____.

Living things are classified using ___SEVEN_____ major classification groups.

The largest classification group is the __KINGDOM_____.

The Greek philosopher __ARISTOTLE_____ was one of the first people to develop a system of classification.

Describe the system of binomial nomenclature.

BINOMIAL NOMENCLATURE IS A SYSTEM FOR NAMING ORGANISMS. EACH ORGANISM IS GIVEN A GENUS NAME AND SPECIES NAME. THE GENUS NAME AND SPEICIES NAME COMBINE TO MAKE UP THE ORGANISM'S SCIENTIFIC NAME.

Why did scientists need a system for naming organisms?

PEOPLE LIVING IN VARIOUS PARTS OF THE WORLD MAY HAVE DIFFERENT COMMON NAMES FOR THE SAME ORGANISM. THROUGH THE SYSTEM OF BINOMIAL NOMENCLATURE, A UNIQUE NAME IS ASSIGNED TO EVERY LIVING THING. THIS ORDERLY NAMING SYSTEM ELIMINATES CONFUSION AMONG SCIENTISTS.

APPENDIX G (1)

Classification Test

Name: _____

Multiple Choice

Write the letter of the correct answer on the line at the left.

_____ 1. In science, grouping objects or organisms according to similar characteristics is called
a. characteristics c. ordering
b. classifying d. clustering

_____2. Grouping living things in an orderly way is the job of a
a. microscopist c. taxonomist
b. chemist d. computer specialist

_____3. Aristotle, one of the first scientists to group organisms, grouped animals according to the way
a. they moved c. they reproduced
b. they ate d. they raised their young

_____4. The term "binomial nomenclature" refers to an organism's
a. kingdom and phylum c. family and genus
b. class and order d. genus and species

_____5. A group of organisms that is able to produce offspring is called a
a. kingdom c. class
b. family d. species

_____ 6. Most often, the scientific name of an organism is in
a. English c. French
b. Latin d. Greek

_____ 7. Classes of organisms can be found within a (an)
a. phylum c. species
b. order d. family

_____8. Mushrooms are found in the _____ kingdom.
a. Protist c. Moneran
b. Fungus d. Animal

_____9. An organism that can make its own food is called a (an)
a. heterotroph c. autotrophy
b. moneran d. protist

_____ 10. If an organism is unicellular, it is most likely a (an)
a. moneran or plant c. plant or fungus
b. animal or protist d. protist or moneran

APPENDIX G (1), page 2

Completion

Complete each statement of the line at the left.

_____ 1. In scientific classification, the number of major groups that organisms can be divided into is ___.

_____ 2. The classification system most scientists use includes ___ kingdoms.

_____ 3. Organisms that cannot make their own food are called ___.

_____ 4. The Swedish scientist, ___, developed the system of binomial nomenclature.

_____ 5. In scientific classification, orders are divided into ___.

True or False

___ 1. In general, plants are autotrophs.

___ 2. In scientific classification, classes are divided into phyla.

___ 3. Organisms whose cells do not contain a well-defined nucleus are placed in the Fungus Kingdom.

___ 4. Dogs are placed in the Animal Kingdom.

___ 5. All members of the same species have a different scientific name.

Essay (write on a piece of lined notebook paper and staple to your test)

Describe ways in which classification systems are helpful in grocery stores, clothing stores, and restaurants.

Describe three categories that could be used to classify the following objects: baseball cap, cowboy hat, ski hat, golf visor, wide-brimmed sunbonnet, racer's swim cap, shower cap, and fishing hat.

APPENDIX G (2)

Classification Test Answer Key

Name: __ANSWER KEY_____

Multiple Choice

Write the letter of the correct answer on the line at the left.

__B__ 1. In science, grouping objects or organisms according to similar characteristics is called
a. characteristics c. ordering
b. classifying d. clustering

__C___2. Grouping living things in an orderly way is the job of a
a. microscopist c. taxonomist
b. chemist d. computer specialist

__A___3. Aristotle, one of the first scientists to group organisms, grouped animals according to the way
a. they moved c. they reproduced
b. they ate d. they raised their young

__D___4. The term "binomial nomenclature" refers to an organism's
a. kingdom and phylum c. family and genus
b. class and order d. genus and species

__D___5. A group of organisms that is able to produce offspring is called a
a. kingdom c. class
b. family d. species

__B___ 6. Most often, the scientific name of an organism is in
a. English c. French
b. Latin d. Greek

__A___ 7. Classes of organisms can be found within a (an)
a. phylum c. species
b. order d. family

__B___8. Mushrooms are found in the _____ kingdom.
a. Protist c. Moneran
b. Fungus d. Animal

__C___9. An organism that can make its own food is called a (an)
a. heterotroph c. autotrophy
b. moneran d. protist

__D__ 10. If an organism is unicellular, it is most likely a (an)
a. moneran or plant c. plant or fungus
b. animal or protist d. protist or moneran

Completion

Complete each statement of the line at the left.

__SEVEN _____ 1. In scientific classification, the number of major groups that organisms can be divided into is ___.

__FIVE_____ 2. The classification system most scientists use includes ___ kingdoms.

___HETEROTROPH__ 3. Organisms that cannot make their own food are called ___.

__LINNAEUS_____ 4. The Swedish scientist, ___, developed the system of binomial nomenclature.

____FAMILIES_____ 5. In scientific classification, orders are divided into ___.

True or False

T 1. In general, plants are autotrophs.

F 2. In scientific classification, classes are divided into phyla.

F 3. Organisms whose cells do not contain a well-defined nucleus are placed in the Fungus Kingdom.

T 4. Dogs are placed in the Animal Kingdom.

F 5. All members of the same species have a different scientific name.

Essay (write on a piece of lined notebook paper and staple to your test)

Describe ways in which classification systems are helpful in grocery stores, clothing stores, and restaurants.

A CLASSIFICATION SYSTEM IS HELPFUL IN ANY KIND OF STORE TO FIND PRODUCTS MORE EASILY. FOR EXAMPLE, CANNED CORN WOULD BE LOCATED WITH ALL OTHER CANNED VEGETABLES. MEN'S PANTS WOULD BE WITH MEN'S CLOTHING. CLASSIFICATION IN A RESTAURANT MENU MAKES DECIDING ON A SELECTION MUCH EASIER.

Describe three categories that could be used to classify the following objects: baseball cap, cowboy hat, ski hat, golf visor, wide-brimmed sunbonnet, racer's swim cap, shower cap, and fishing hat.

ANSWERS WILL VARY. STUDENTS COULD USE SUCH CATEGORIES AS: WATER/NO WATER, ATHLETIC/NON-ATHLETIC, PLASTIC/CLOTH, WINTER/SUMMER, AND SO FORTH.

APPENDIX H (1)

Viruses (Special Monerans)

Viruses are tiny particles that can invade living cells. Because viruses are not cells, they cannot perform all the functions of living cells. Biologists do not agree about whether viruses are living things or not.

Viruses by themselves, show no signs of life. In fact the only life function they share with cells is reproduction. However, viruses cannot reproduce on their own. They need the help of living things called hosts. Hosts are living things that provide a home and/or food for a parasite. A parasite is an organism that survives by living on or in a host organism, thus harming it. Because viruses harm their host cells, they are considered to be parasites.

Viruses affect all five kingdoms of living things. Experts suspect that all cells are subject to invasion by some kind of virus. However, it is interesting to note that each type of virus can only affect a certain type of cell. For example, the rabies virus infects only nerve cells in the brain and spinal cord of mammals. So a mammal's skin cells could not be infected and if an organism wasn't a mammal, such as a tree or frog, they cannot get the rabies virus.

A virus has two basic parts: a core of heredity material and an outer coat of protein. The heredity material controls the production of new viruses. The protein coat encloses and protects the virus. This protective coat is so good that some viruses survive after being dried and frozen for years. The protein coat also allows the virus to identify and attach itself to hosts.

Viruses cause disease in organisms in the five kingdoms. They do this by invading cells. This invasion is done differently from virus to virus but the basic pattern of reproduction is the same for all viruses. First, a virus gets its heredity material into the host cell. Then the host cell makes more virus particles. Finally, the virus particles leave the original host cell by bursting it, and then move on to infect new host cells.

Viruses cause a large number of human diseases. Some of these diseases, such as colds, fever blisters, and warts, are simply annoying and perhaps a bit painful. Others are serious and can cause permanent damage or even death. Among the diseases caused by viruses are AIDS, measles, influenza, hepatitis, smallpox, polio, and mumps.

Most of the research on viruses has concerned itself with ways of preventing and treating virus diseases. However, researchers have found ways of using viruses to help humans. Weakened or killed viruses are used to make some vaccines. A vaccine helps the body to produce antibodies (substances that prevent infection). Viruses can also be used to wage germ warfare on disease causing bacteria and insects and on other agricultural pests.

Recently, researchers have learned to put hereditary material into viruses. They can then use the viruses to put the hereditary material into cells. In the not too distant future, scientists may be able to use viruses to replace damaged hereditary material in a person's cells. This could cure diseases such as, diabetes, cystic fibrosis, sickle cell anemia, and many other hereditary disorders. Scientists may also be able to use viruses to improve crops. For example, corn plants might be able to resist pests that destroyed them with the help of viruses.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: PrenticeHall,1997. ISBN 0-13-423252-6)

APPENDIX H (2)

Viruses (Special Monerans) Teacher Copy

Viruses are tiny particles that can invade living cells. Because viruses are not cells, they cannot perform all the functions of living cells. Biologists do not agree about whether viruses are living things or not.

Viruses by themselves, show no signs of life. In fact the only life function they share with cells is reproduction. However, viruses cannot reproduce on their own. They need the help of living things called hosts. Hosts are living things that provide a home and/or food for a parasite. A parasite is an organism that survives by living on or in a host organism, thus harming it. Because viruses harm their host cells, they are considered to be parasites.

Viruses affect all five kingdoms of living things. Experts suspect that all cells are subject to invasion by some kind of virus. However, it is interesting to note that each type of virus can only affect a certain type of cell. For example, the rabies virus infects only nerve cells in the brain and spinal cord of mammals. So a mammal's skin cells could not be infected and if an organism wasn't a mammal, such as a tree or frog, they cannot get the rabies virus.

A virus has two basic parts: a core of heredity material and an outer coat of protein. The heredity material controls the production of new viruses. The protein coat encloses and protects the virus. This protective coat is so good that some viruses survive after being dried and frozen for years. The protein coat also allows the virus to identify and attach itself to hosts.

Viruses cause disease in organisms in the five kingdoms. They do this by invading cells. This invasion is done differently from virus to virus but the basic pattern of reproduction is the same for all viruses. First, a virus gets its heredity material into the host cell. Then the host cell makes more virus particles. Finally, the virus particles leave the original host cell by bursting it, and then move on to infect new host cells.

Viruses cause a large number of human diseases. Some of these diseases, such as colds, fever blisters, and warts, are simply annoying and perhaps a bit painful. Others are serious and can cause permanent damage or even death. Among the diseases caused by viruses are AIDS, measles, influenza, hepatitis, smallpox, polio, and mumps.

Most of the research on viruses has concerned itself with ways of preventing and treating virus diseases. However, researchers have found ways of using viruses to help humans. Weakened or killed viruses are used to make some vaccines. A vaccine helps the body to produce antibodies (substances that prevent infection). Viruses can also be used to wage germ warfare on disease causing bacteria and insects and on other agricultural pests.

Recently, researchers have learned to put hereditary material into viruses. They can then use the viruses to put the hereditary material into cells. In the not too distant future, scientists may be able to use viruses to replace damaged hereditary material in a person's cells. This could cure diseases such as, diabetes, cystic fibrosis, sickle cell anemia, and many other hereditary disorders. Scientists may also be able to use viruses to improve crops. For example, corn plants might be able to resist pests that destroyed them with the help of viruses.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: PrenticeHall,1997. ISBN 0-13-423252-6)

APPENDIX H (3)

Name: _____ Date: _____

Viruses (Special Monerans)

Define the following words.

Virus: _____

Parasite: _____

Host: _____

Vaccine: _____

Antibody: _____

In any virus "life cycle," there are three basic steps. Summarize the steps in the spaces provided.

Step One: _____

Step Two: _____

Step Three: _____

In the space provided, write a short paragraph telling what you have learned about the interaction between viruses and human hosts. (Concentrate on information that you found to be interesting.)

APPENDIX H (4)

Name: ____TEACHER ANSWER KEY_____ Date: _____

Viruses (Special Monerans)

Define the following words.

Virus: __IS A TINY PARTICLE THAT INVADES A LIVING CELL___

Parasite: __AN ORGANISM THAT LIVES IN OR ON ANOTHER ORGANISM, CAUSING HARM__

Host: __A LIVING ORGANISM THAT PROVIDES A HOME AND/OR FOOD FOR A PARASITE___

Vaccine: __HELPS THE BODY PRODUCE ANTIBODIES_____

Antibody: ___ SUBSTANCE THAT PREVENTS INFECTION_____

In any virus "life cycle," there are three basic steps. Summarize the steps in the spaces provided.

Step One: ___VIRUS GETS ITS HEREDITARY MATERIAL INTO HOST CELL_____

Step Two: ____THEN THE HOST MAKES MORE VIRUS PARTICLES__

Step Three: __THE VIRUS PARTICLES LEAVE THE ORIGINAL HOST TO INFECT NEW HOSTS_

In the space provided, write a short paragraph telling what you have learned about the interaction between viruses and human hosts. (Concentrate on information that you found to be interesting.)

___ANSWERS WILL VARY_____

APPENDIX I (1)

Monerans (Bacteria)

Monerans are tiny organisms that consist of a single cell. Moneran cells are different from all other cells because they lack a nucleus and certain other cell structures. At one time the term bacteria was used to describe only a certain kind of moneran. But today all monerans are considered to be bacteria.

Bacteria are among the most numerous organisms on Earth. Scientists estimate that there are about 2.5 billion bacteria in a gram of garden soil. And the total number of bacteria living in your mouth is greater than the number of people who have ever lived.

With so many billions of bacteria out there they are quite varied. They may be rod shaped like a medicine capsule, round as a marble, coiled like a stretched spring, round and stalked like a candied apple on a stick, or completely shapeless. As varied are their sizes so are their colors. They come in reds, yellows, blues and violets. Some bacteria live alone as single cells. Others live in groups of cells that are attached to one another.

Bacteria are found in water, air, soil, and the bodies of larger organisms. In fact, bacteria live almost everywhere, even in places where other living things cannot survive. For example, some bacteria live in volcanic vents at the bottom of the ocean, where the temperature is two and one-half times the temperature of boiling water.

Bacteria are considered the simplest organisms. However, bacteria are more complex than you might realize. Each bacteria cell performs the same functions that more complex organisms, including you, perform.

One of the most noticeable features of a bacterium is the cell wall. The cell wall is a tough, rigid structure that surrounds, supports, shapes, and protects the cell. Almost all bacteria have a cell wall. In some bacteria, there is a coating over the cell wall. This coating is called the capsule. Inside the cell wall is the cell membrane. The cell membrane controls which substances enter and leave the cell. Within the cell membrane is the cytoplasm. The cytoplasm is a jellylike mixture that makes up most of the cell. Since the moneran or bacteria has no nucleus, the hereditary material is in the cytoplasm.

Many bacteria are not able to move on their own. They can be carried from one place to another place by air and water currents, clothing, and other objects. Other bacteria have special structures that help them move in watery surroundings. One such structure is a flagellum. A flagellum is a long, thin, whip like structure that propels bacteria through its environment. Some may have many flagella.

Bacteria have more different ways of getting the energy they need to live that any other kingdom of organisms. In fact, bacteria obtain energy in more ways than all of the other kingdoms put together. Many bacteria are heterotrophs. A heterotroph cannot make its own food. Some bacteria feed on living organisms. These bacteria are parasites. Other bacteria feed on dead organisms. These bacteria are called decomposers. Decomposers break down dead organism into simpler substances. In this process, they return important materials to the soil and water.

Bacteria are very helpful to people in many ways. They are used to make cucumbers into pickles. They are also used to make cabbage into sauerkraut. Milk becomes cheese because of the amount of bacteria. Bacteria are helpful to plants, too. In fact, plants would not be able to live without the help of bacteria.

Along with being helpful, bacteria can also be harmful. The trouble comes in a number of forms. Some harmful bacteria can spoil food or poison water supplies. Others damage property or disrupt manufacturing processes. Still others cause disease in people, pets, livestock, and food crops.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX I (2)

Monerans (Bacteria)

Monerans are tiny organisms that consist of a single cell. Moneran cells are different from all other cells because they lack a nucleus and certain other cell structures. At one time the term bacteria was used to describe only a certain kind of moneran. But today all monerans are considered to be bacteria.

Bacteria are among the most numerous organisms on Earth. Scientists estimate that there are about 2.5 billion bacteria in a gram of garden soil. And the total number of bacteria living in your mouth is greater than the number of people who have ever lived.

With so many billions of bacteria out there they are quite varied. They may be rod shaped like a medicine capsule, round as a marble, coiled like a stretched spring, round and stalked like a candied apple on a stick, or completely shapeless. As varied are their sizes so are their colors. They come in reds, yellows, blues and violets. Some bacteria live alone as single cells. Others live in groups of cells that are attached to one another.

Bacteria are found in water, air, soil, and the bodies of larger organisms. In fact, bacteria live almost everywhere, even in places where other living things cannot survive. For example, some bacteria live in volcanic vents at the bottom of the ocean, where the temperature is two and one-half times the temperature of boiling water.

Bacteria are considered the simplest organisms. However, bacteria are more complex than you might realize. Each bacteria cell performs the same functions that more complex organisms, including you, perform.

One of the most noticeable features of a bacterium is the cell wall. The cell wall is a tough, rigid structure that surrounds, supports, shapes, and protects the cell. Almost all bacteria have a cell wall. In some bacteria, there is a coating over the cell wall. This coating is called the capsule. Inside the cell wall is the cell membrane. The cell membrane controls which substances enter and leave the cell. Within the cell membrane is the cytoplasm. The cytoplasm is a jellylike mixture that makes up most of the cell. Since the moneran or bacteria has no nucleus, the hereditary material is in the cytoplasm.

Many bacteria are not able to move on their own. They can be carried from one place to another place by air and water currents, clothing, and other objects. Other bacteria have special structures that help them move in watery surroundings. One such structure is a flagellum. A flagellum is a long, thin, whip like structure that propels bacteria through its environment. Some may have many flagella

Bacteria have more different ways of getting the energy they need to live that any other kingdom of organisms. In fact, bacteria obtain energy in more ways than all of the other kingdoms put together. Many bacteria are heterotrophs. A heterotroph cannot make its own food. Some bacteria feed on living organisms. These bacteria are parasites. Other bacteria feed on dead organisms. These bacteria are called decomposers. Decomposers break down dead organism into simpler substances. In this process, they return important materials to the soil and water.

Bacteria are very helpful to people in many ways. They are used to make cucumbers into pickles. They are also used to make cabbage into sauerkraut. Milk becomes cheese because of the amount of bacteria. Bacteria are helpful to plants, too. In fact, plants would not be able to live without the help of bacteria.

Along with being helpful, bacteria can also be harmful. The trouble comes in a number of forms. Some harmful bacteria can spoil food or poison water supplies. Others damage property or disrupt manufacturing processes. Still others cause disease in people, pets, livestock, and food crops.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX J (1)

Protists

Protists are another group of one-celled organisms. They are not monerans because they have a nucleus in their cells. Yet they are neither plants nor animals. In a way, the protist kingdom is a catchall kingdom. It is made up of organisms that do not clearly fit into any other kingdom. Simply put, protists are defined as single-celled organisms that contain a nucleus.

Most protists live in a watery environment. They can be found in the salty ocean and in bodies of fresh water. Some protists live in moist soil. Others live inside larger organisms. Many of these internal protists are parasites. But some of the protists that live inside other organisms help their hosts.

Protists generally live as individual cells, but some live in colonies. A protist colony consists of a number of relatively independent cells of the same species that are attached to one another. Along with this difference in how they live, protists also vary in their appearance and the ways in which they carry out their life functions. For example, some protists are autotrophs while others are heterotrophs. Some can even be both depending on their surroundings.

Protists can be grouped in three general categories: animal like protists, plantlike protists, and fungus like protists.

Animal like protists are sometimes know as protozoans, which means first animals. Long ago, these organisms were classified as animals because they have several characteristics in common with animals. Their cells contain a nucleus and lack a cell wall. They are heterotrophs. Most of them can move. Animal like protists are divided into four main groups. These four groups are the sarcodines, the ciliates, the zooflagellates, and the sporozoans.

Sarcodines are organisms with extensions of the cell membrane and cytoplasm known as pseudopods. Psuedopods are foot like extensions that are temporary, which they use to capture and engulf particles of food. Some sarcodines use pseudopods to move from one place to another. Many sarcodines have shells that support and protect the cell. These shells come in many forms. Some resemble coins, the spiral burner of an electric stove, clusters of bubbles, and even like crystal holiday ornaments. When these protists die their shells sink to the bottom of the ocean floor and form thick layers. The shells are changed to rock, such as limestone and marble. Some are used in chalk.

The most familiar type of sarcodine is the ameba. Amebas use their psuedopods to move and to obtain food. An ameba first extends a thick, round

pseudopod from part of its cell. Then the rest of the cell flows into the pseudopod. As an ameba nears a small piece of food it extends a pseudopod around the food. Soon the food particle is completely surrounded. This process produces a bubble like structure that contains the food. This structure is called a food vacuole. The food is digested inside the food vacuole. The digested food can then be used for energy and growth. Amebas reproduce by dividing into two new cells.

Ciliates have small hair like projections called cilia on the outside of their cells. The cilia act like tiny oars and help these organisms move. The beating of the cilia also helps to sweep food toward the ciliates. In addition, the cilia function as sensors. Cilia may cover the entire surface of a ciliate or may be concentrated in certain areas. A few ciliates possess cilia only when they are young. As adults, they attach to a surface and lose their cilia.

One of the most interesting ciliates is the paramecium. A paramecium has a tough outer covering, called the pellicle. The pellicle consists of the cell membrane and other structures giving the paramecium its slipper shape. The cilia of the paramecium sweep food particles floating in the water into an indentation or notch on the side of the paramecium. This notch is called the oral groove leads to a funnel like structure called the gullet. At the base of the gullet, food vacuoles form around the incoming food. Then the food vacuoles pinch off into the cytoplasm where they are digested.

The paramecium has two kinds of nuclei, like the other ciliates. The large nucleus controls the life functions of the cell and the small nucleus is involved in a process where two ciliates join together to exchange part of their hereditary material. Paramecium reproduces by splitting in half crosswise. During this process, many cell structures are copied, divided, broken apart, and formed anew.

Zooflagellates are protists that move with one to eight flagella depending on the species. However, some zooflagellates have thousands of flagella. Many live inside the bodies of animals. They are both helpful and harmful. For example, the termite relies on the zooflagellates inside it to help to digest the wood it eats, without these protists the termite would starve. A parasitic zooflagellate causes African sleeping sickness, which is transmitted through the bite of the tsetse fly. Others cause various types of diseases of the intestines.

Sporozoans are parasites that feed on the cells and body fluids of their host animals. Many have more than one host during their life cycle. During these life cycles the form cells known as spores. The spores enable them to pass from one host to another. How does this happen? A new host may become infected with the sporozoans if it eats food containing the spores. Or it may become infected if a tick, mosquito, or other animal that has spores in its body bites it.

Like other protists, plantlike protists are unicellular and most of them are capable of movement. Like plants, plantlike protists are autotrophs that use light energy to make their own food from simple raw materials. In addition to capturing energy and making it available to other organisms in the form of food, plantlike protists play another important role in the world. They produce oxygen as a byproduct of their food making process. About 70 percent of the Earth's supply of oxygen is produced by plantlike protists. Most plantlike protists are flagellates, meaning they move with flagella. There are many different kinds of plantlike protists but we will talk about the three more interesting ones. They are euglenas, diatoms, and dinoflagellates.

Euglenas come in a variety of forms. Some are long and oval. Others are shaped like triangles, hearts or tops. Although euglenas are quite varied most share three characteristics: a pouch that holds two flagella, a reddish eyespot, and a number of grass green structures that are used in the food making process.

Diatoms are among the most numerous protists. There are about 10,000 living species of these water organisms. Each diatom is enclosed in a two part glassy shell. The shell looks like a tiny glass box with one side fitting snuggly into the other. The two parts of the shell are covered with beautiful patterns of tiny ridges, spines, and/or holes. When diatoms die, their glassy shells remain. They are used as a powdery material that makes an excellent polishing agent, an important ingredient in toothpastes and car polish. It is also added to the paint used to make traffic lanes because it reflects light.

Dinoflagellates have cell walls that look like plates of armor. They also have two flagella that propel them through the water. One flagellum trails at the end like a tail and the other wraps around the middle of the organism like a belt. The movement of this flagellum causes the dinoflagellate to spin like a tiny top. Dinoflagellates cause red tides when they reproduce so rapidly that the water becomes colored with them. These red tides kill all fish and plants.

Fungus like protists are important but it is not clear exactly what they are. But scientists do know about their characteristics. Fungus like protists is heterotrophs. Most have cell wall and some have flagella at some point in their life. One of the more interesting types of fungus like protists is the slime mold. At one point in their life cycle, these protists are moist, flat, shapeless, blobs that ooze slowly over dead trees, piles of fallen leaves, and compost heaps. Reproduction in slime molds involves the production of a structure called a fruiting body, which contains spores. Each spore can develop into a new organism.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX J (2)

Protists

Protists are another group of one-celled organisms. They are not monerans because they have a nucleus in their cells. Yet they are neither plants nor animals. In a way, the protist kingdom is a catchall kingdom. It is made up of organisms that do not clearly fit into any other kingdom. Simply put, protists are defined as single-celled organisms that contain a nucleus.

Most protists live in a watery environment. They can be found in the salty ocean and in bodies of fresh water. Some protists live in moist soil. Others live inside larger organisms. Many of these internal protists are parasites. But some of the protists that live inside other organisms help their hosts.

Protists generally live as individual cells, but some live in colonies. A protist colony consists of a number of relatively independent cells of the same species that are attached to one another. Along with this difference in how they live, protists also vary in their appearance and the ways in which they carry out their life functions. For example, some protists are autotrophs while others are heterotrophs. Some can even be both depending on their surroundings.

Protists can be grouped in three general categories: animal like protists, plantlike protists, and fungus like protists.

Animal like protists are sometimes know as protozoans, which means first animals. Long ago, these organisms were classified as animals because they have several characteristics in common with animals. Their cells contain a nucleus and lack a cell wall. They are heterotrophs. Most of them can move. Animal like protists are divided into four main groups. These four groups are the sarcodines, the ciliates, the zooflagellates, and the sporozoans.

Sarcodines are organisms with extensions of the cell membrane and cytoplasm known as pseudopods. Psuedopods are foot like extensions that are temporary, which they use to capture and engulf particles of food. Some sarcodines use pseudopods to move from one place to another. Many sarcodines have shells that support and protect the cell. These shells come in many forms. Some resemble coins, the spiral burner of an electric stove, clusters of bubbles, and even like crystal holiday ornaments. When these protists die their shells sink to the bottom of the ocean floor and form thick layers. The shells are changed to rock, such as limestone and marble. Some are used in chalk.

The most familiar type of sarcodine is the ameba. Amebas use their psuedopods to move and to obtain food. An ameba first extends a thick, round

pseudopod from part of its cell. Then the rest of the cell flows into the pseudopod. As an ameba nears a small piece of food it extends a pseudopod around the food. Soon the food particle is completely surrounded. This process produces a bubble like structure that contains the food. This structure is called a food vacuole. The food is digested inside the food vacuole. The digested food can then be used for energy and growth. Amebas reproduce by dividing into two new cells.

Ciliates have small hair like projections called cilia on the outside of their cells. The cilia act like tiny oars and help these organisms move. The beating of the cilia also helps to sweep food toward the ciliates. In addition, the cilia function as sensors. Cilia may cover the entire surface of a ciliate or may be concentrated in certain areas. A few ciliates possess cilia only when they are young. As adults, they attach to a surface and lose their cilia.

One of the most interesting ciliates is the paramecium. A paramecium has a tough outer covering, called the pellicle. The pellicle consists of the cell membrane and other structures giving the paramecium its slipper shape. The cilia of the paramecium sweep food particles floating in the water into an indentation or notch on the side of the paramecium. This notch is called the oral groove leads to a funnel like structure called the gullet. At the base of the gullet, food vacuoles form around the incoming food. Then the food vacuoles pinch off into the cytoplasm where they are digested.

The paramecium has two kinds of nuclei, like the other ciliates. The large nucleus controls the life functions of the cell and the small nucleus is involved in a process where two ciliates join together to exchange part of their hereditary material. Paramecium reproduces by splitting in half crosswise. During this process, many cell structures are copied, divided, broken apart, and formed anew.

Zooflagellates are protists that move with one to eight flagella depending on the species. However, some zooflagellates have thousands of flagella. Many live inside the bodies of animals. They are both helpful and harmful. For example, the termite relies on the zooflagellates inside it to help to digest the wood it eats, without these protists the termite would starve. A parasitic zooflagellate causes African sleeping sickness, which is transmitted through the bite of the tsetse fly. Others cause various types of diseases of the intestines.

Sporozoans are parasites that feed on the cells and body fluids of their host animals. Many have more than one host during their life cycle. During these life cycles the form cells known as spores. The spores enable them to pass from one host to another. How does this happen? A new host may become infected with the sporozoans if it eats food containing the spores. Or it may become infected if a tick, mosquito, or other animal that has spores in its body bites it.

Like other protists, plantlike protists are unicellular and most of them are capable of movement. Like plants, plantlike protists are autotrophs that use light energy to make their own food from simple raw materials. In addition to capturing energy and making it available to other organisms in the form of food, plantlike protists play another important role in the world. They produce oxygen as a byproduct of their food making process. About 70 percent of the Earth's supply of oxygen is produced by plantlike protists. Most plantlike protists are flagellates, meaning they move with flagella. There are many different kinds of plantlike protists but we will talk about the three more interesting ones. They are euglenas, diatoms, and dinoflagellates.

Euglenas come in a variety of forms. Some are long and oval. Others are shaped like triangles, hearts or tops. Although euglenas are quite varied most share three characteristics: a pouch that holds two flagella, a reddish eyespot, and a number of grass green structures that are used in the food making process.

Diatoms are among the most numerous protists. There are about 10,000 living species of these water organisms. Each diatom is enclosed in a two part glassy shell. The shell looks like a tiny glass box with one side fitting snuggly into the other. The two parts of the shell are covered with beautiful patterns of tiny ridges, spines, and/or holes. When diatoms die, their glassy shells remain. They are used as a powdery material that makes an excellent polishing agent, an important ingredient in toothpastes and car polish. It is also added to the paint used to make traffic lanes because it reflects light.

Dinoflagellates have cell walls that look like plates of armor. They also have two flagella that propel them through the water. One flagellum trails at the end like a tail and the other wraps around the middle of the organism like a belt. The movement of this flagellum causes the dinoflagellate to spin like a tiny top. Dinoflagellates cause red tides when they reproduce so rapidly that the water becomes colored with them. These red tides kill all fish and plants.

Fungus like protists are important but it is not clear exactly what they are. But scientists do know about their characteristics. Fungus like protists are heterotrophs. Most have cell wall and some have flagella at some point in their life. One of the more interesting types of fungus like protists is the slime mold. At one point in their life cycle, these protists are moist, flat, shapeless, blobs that ooze slowly over dead trees, piles of fallen leaves, and compost heaps. Reproduction in slime molds involves the production of a structure called a fruiting body, which contains spores. Each spore can develop into a new organism.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX K (1)

Fungus

Fungi range in size from tiny unicellular yeasts to huge tree fungus over 140 centimeters long. Fungi may look like wisps of gray cotton, white volleyballs, tiny brightly colored umbrellas, blobs of melted wax, stubby fingers of yellow-green slime, or miniature red bowls. Although fungi come in a variety of shapes, sizes and colors, they share many important characteristics. They are similar in the way they get their food, in their structure, and in the way they reproduce.

Fungi are all heterotrophs. They obtain the energy and chemicals they need by growing on a source of food. Fungi release these chemicals on the food they are growing and then absorb the digested food. Many species of fungi get their food from the remains of dead organisms. These fungi are decomposers. A few fungi, such as yeasts used by bakers, are unicellular. Most, however are multicellular. Multicellular fungi are made up of threadlike tubes called hyphae. the hyphae branch and weave together in various ways to produce the many shapes of fungi. The hyphae of fungi are continuous threads of cytoplasm that contain many nuclei.

Many fungi reproduce by means of spores. Fungal spores are tiny reproductive cells that are enclosed in a protective cell wall. Since spores are light in weight they can be carried by the wind. If a spore lands in a place where the growing conditions are right, it can sprout and develop hyphae. Fungi produce spores in a special structure called the fruiting body.

Even fungi are classified into groups, however these are not formal classification groups they are based on the basic form, or shape of the fungus. There are three basic forms of fungi: mushrooms, yeasts, and molds. Mushrooms are shaped like umbrellas. There are many kinds of mushrooms. Never eat any you find outdoors. Many poisonous fungi look just like the kind you find in grocery stores. One bite of some kinds of mushrooms can be deadly.

Yeasts consist of single cells. They are used in making bread. The yeast cells feed on the sugar in the bread dough which creates bubbles pushing up the

bread. Yeasts reproduce differently than other fungi, in a process called budding. During budding, a portion of the yeast cell pushes out of the cell well and forms a tiny bud. In time the bud breaks away from the parent cell and becomes new yeast.

Molds are fuzzy, shapeless, fairly flat fungi that grow on the surface of an object. Molds like dark warm places. Perhaps you have found mold on old bread or fruit. Molds are used to make many foods, such as tofu, soy sauce, and cheeses. Not all are used for food some are used in medicines, like penicillin.

Fungi can also be harmful to humans. There are plant diseases that damage crops. Among the plant diseases are wheat rust and corn smut. Most fungal diseases are associated with plants there are a few that cause disease in humans. Among the more familiar conditions caused by fungi are athlete's foot, ringworm, and thrush.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX K (2)

Fungus

Fungi range in size from tiny unicellular yeasts to huge tree fungus over 140 centimeters long. Fungi may look like wisps of gray cotton, white volleyballs, tiny brightly colored umbrellas, blobs of melted wax, stubby fingers of yellow-green slime, or miniature red bowls. Although fungi come in a variety of shapes, sizes and colors, they share many important characteristics. They are similar in the way they get their food, in their structure, and in the way they reproduce.

Fungi are all heterotrophs. They obtain the energy and chemicals they need by growing on a source of food. Fungi release these chemicals on the food they are growing and then absorb the digested food. Many species of fungi get their food from the remains of dead organisms. These fungi are decomposers. A few fungi, such as yeasts used by bakers, are unicellular. Most, however are multicellular. Multicellular fungi are made up of threadlike tubes called hyphae. the hyphae branch and weave together in various ways to produce the many shapes of fungi. The hyphae of fungi are continuous threads of cytoplasm that contain many nuclei.

Many fungi reproduce by means of spores. Fungal spores are tiny reproductive cells that are enclosed in a protective cell wall. Since spores are light in weight they can be carried by the wind. If a spore lands in a place where the growing conditions are right, it can sprout and develop hyphae. Fungi produce spores in a special structure called the fruiting body. SHOW STUDENTS SAMPLE OF SPREADING SPORES. (Procedure Step 12 if making with students or just pop the balloon.)

Even fungi are classified into groups, however these are not formal classification groups they are based on the basic form, or shape of the fungus. There are three basic forms of fungi: mushrooms, yeasts, and molds. Mushrooms are shaped like umbrellas. There are many kinds of mushrooms. Never eat any you find outdoors. Many poisonous fungi look just like the kind you find in grocery stores. One bite of some kinds of mushrooms can be deadly.

Yeasts consist of single cells. They are used in making bread. The yeast cells feed on the sugar in the bread dough which creates bubbles pushing up the

bread. Yeasts reproduce differently than other fungi, in a process called budding. During budding, a portion of the yeast cell pushes out of the cell well and forms a tiny bud. In time the bud breaks away from the parent cell and becomes new yeast.

Molds are fuzzy, shapeless, fairly flat fungi that grow on the surface of an object. Molds like dark warm places. Perhaps you have found mold on old bread or fruit. Molds are used to make many foods, such as tofu, soy sauce, and cheeses. Not all are used for food some are used in medicines, like penicillin.

Fungi can also be harmful to humans. There are plant diseases that damage crops. Among the plant diseases are wheat rust and corn smut. Most fungal diseases are associated with plants there are a few that cause disease in humans. Among the more familiar conditions caused by fungi are athlete's foot, ringworm, and thrush.

(Adapted from: Maton, A. *Parade of Life: Monerans, Protists, Fungi and Plants.* Upper Saddle River, New Jersey: Prentice Hall, 1997. ISBN 0-13-423252-6)

APPENDIX K (3)

Name: _____ Date: _____

Fungus Worksheet

Sequence the events in the life cycle of a fungus.
_____ Mature spores are released.

_____ Hyphae begin to grow from spore.

_____ Spores are carried by wind to a new location.

_____ Egg shaped fruiting body grows upward from hyphae.

How do fungi obtain energy and nutrients?

True or False
___Most fungi are made up of threadlike structures know as fruiting bodies.

___Molds produce a medicine called penicillin.

___The three basic forms of fungi are mushrooms, molds, and mildews.

Most fungi reproduce by means of _____.

Yeasts consist of_____.

Fungi that get their food from the remains of dead organisms are called _____.

Fungi produce spores in structures called _____.

The blue-green fungus on your leftovers is probably a _____.

APPENDIX K (4)

Name: ___ANSWER KEY_____ Date: _____

Fungus Worksheet

Sequence the events in the life cycle of a fungus.
__3__ Mature spores are released.

__1__ Hyphae begin to grow from spore.

__4__ Spores are carried by wind to a new location.

__2__ Egg shaped fruiting body grows upward from hyphae.

How do fungi obtain energy and nutrients?

BY GROWING ON A SOURCE OF FOOD THEY RELEASE CHEMICALS ON THE FOOD THEY ARE GROWING AND THEN ABSORB THE DIGESTED FOOD.

True or False
_F_Most fungi are made up of threadlike structures know as fruiting bodies.

_T_Molds produce a medicine called penicillin.

_F_The three basic forms of fungi are mushrooms, molds, and mildews.

Most fungi reproduce by means of ___SPORES_____.

Yeasts consist of___SINGLE CELLS_____.

Fungi that get their food from the remains of dead organisms are called _DECOMPOSERS____.

Fungi produce spores in structures called __FRUITING BODIES_____.

The blue-green fungus on your leftovers is probably a __MOLD_____.

APPENDIX L (1)

The Study of Plants Without Seeds

The plant kingdom is huge. It includes a great deal of variety, from tiny algae floating in the water all the way up to huge redwoods. Biologists group plants in order to study them. So what is a plant? That may sound like a silly question. Everyone knows that plants are trees, bushes, grasses, and flowers. But plants have a few special characteristics. These characteristics put them in the plant kingdom.

Plants have chlorophyll in their cells. All plants make their own food by using energy from the sun. Chlorophyll is the green substance in plant cells that absorbs sunlight energy.

Plants are many-celled. Even if they have chlorophyll in their cells, one-celled organisms cannot be plants.

Plants have specialized cells. This means that each plant organism has several different kinds of cells. The different cells perform different jobs.

The cells of plants have cell walls.

Plants cannot move from place to place. That is they cannot walk, swim, or fly. Plants do move. But they stay rooted in the ground.

Like all living things, plants need food, oxygen, and water. They also need light, carbon dioxide, and minerals.

Plants need carbon dioxide for photosynthesis. They need oxygen for respiration. They get both of these gases from the air.

Plants also need light for photosynthesis. They get light from the sun. And plants get water, which is also needed for photosynthesis from the ground.

Plants make their own food. The chlorophyll in plant cells traps sunlight. Carbon dioxide from the air enters plants cells. Water is absorbed from the ground. The energy from the sunlight combines the carbon dioxide and water. The result is sugar.

Plants are very important. Chocolate comes from a bean grown on a plant. Your favorite pair of blue jeans was made from a plant. Plants may even keep your house warm. If you use a fireplace, you burn wood. Coal and gas are plant products, too. Several important drugs for curing diseases come from plants.

Almost every single thing you eat is a product of plants. That even includes steak or bacon. After all, if plants weren't carrying out photosynthesis to make food, cows and pigs would have nothing to eat. Without cows and pigs, there would be no steak or bacon.

Finally, plants give you the oxygen you need to breathe. Remember that oxygen is a by-product of photosynthesis. If some organisms, like green plants, did not give off oxygen, you would not exist at all.

The plant kingdom has two main groups besides those plants without seeds and those with seeds. One group has special cells for transporting water, food, and minerals. These cells connect to form tube-like structures. Roots absorb water. Then the water is moved up this tube like structures to other parts of the plants.

At the same time, plant leaves make food. Some of this food can be moved down the tube-like structures to feed the roots. Plants that have these structures for transporting water and food are called vascular plants. Plants that do not have these special transport cells are called nonvascular plants. Water cannot be stored or moved in nonvascular plants.

Nonvascular plants must live in places that have a constant supply of water. These plants are usually very small. Mosses and liverworts are two kinds of nonvascular plants. These are the simplest plants on land. Biologists believe that mosses were the first plants to grow on land.

You may be familiar with mosses. These green plants often form soft carpets on forest floors. Sometimes they grow on logs or on wet rocks. Mosses like wet, shady places. Shade slows the rate of moisture loss.

Mosses are very important in nature. They are among the first plants to grow in barren area. They grow rapidly, and form a great deal of organic matter in the soil. This organic matter makes the soil more suitable for more complex plants.

Mosses do not have true roots or leaves. Root-like structures on mosses cannot deliver water to the rest of the plant. And the leaf-like structures are really just sheets of cells.

But mosses are different from algae because their cells are specialized. All algae cell do the same work. In mosses, though the root-like parts are better at soaking up water than the leaf-like parts. Also, these root-like parts are underground. Only the leaf-like parts carry out photosynthesis.

Liverworts also grow in wet places. They can be found along stream banks or near springs. A liverwort looks like a leathery leaf lying flat against the ground. It has hair-like structures that anchor the plant to the ground. These hair-like structures also absorb water from the soil.

Unlike mosses and liverworts, ferns are a different kind of seedless plant. Ferns have to do a number of adaptations to life on land. For example, they have a waxy covering on their leaves that helps to prevent water loss and roots that enable them to gather water and minerals form the soil. The most important adaptations, however, involve a system of tiny tubes that transport food, water, and other materials throughout the body of the fern. These tiny tubes are known as vascular tissue. Ferns are thus called a simple vascular plant. Thanks to these vascular tissues, ferns can grow much taller than mosses or liverworts.

Ferns also have true roots, stems, and leaves. Ferns grow in woods, swamps, and gardens where there is lots of water.

The stems of ferns can be above the ground hidden by the leaves and some are underground. These grow horizontally just beneath the soil surface. The leaves of a fern are called fronds. They grow up from the stem. The roots grow down form the stem.

Ferns have an interesting way of reproducing. It happens in two stages. On the bottom of fern leaves, you will see little brown spots. These are spore cases. When these open, spores fly out. If a spore lands in a good place for growing, a small plant grows. This small plant does not look like the parent fern, however. It is a heart-shaped plant.

Then the second stage of reproduction begins. The heart-shaped plant forms sperm and egg cells. The sperm cells swim to the egg cells through dew or rainwater on the plant.

The joining of sperm and egg cells is called fertilization. A new fern plant grows from the fertilized egg.

The first stage in fern reproduction is asexual. There is only one parent cell, the spore. The second stage is sexual. There are two parent cells, the sperm and the egg.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX L (2)

The Study of Plants Without Seeds – Teacher Copy

The plant kingdom is huge. It includes a great deal of variety, from tiny algae floating the water all the way up to huge redwoods. Biologists group plants in order to study them. So what is a plant? That may sound like a silly question. Everyone knows that plants are trees, bushes, grasses, and flowers. But plants have a few special characteristics. These characteristics put them in the plant kingdom.

Plants have chlorophyll in their cells. All plants make their own food by using energy from the sun. Chlorophyll is the green substance in plant cells that absorbs sunlight energy.

Plants are many-celled. Even if they have chlorophyll in their cells, one-celled organisms cannot be plants.

Plants have specialized cells. This means that each plant organism has several different kinds of cells. The different cells perform different jobs.

The cells of plants have cell walls.

Plants cannot move from place to place. That is they cannot walk, swim, or fly. Plants do move. But they stay rooted in the ground.

Like all living things, plants need food, oxygen, and water. They also need light, carbon dioxide, and minerals.

Plants need carbon dioxide for photosynthesis. They need oxygen for respiration. They get both of these gases from the air.

Plants also need light for photosynthesis. They get light from the sun. And plants get water, which is also needed for photosynthesis from the ground.

Plants make their own food. The chlorophyll in plant cells traps sunlight. Carbon dioxide from the air enters plants cells. Water is absorbed from the ground. The energy from the sunlight combines the carbon dioxide and water. The result is sugar.

Plants are very important. Chocolate comes from a bean grown on a plant. Your favorite pair of blue jeans was made from a plant. Plants may even keep your house warm. If you use a fireplace, you burn wood. Coal and gas are plant products, too. Several important drugs for curing diseases come from plants.

Almost every single thing you eat is a product of plants. That even includes steak or bacon. After all, if plants weren't carrying out photosynthesis to make food, cows and pigs would have nothing to eat. Without cows and pigs, there would be no steak or bacon.

Finally, plants give you the oxygen you need to breathe. Remember that oxygen is a by-product of photosynthesis. If some organisms, like green plants, did not give off oxygen, you would not exist at all.

The plant kingdom has two main groups besides those plants without seeds and those with seeds. One group has special cells for transporting water, food, and minerals. These cells connect to form tube-like structures. Roots absorb water. Then the water is moved up this tube like structures to other parts of the plants.

At the same time, plant leaves make food. Some of this food can be moved down the tube-like structures to feed the roots. Plants that have these structures for transporting water and food are called vascular plants. Plants that do not have these special transport cells are called nonvascular plants. Water cannot be stored or moved in nonvascular plants.

Nonvascular plants must live in places that have a constant supply of water. These plants are usually very small. Mosses and liverworts are two kinds of nonvascular plants. These are the simplest plants on land. Biologists believe that mosses were the first plants to grow on land.

You may be familiar with mosses. These green plants often form soft carpets on forest floors. Sometimes they grow on logs or on wet rocks. Mosses like wet, shady places. Shade slows the rate of moisture loss.

Mosses are very important in nature. They are among the first plants to grow in barren area. They grow rapidly, and form a great deal of organic matter in the soil. This organic matter makes the soil more suitable for more complex plants.

Mosses do not have true roots or leaves. Root-like structures on mosses cannot deliver water to the rest of the plant. And the leaf-like structures are really just sheets of cells.

But mosses are different from algae because their cells are specialized. All algae cell do the same work. In mosses, though the root-like parts are better at soaking up water than the leaf-like parts. Also, these root-like parts are underground. Only the leaf-like parts carry out photosynthesis.

Liverworts also grow in wet places. They can be found along stream banks or near springs. A liverwort looks like a leathery leaf lying flat against the ground. It has hair-like structures that anchor the plant to the ground. These hair-like structures also absorb water from the soil.

Unlike mosses and liverworts, ferns are a different kind of seedless plant. Ferns have to do a number of adaptations to life on land. For example, they have a waxy covering on their leaves that helps to prevent water loss and roots that enable them to gather water and minerals form the soil. The most important adaptations, however, involve a system of tiny tubes that transport food, water, and other materials throughout the body of the fern. These tiny tubes are known as vascular tissue. Ferns are thus called a simple vascular plant. Thanks to these vascular tissues, ferns can grow much taller than mosses or liverworts.

Ferns also have true roots, stems, and leaves. Ferns grow in woods, swamps, and gardens where there is lots of water.

The stems of ferns can be above the ground hidden by the leaves and some are underground. These grow horizontally just beneath the soil surface. The leaves of a fern are called fronds. They grow up from the stem. The roots grow down form the stem.

Ferns have an interesting way of reproducing. It happens in two stages. On the bottom of fern leaves, you will see little brown spots. These are spore cases. When these open, spores fly out. If a spore lands in a good place for growing, a small plant grows. This small plant does not look like the parent fern, however. It is a heart-shaped plant.

Then the second stage of reproduction begins. The heart-shaped plant forms sperm and egg cells. The sperm cells swim to the egg cells through dew or rainwater on the plant.

The joining of sperm and egg cells is called fertilization. A new fern plant grows from the fertilized egg.

The first stage in fern reproduction is asexual. There is only one parent cell, the spore. The second stage is sexual. There are two parent cells, the sperm and the egg.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX L (3)

Name: _____ Date: _____

Plants Without Seeds Worksheet

What are the five characteristics common to all plants?

What six things do plants need to live?

Name three plants you eat.

What is the difference between vascular and nonvascular plants?

How does a fern reproduce?

What is the difference between sexual and asexual reproduction?

APPENDIX L (4)

Name: *TEACHER ANSWER KEY*_____ Date: _____

Plants Without Seeds Worksheet ANSWER KEY

What are the five characteristics common to all plants?

have chlorophyll
many celled
specialized cells
cells have cell walls
cannot move from place to place

What six things do plants need to live?

food, oxygen, water, light, carbon dioxide, and minerals

Name three plants you eat.

Answers will vary

What is the difference between vascular and nonvascular plants?

Vas- has structures for transporting water and food
Non- does not have transport structures

How does a fern reproduce?

On the bottom of the fern are spores. If the spores land in the right place they produce a heart shaped plant that forms sperm and eggs cells. The sperm cells swim to the egg cells. Once joined a new plant grows.

What is the difference between sexual and asexual reproduction?
Asexual – one parent cell Sexual – two parent cells

APPENDIX M (1)

Structure of Seed Plants

Seed plants are among the most numerous plants on Earth. They are also the plants with which most people are familiar. Seed plants are vascular plants that produce seeds instead of spores. A seed is a protective covering for the first stage of a tiny new plant. The tiny new plant is called a plant embryo. Most of the seed consists of a food supply for the embryo. The food gives the embryo a quick start when conditions are right for it to grow into a full plant. Like all vascular plants, seed plants have true roots, stems, and leaves.

What are roots? Roots are one kind of plant organ. Roots are the parts of the plants that grow underground. There is usually as much root underground as there is plant above ground. Plant roots usually grow as wide as the leaves or branches above ground.

There are two kinds of roots. A taproot is one thick root. Carrots and dandelions have taproots. Fibrous roots are many smaller roots. Grasses have fibrous roots.

One important job of roots is to absorb water and minerals from the soil and transport it up to the stem of the plant. Roots are covered with tiny structures called root hairs. If you study a carrot or a radish, you will see some small root hairs, but by the time they make it to the store most have been rubbed off.

Some plants use the roots to store food. Sometimes a plant makes more sugar than it needs. This sugar is changed to a starch. The starch is stored in the roots for later use. The carrots and sweet potatoes people eat are examples of this stored starch.

What are stems? Sugar is made from the stems of sugar cane plants. Bamboo shoots, bean sprouts, and asparagus are all stems that people eat.

Stems are the parts of plants that connect roots and leaves. There are two kinds of stems. Herbaceous stems are green and soft. They do not grow very big. Tomato, daffodil, and corn plants have herbaceous stems. Woody stems are brown and hard. Tree trunks and shrubs have woody stems.

The most important job of stems is to move or transport water, minerals and food. Leaves need water delivered to them from the roots. Roots cannot carry out photosynthesis. So roots need food delivered to them from the leaves.

Xylem is a special kind of cell tissue that carries water and minerals. This tissue begins in the roots where the water and minerals are gathered. The xylem tissue delivers the water and minerals all the way up the plant. This tissue is made of long, thin tubes. It is at the center of the stems.

Another special kind of tissue carries food down the stem to the roots. This special tissue is called the phloem. The food travels in the form of sap.

Another job of stems is to hold plants upright. This keeps the leaves in a position to absorb sunlight. Not all stems are upright. You may remember that fern stems are underground. Strawberry and cucumber stems lie along the ground.

Leaves are the green structures that grow off branches and stems. People eat many kinds of leaves, such as lettuce and cabbage. There are three main parts to leaves. The broad flat part is the blade. It is connected to the plant by a thin rib called a petiole. The even thinner ribs throughout the blade are called veins.

Leaves are the food makers for plants. Most of a plant's chlorophyll is in its leaves. So the leaf's most important job is to absorb sunlight for photosynthesis that is why the leaves are broad and flat.

Leaves of plants in hot, sunny climates tend to be small. They also tend to have thick skins. This protects them from water loss. In shady, wet places, leaves tend to grow big and thin. They need to gather all the sunlight they can. And the moist air will help keep them from drying out.

Water and food move up and down plant stems. But how do important gases, such as oxygen and carbon dioxide, move into and out of the plant? Plant leaves have many tiny pores. A pore is a little opening. These pores are called stomata. The carbon dioxide necessary for photosynthesis enters the stomata from the air. By products of photosynthesis, oxygen and water vapor, leave through the stomata.

Two special cells guard each stoma. These cells are like doors to the stoma. They control the opening and closing of the stoma. When there is lots of water in the plant, these guard cells are swollen like balloons. This makes them pull back from the stoma. Water vapor can escape. Gases can come in. But if the plant is dry, the guard cells flop together. This closes the opening of the stoma. The guard cells help keep a plant from drying out too much.

Look again at photosynthesis: sunlight + water + carbon dioxide = food + oxygen. You know that the water comes from the plant roots. This is carried by xylem tissue up the plant stem to the leaves. The carbon dioxide enters the plant leaves through the stomata. Chlorophyll in the plant leaves absorbs sunlight.

The sunlight is used as energy to change the carbon dioxide and water into sugar (food). The waste oxygen leaves the plants through the stomata in the leaves. The food is used for plant growth and energy to carry out other plant jobs. Some food is delivered to the roots by the phloem tissue. Extra food is stored in roots, stems, or leaves. This surplus food is what makes the fleshy part of many of the vegetables we eat, such as potatoes and carrots.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX M (2)

Structure of Seed Plants

Seed plants are among the most numerous plants on Earth. They are also the plants with which most people are familiar. Seed plants are vascular plants that produce seeds instead of spores. A seed is a protective covering for the first stage of a tiny new plant. The tiny new plant is called a plant embryo. Most of the seed consists of a food supply for the embryo. The food gives the embryo a quick start when conditions are right for it to grow into a full plant. Like all vascular plants, seed plants have true roots, stems, and leaves.

What are roots? Roots are one kind of plant organ. Roots are the parts of the plants that grow underground. There is usually as much root underground as there is plant above ground. Plant roots usually grow as wide as the leaves or branches above ground.

There are two kinds of roots. A taproot is one thick root. Carrots and dandelions have taproots. Fibrous roots are many smaller roots. Grasses have fibrous roots.

One important job of roots is to absorb water and minerals from the soil and transport it up to the stem of the plant. Roots are covered with tiny structures called root hairs. If you study a carrot or a radish, you will see some small root hairs, but by the time they make it to the store most have been rubbed off.

Some plants use the roots to store food. Sometimes a plant makes more sugar than it needs. This sugar is changed to a starch. The starch is stored in the roots for later use. The carrots and sweet potatoes people eat are examples of this stored starch.

What are stems? Sugar is made from the stems of sugar cane plants. Bamboo shoots, bean sprouts, and asparagus are all stems that people eat.

Stems are the parts of plants that connect roots and leaves. There are two kinds of stems. Herbaceous stems are green and soft. They do not grow very big. Tomato, daffodil, and corn plants have herbaceous stems. Woody stems are brown and hard. Tree trunks and shrubs have woody stems.

The most important job of stems is to move or transport water, minerals and food. Leaves need water delivered to them from the roots. Roots cannot carry out photosynthesis. So roots need food delivered to them from the leaves.

Xylem is a special kind of cell tissue that carries water and minerals. This tissue begins in the roots where the water and minerals are gathered. The xylem tissue delivers the water and minerals all the way up the plant. This tissue is made of long, thin tubes. It is at the center of the stems.

Another special kind of tissue carries food down the stem to the roots. This special tissue is called the phloem. The food travels in the form of sap.

Another job of stems is to hold plants upright. This keeps the leaves in a position to absorb sunlight. Not all stems are upright. You may remember that fern stems are underground. Strawberry and cucumber stems lie along the ground.

Leaves are the green structures that grow off branches and stems. People eat many kinds of leaves, such as lettuce and cabbage. There are three main parts to leaves. The broad flat part is the blade. It is connected to the plant by a thin rib called a petiole. The even thinner ribs throughout the blade are called veins.

Leaves are the food makers for plants. Most of a plant's chlorophyll is in its leaves. So the leaf's most important job is to absorb sunlight for photosynthesis that is why the leaves are broad and flat.

Leaves of plants in hot, sunny climates tend to be small. They also tend to have thick skins. This protects them from water loss. In shady, wet places, leaves tend to grow big and thin. They need to gather all the sunlight they can. And the moist air will help keep them from drying out.

Water and food move up and down plant stems. But how do important gases, such as oxygen and carbon dioxide, move into and out of the plant? Plant leaves have many tiny pores. A pore is a little opening. These pores are called stomata. The carbon dioxide necessary for photosynthesis enters the stomata from the air. By products of photosynthesis, oxygen and water vapor, leave through the stomata.

Two special cells guard each stoma. These cells are like doors to the stoma. They control the opening and closing of the stoma. When there is lots of water in the plant, these guard cells are swollen like balloons. This makes them pull back from the stoma. Water vapor can escape. Gases can come in. But if the plant is dry, the guard cells flop together. This closes the opening of the stoma. The guard cells help keep a plant from drying out too much.

Look again at photosynthesis: sunlight + water + carbon dioxide = food + oxygen. You know that the water comes from the plant roots. This is carried by xylem tissue up the plant stem to the leaves. The carbon dioxide enters the plant leaves through the stomata. Chlorophyll in the plant leaves absorbs sunlight.

The sunlight is used as energy to change the carbon dioxide and water into sugar (food). The waste oxygen leaves the plants through the stomata in the leaves. The food is used for plant growth and energy to carry out other plant jobs. Some food is delivered to the roots by the phloem tissue. Extra food is stored in roots, stems, or leaves. This surplus food is what makes the fleshy part of many of the vegetables we eat, such as potatoes and carrots.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX M (3)

Photosynthesis Song

To the tune of "Oh My Darling, Clementine"

Here's a story
Of photosynthesis.
It's how green plants make their food.
It's amazing and exciting
I know this so well

First the sun shines
On the stoma
And they let in CO2.
Next the root hairs pull in water
It goes up the xylem.

Next the chlorophyll
Absorbs sun's energy.
And they work together well.
Then the CO2 and the water,
Change to oxygen and food.

The oxygen is let out
By stomata in the leaves
The phloem
Moves the glucose
To be stored inside the roots

This was all about
Photosynthesis.
How green plants make their food.
It's amazing and exciting
I'm so smart, can you tell?

(Taken from Tamie Berg, 5th Grade, Liberty Common School, Fort Collins, CO)

APPENDIX N (1)

Life Cycle of Seed Plants

The seed plants are divided into two groups: cone bearing and flowering plants. Cone-bearing plants are usually evergreen tree. Pines, firs, redwoods, and spruces are all cone-bearers. Most of these trees have needles for leaves. The seeds of these plants are found in the cones. Flowering plants produce seeds inside a fruit. Daisies, grass, corn, lemon trees, and maple trees are all flowering plants.

A seed becomes a plant by a process called germination. When a seed germinates, the embryo inside it starts developing and growing. To do this, the seed needs the right temperature and moisture. And it needs enough oxygen. Special chemicals in the seed tell it when it is time to germinate. Once the plant grows we can move to the next step of the life cycle.

The reproductive structures of seed plants are known as cones and flowers. Female cones and flower parts contain structures called ovules, which contain the egg. Male cone and flower parts produce tiny grains of pollen, which house the sperm. For reproduction to take place, a sperm cell and egg cell must join. This means that a pollen grain must somehow get to the ovule. The way this happens is called pollination.

Wind can play a big part in pollination. Pollen grains are light and dusty. Wind knocks them off and they land by the ovule. Animals also help in pollinating plants. Bees, butterflies, moths, birds, land on the part where pollen is and carry it to the ovule of the other plant. This is called cross-pollination. Plants can also self-pollinate. This happens when the pollen from a plant lands on the same plant.

If everything goes right, pollination is followed by fertilization. This is where the sperm cell joins with the egg cell. Soon a seed begins to grow. If all seeds fell right under the parent plant, they would have a hard time growing. They would be too crowded. They would die for lack of water, sunlight and nutrients.

However, many seeds have special ways of getting some distance away from the parent plant. Fruits play a big part in this. Animals often gather fruits and carry them away to eat. They may be far away before the seeds are dropped. The wind also carries seeds away. Other seeds attach to people's clothing or to animal fur. For this reason, plants produce many, many seeds. Only a few grow into new plants. If the seed lands in the right spot, it will grow into a new plant and the cycle is complete.

All seed plants reproduce sexually. However, some can also reproduce asexually. Some trees send up suckers from the roots. These are new shoots that grow straight out of the roots. They form new young trees.

Strawberry plants produce runners. These are stems that grow along the ground. Sometimes a runner grows roots. A new strawberry plant begins growing where the roots are. Mint plants have underground runners. In this way, mint plants reproduce very quickly.

Some plants grow from bulbs. Bulbs are plant stems with stored food. An onion is a bulb. Many flowers such as tulips grow from bulbs.

Another way for plants to reproduce asexually is from cuttings. A cutting is a part of a plant stem or a leaf. It is cut off a plant and put in water. The cutting will grow roots and become a new plant.

Plants that are produced asexually are exactly like the parent plant. They have the same genetic makeup. For this reason, asexual reproduction is an important tool for farmers and gardeners. They are able to keep the high quality of a plant by taking cuttings to make more of the high quality plant.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX N (2)

Life Cycle of Seed Plants

The seed plants are divided into two groups: cone bearing and flowering plants. Cone-bearing plants are usually evergreen tree. Pines, firs, redwoods, and spruces are all cone-bearers. Most of these trees have needles for leaves. The seeds of these plants are found in the cones. Flowering plants produce seeds inside a fruit. Daisies, grass, corn, lemon trees, and maple trees are all flowering plants.

A seed becomes a plant by a process called germination. When a seed germinates, the embryo inside it starts developing and growing. To do this, the seed needs the right temperature and moisture. And it needs enough oxygen. Special chemicals in the seed tell it when it is time to germinate. Once the plant grows we can move to the next step of the life cycle.

The reproductive structures of seed plants are known as cones and flowers. Female cones and flower parts contain structures called ovules, which contain the egg. Male cone and flower parts produce tiny grains of pollen, which house the sperm. For reproduction to take place, a sperm cell and egg cell must join. This means that a pollen grain must somehow get to the ovule. The way this happens is called pollination.

Wind can play a big part in pollination. Pollen grains are light and dusty. Wind knocks them off and they land by the ovule. Animals also help in pollinating plants. Bees, butterflies, moths, birds, land on the part where pollen is and carry it to the ovule of the other plant. This is called cross-pollination. Plants can also self-pollinate. This happens when the pollen from a plant lands on the same plant.

If everything goes right, pollination is followed by fertilization. This is where the sperm cell joins with the egg cell. Soon a seed begins to grow. If all seeds fell right under the parent plant, they would have a hard time growing. They would be too crowded. They would die for lack of water, sunlight and nutrients.

However, many seeds have special ways of getting some distance away from the parent plant. Fruits play a big part in this. Animals often gather fruits and carry them away to eat. They may be far away before the seeds are dropped. The wind also carries seeds away. Other seeds attach to people's clothing or to animal fur. For this reason, plants produce many, many seeds. Only a few grow into new plants. If the seed lands in the right spot, it will grow into a new plant and the cycle is complete.

All seed plants reproduce sexually. However, some can also reproduce asexually. Some trees send up suckers from the roots. These are new shoots that grow straight out of the roots. They form new young trees.

Strawberry plants produce runners. These are stems that grow along the ground. Sometimes a runner grows roots. A new strawberry plant begins growing where the roots are. Mint plants have underground runners. In this way, mint plants reproduce very quickly.

Some plants grow from bulbs. Bulbs are plant stems with stored food. An onion is a bulb. Many flowers such as tulips grow from bulbs.

Another way for plants to reproduce asexually is from cuttings. A cutting is a part of a plant stem or a leaf. It is cut off a plant and put in water. The cutting will grow roots and become a new plant.

Plants that are produced asexually are exactly like the parent plant. They have the same genetic makeup. For this reason, asexual reproduction is an important tool for farmers and gardeners. They are able to keep the high quality of a plant by taking cuttings to make more of the high quality plant.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX N (3)

Life Cycle of a Plant

Start slow and get faster – do several times

Germination – Hand growing out of other hand (like a flower)

Pollination – Fist in air, other hand sprinkles invisible pollen on other hand

Fertilization – Two fists meet (represents the egg and the sperm joining)

Seed dispersal – Shake hand in front of you as if feeding grain to chickens

(Taken form Tamie Berg, 5th Grade, Liberty Common School, Fort Collins, CO)

APPENDIX O (1)

Parts of a Flower

Some flowers are much more showy than others. Roses, cherry blossoms, and irises are all examples of bright, beautiful flowers. Grasses, on the other hand, have flowers you cannot even see. The job of flowers, whether showy or not, is to help reproduce the plant. As you read about the typical parts of a flower, keep in mind that the descriptions do not apply to all flowers. For example, some flowers have only male reproductive parts, and some lack petals.

When a flower is still a bud, it is enclosed by leaf like structures called sepals. Sepals protect the developing flower. Once the sepals fold back and the flower opens, colorful leaf like structures called petals are revealed. The colors, shapes and odors of the petals attract insects and other animals. These creatures play a vital role in the reproduction of flowering plants.

Within the petals are the flower's reproductive organs. Petals can be groups of three, called monocots or in groups of fours or fives, called dicots. The thin stalks topped by small knobs are the male reproductive organs, or stamens. The stalk-like part of the stamen is called the filament, and the knob like part is called the anther. The anther produces pollen.

The female reproductive organs, or pistils, are found in the center of the flower. Some flowers have two or more pistils; others have only one. The pistil has two parts the sticky top is the stigma and the hollow stick leading to a fat part is the style. The fat part at the bottom of the pistil is the plant ovary. The ovary contains the egg cells.

Besides the parts of the flower, flowers tend to fall into three groups based on how long it takes them to produce flowers and how long they live. The three groups are annuals, biennials, and perennials. Annuals are plants that complete their life cycle within one growing season. Plants that complete their life cycle in two years are called biennials. Still others live for more growing seasons. Plants that live for many years are called perennials.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX O (2)

Parts of a Flower

Some flowers are much more showy than others. Roses, cherry blossoms, and irises are all examples of bright, beautiful flowers. Grasses, on the other hand, have flowers you cannot even see. The job of flowers, whether showy or not, is to help reproduce the plant. As you read about the typical parts of a flower, keep in mind that the descriptions do not apply to all flowers. For example, some flowers have only male reproductive parts, and some lack petals.

When a flower is still a bud, it is enclosed by leaf like structures called sepals. Sepals protect the developing flower. Once the sepals fold back and the flower opens, colorful leaf like structures called petals are revealed. The colors, shapes and odors of the petals attract insects and other animals. These creatures play a vital role in the reproduction of flowering plants.

Within the petals are the flower's reproductive organs. Petals can be groups of three, called monocots or in groups of fours or fives, called dicots. The thin stalks topped by small knobs are the male reproductive organs, or stamens. The stalk-like part of the stamen is called the filament, and the knob like part is called the anther. The anther produces pollen.

The female reproductive organs, or pistils, are found in the center of the flower. Some flowers have two or more pistils; others have only one. The pistil has two parts the sticky top is the stigma and the hollow stick leading to a fat part is the style. The fat part at the bottom of the pistil is the plant ovary. The ovary contains the egg cells.

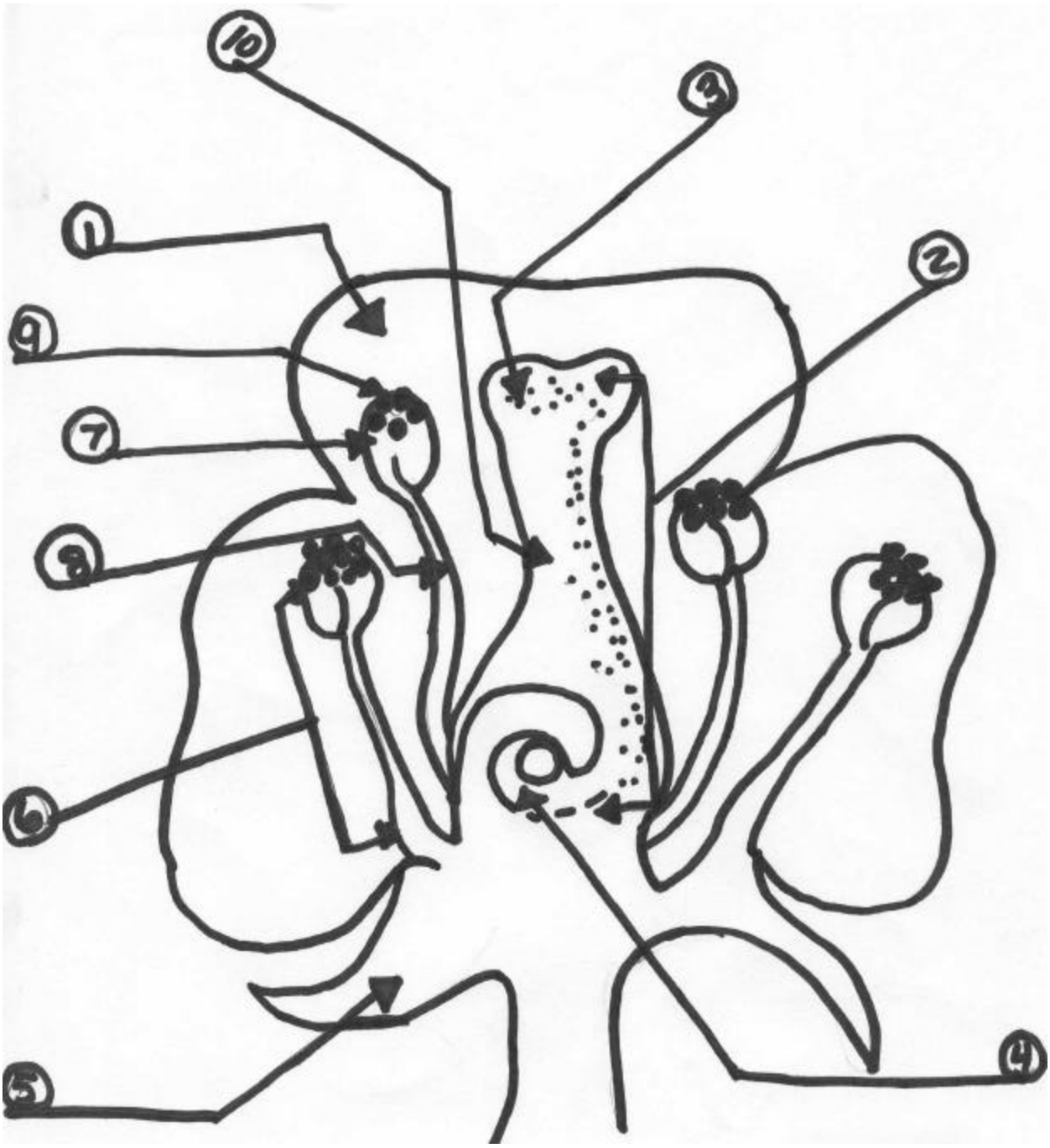
Besides the parts of the flower, flowers tend to fall into three groups based on how long it takes them to produce flowers and how long they live. The three groups are annuals, biennials, and perennials. Annuals are plants that complete their life cycle within one growing season. Plants that complete their life cycle in two years are called biennials. Still others live for more growing seasons. Plants that live for many years are called perennials.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX O (3)

Name: _____ Date: _____

Parts of A Flower



APPENDIX O (4)

Name: __TEACHER KEY_____ Date: _____

Parts of A Flower

1. PETAL
2. PISTIL
3. STIGMA
4. OVARY
5. SEPAL
6. STAMEN
7. ANTHER
8. FILAMENT
9. POLLEN
10. STYLE

APPENDIX P (1)

Invertebrates

The animal kingdom has two main characteristics. First, all animals have many cells. These cells are specialized. Second, animals all get their energy by eating other organisms. Animals cannot make their own food. So, animals must be able to move around.

The animal kingdom is broken into two main groups. The first group is made of animals without backbones. Animals with no backbones are called invertebrates. Jellyfish, worm, starfish, snails, octopuses, insects, and spiders are all invertebrates. Animals that have backbones are called vertebrates. Vertebrate animals are usually more complex than invertebrate animals. Fishes, birds, bears, lizards, snakes, squirrels, and monkeys are all vertebrates.

Sponges are the simplest kind of animal. They have a few kinds of specialized cells. Sponges are able to reproduce in a special asexual way. One sponge can be cut into ten pieces. Each of those pieces becomes a new sponge. Sponges also reproduce sexually. The offspring swim away from the parent and find another rock to attach to.

Jellyfish, sea anemones, and coral belong to another group of invertebrates called hollow-bodied animals. They are all alike in that their bodies are big sacks. This big sack has one opening, a mouth. Surrounding the mouth of the jellyfish are tentacles. These are like arms but they have stingers. Corals are different in that they have a hard covering called an exoskeleton.

All worm are invertebrates. There are three groups: flatworms, roundworms, and segmented worms. Most flatworms are parasites. A tapeworm is a common type of flatworm. Roundworms have simple digestive systems and a well-developed nervous system. The common earthworm is a segmented worm. Its body is divided into 100 to 180 ring-like segments. Earthworms move by means of muscles. Tiny bristles on their skin make moving in soil easier. These animals are much more developed than flatworms or roundworms. Earthworms have a head, tail, mouth, intestines, blood, nerves, and even a tiny brain.

Starfish, sea urchins, and sand dollars all belong to another group of animals called spiny-skinned animals. They all live in the ocean. They have thin delicate skins. The skin is covered with spines. Starfish have tube feet. They use these to hold onto rocks. They also use them to open clams as food. Once a starfish has opened a shellfish, it does something unusual. It opens its mouth and pushes out it stomach. The stomach goes into the shell and digests the food. Then the starfish swallows its own stomach again.

Mollusks can be very tasty food for people. Clams, oysters, squid, octopus, and snails are all mollusks. All mollusks have soft bodies. Most of them have shell coverings, though squids and octopuses do not. The shell form on a special part of the skin called the mantle. Most mollusks live in salt water. Besides being eaten, many mollusks are helpful to people. Chickens eat crushed oyster shells for calcium and snails help keep aquariums clean for clear viewing.

Arthropods include insects, spiders, crabs, lobsters, scorpions, centipedes, and millipedes. These animals all have three things in common. First, they are covered with a hard exoskeleton. Second, they have bodies that are divided into segments. Third, they have jointed appendages. Appendages are body parts that extend out from the body such as arms, legs, wings, and claws. Jointed appendages are ones that can bend at certain places.

Insects are the biggest group of arthropods. In fact, they are the biggest group of animals living on land. Grasshoppers, flies, butterflies, beetles, and bees are just a few. The bodies of insects are divided into three parts: a head, a thorax, or chest area, and an abdomen, the end part. Insects have three pairs of legs and usually have wings, too.

Spiders are another kind of arthropod. They help keep the number of insects down by eating them. People usually confuse spiders for insects but they are really arachnids. Spiders have only two body sections and have four pairs of legs.

Lobsters and crabs are in another class of arthropods called crustaceans. Crustaceans have hard shells, a two-part body, and antennae. Crustaceans are very popular seafood.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX P (2)

Invertebrates

The animal kingdom has two main characteristics. First, all animals have many cells. These cells are specialized. Second, animals all get their energy by eating other organisms. Animals cannot make their own food. So, animals must be able to move around.

The animal kingdom is broken into two main groups. The first group is made of animals without backbones. Animals with no backbones are called invertebrates. Jellyfish, worm, starfish, snails, octopuses, insects, and spiders are all invertebrates. Animals that have backbones are called vertebrates. Vertebrate animals are usually more complex than invertebrate animals. Fishes, birds, bears, lizards, snakes, squirrels, and monkeys are all vertebrates.

Sponges are the simplest kind of animal. They have a few kinds of specialized cells. Sponges are able to reproduce in a special asexual way. One sponge can be cut into ten pieces. Each of those pieces becomes a new sponge. Sponges also reproduce sexually. The offspring swim away from the parent and find another rock to attach to.

Jellyfish, sea anemones, and coral belong to another group of invertebrates called hollow-bodied animals. They are all alike in that their bodies are big sacks. This big sack has one opening, a mouth. Surrounding the mouth of the jellyfish are tentacles. These are like arms but they have stingers. Corals are different in that they have a hard covering called an exoskeleton.

All worm are invertebrates. There are three groups: flatworms, roundworms, and segmented worms. Most flatworms are parasites. A tapeworm is a common type of flatworm. Roundworms have simple digestive systems and a well-developed nervous system. The common earthworm is a segmented worm. Its body is divided into 100 to 180 ring-like segments. Earthworms move by means of muscles. Tiny bristles on their skin make moving in soil easier. These animals are much more developed than flatworms or roundworms. Earthworms have a head, tail, mouth, intestines, blood, nerves, and even a tiny brain.

Starfish, sea urchins, and sand dollars all belong to another group of animals called spiny-skinned animals. They all live in the ocean. They have thin delicate skins. The skin is covered with spines. Starfish have tube feet. They use these to hold onto rocks. They also use them to open clams as food. Once a starfish has opened a shellfish, it does something unusual. It opens its mouth and pushes out it stomach. The stomach goes into the shell and digests the food. Then the starfish swallows its own stomach again.

Mollusks can be very tasty food for people. Clams, oysters, squid, octopus, and snails are all mollusks. All mollusks have soft bodies. Most of them have shell coverings, though squids and octopuses do not. The shell form on a special part of the skin called the mantle. Most mollusks live in salt water. Besides being eaten, many mollusks are helpful to people. Chickens eat crushed oyster shells for calcium and snails help keep aquariums clean for clear viewing.

Arthropods include insects, spiders, crabs, lobsters, scorpions, centipedes, and millipedes. These animals all have three things in common. First, they are covered with a hard exoskeleton. Second, they have bodies that are divided into segments. Third, they have jointed appendages. Appendages are body parts that extend out from the body such as arms, legs, wings, and claws. Jointed appendages are ones that can bend at certain places.

Insects are the biggest group of arthropods. In fact, they are the biggest group of animals living on land. Grasshoppers, flies, butterflies, beetles, and bees are just a few. The bodies of insects are divided into three parts: a head, a thorax, or chest area, and an abdomen, the end part. Insects have three pairs of legs and usually have wings, too.

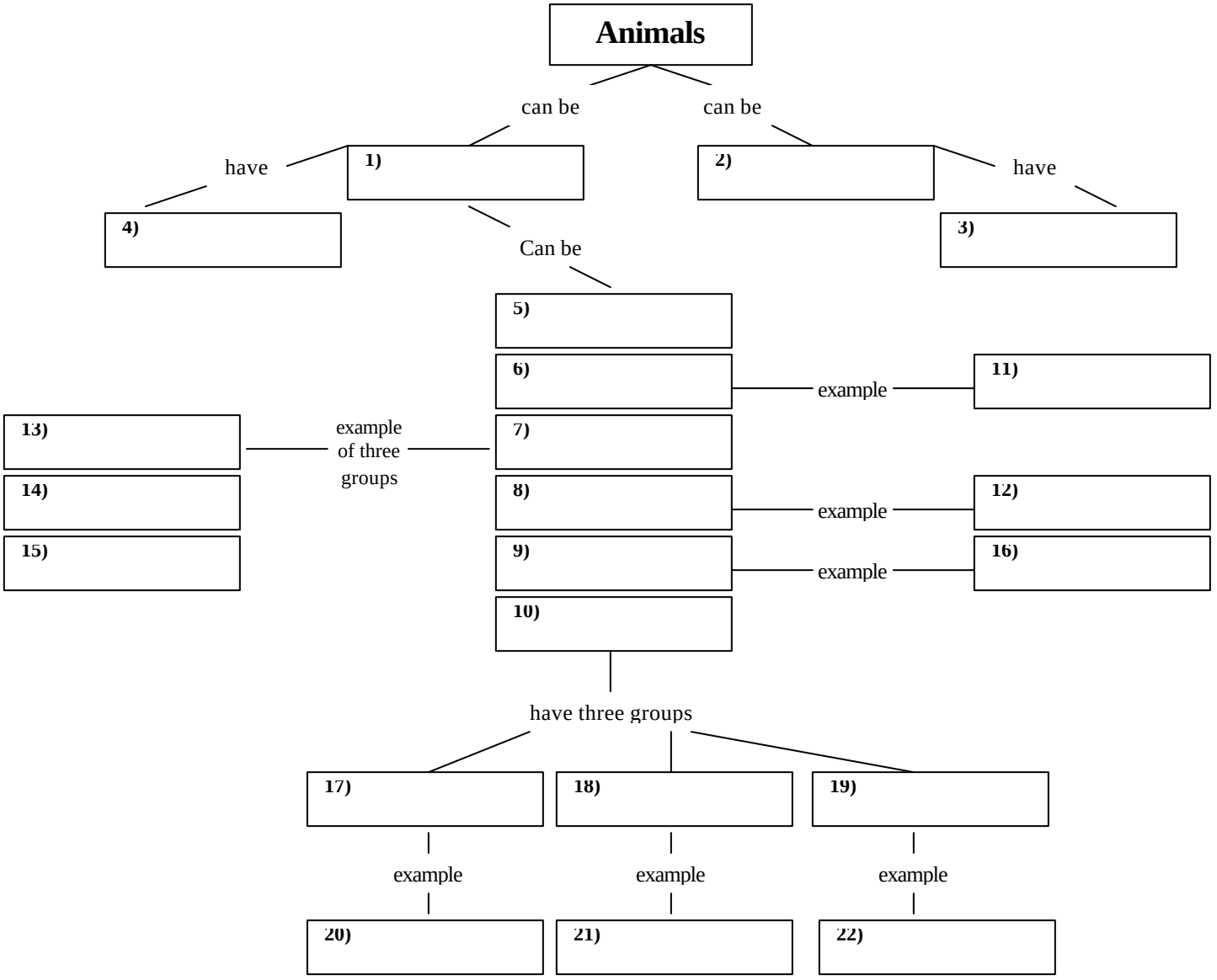
Spiders are another kind of arthropod. They help keep the number of insects down by eating them. People usually confuse spiders for insects but they are really arachnids. Spiders have only two body sections and have four pairs of legs.

Lobsters and crabs are in another class of arthropods called crustaceans. Crustaceans have hard shells, a two-part body, and antennae. Crustaceans are very popular seafood.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX P (3)

Name_____ Date_____



APPENDIX P (4)

Answer Key to Animals

1. Invertebrates
2. Vertebrates
3. Backbones
4. No backbones
5. Sponges
6. Hollow-bodied animals
7. Worms
8. Spiny-skinned animals
9. Mollusks
10. Arthropods
11. Jellyfish, sea anemones, coral
12. Starfish, sea urchins, sand dollars
13. Flatworms
14. Roundworms
15. Segmented worms
16. Clams, oysters, squid, octopus, snails
17. Insects
18. Arachnids
19. Crustaceans
20. Grasshoppers, flies, butterflies, beetles, bees
21. Spiders
22. Lobsters, crabs

APPENDIX Q (1)

Vertebrates

Vertebrates are animals with backbones. Vertebrates can be either cold-blooded or warm-blooded. Cold-blooded animals do not have a constant body temperature. Their bodies take on the temperature of their environment. Fish, for example are cold-blooded. If they are swimming in cold water, their bodies are cold. If they are swimming in warm water, their bodies are warm.

You are warm-blooded. That means that you maintain a constant body temperature. Fat, feathers, and fur all help warm-blooded animals to maintain their body temperatures. Generally, warm-blooded animals must eat more than cold-blooded ones. That is because warm-blooded animals use a lot of energy trying to stay warm. Warm-blooded animals must maintain their body temperature. The vertebrates are broken down into five groups: fish, amphibians, reptiles, birds, and mammals.

Shark, salmon, goldfish, bass, trout, cod, red snapper, and catfish are all fish. These cold-blooded vertebrates all live in water. Most of them have slim, pointed bodies. This shape allows them to cut through the water better. They use their fins for swimming. Fish also have scales covering their bodies. These scales have rings on them. Each ring stands for one year of growth. Another special feature of fish is gills. Gills are major organs of their respiratory system. Gills are behind the mouth under a flap of skin and bone. The function of the gills is to get oxygen from the water. Female fish reproduce by laying eggs. Some lay millions of eggs. Many of them never get fertilized.

Frogs, toads, and salamanders are all amphibians. Amphibians can live both on land and in water. Amphibians live the early part of their lives in water and the latter parts of their lives on land. These vertebrates have moist, slimy skin. They are cold-blooded. Frogs usually reproduce in the spring. They lay their eggs in water or they would dry out. The fertilized eggs develop into little organisms called tadpoles. They have gills for getting oxygen out of the water. However, as the tadpole develops it loses it gills and develops lungs. A frog when adult can still breathe in the water. They absorb the oxygen through their moist skin.

Lizards, snakes, turtles, crocodiles, and alligators are all reptiles. These are cold-blooded animals that breathe air with lungs and live mostly on land. The skin of reptiles is made of dry scales. These scales help reptiles keep water in their bodies. The scales also protect the animals from rough surfaces such as sand and rocks. Except for snakes and many line lizards, reptiles have four legs. Most reptiles have clawed toes. In reproduction, reptiles fertilize eggs inside the female.

However, development of the young happens outside the female's body. Some reptiles lay leathery eggs on land. The soft shells protect the eggs. They keep the eggs from drying out. Some snakes bear offspring without laying eggs outside their bodies.

Birds are warm-blooded vertebrates. They have lungs for breathing air. They also have four appendages, two wings and two legs. Their bodies are covered with feathers. Feathers allow birds to keep constant body temperatures. They have hollow bones, which keeps their bodies light so they can fly. Fertilization takes place inside the female bird. The female lays hard-shelled, fertilized eggs. Their young start out as a something called a zygote. The zygote grows and matures to become an embryo. The embryo continues growing till the new animal is formed. For all animals these are the basic stages of reproduction. Some animals change the names of steps, or include others.

Mammals are highly developed, hairy, warm-blooded animals that feed on their mother's milk when young. Humans, bears, giraffes, mice, bats, deer, cats, dogs, whales, and raccoons are all mammals. Mammals have two sets of appendages. Mammals that live in the sea have flippers. Mammals that walk have legs. People have arms. Many mammals have tails. All mammals breathe air through lungs.

Mammals all share five important characteristics. Mammals have hair on their bodies. Even the sea mammals are born with a fuzz and as adults have whiskers. Most mammals give birth to live young. This means that they do not lay eggs. At birth, their babies are fully developed infant mammals. Mammals feed their young with milk from their mother's. All female mammals have mammary glands that produce milk. Mammals care for their young until they can care for themselves. Most newly born animals are on their own from the start. Mammals, however, feed and protect their young. Many teach their young how to hunt, clean and protect themselves. Mammals have big brains. They are the most intelligent group of animals on Earth.

There are a few unusual mammals. Bats because they can fly. Whales, porpoises, seals, and dolphins are unusual because they live in the sea. Others include the duck-billed platypus, anteater, and kangaroos. Even with their oddities these animals are all classified as mammals.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX Q (2)

Vertebrates

Vertebrates are animals with backbones. Vertebrates can be either cold-blooded or warm-blooded. Cold-blooded animals do not have a constant body temperature. Their bodies take on the temperature of their environment. Fish, for example are cold-blooded. If they are swimming in cold water, their bodies are cold. If they are swimming in warm water, their bodies are warm.

You are warm-blooded. That means that you maintain a constant body temperature. Fat, feathers, and fur all help warm-blooded animals to maintain their body temperatures. Generally, warm-blooded animals must eat more than cold-blooded ones. That is because warm-blooded animals use a lot of energy trying to stay warm. Warm-blooded animals must maintain their body temperature. The vertebrates are broken down into five groups: fish, amphibians, reptiles, birds, and mammals.

Shark, salmon, goldfish, bass, trout, cod, red snapper, and catfish are all fish. These cold-blooded vertebrates all live in water. Most of them have slim, pointed bodies. This shape allows them to cut through the water better. They use their fins for swimming. Fish also have scales covering their bodies. These scales have rings on them. Each ring stands for one year of growth. Another special feature of fish is gills. Gills are major organs of their respiratory system. Gills are behind the mouth under a flap of skin and bone. The function of the gills is to get oxygen from the water. Female fish reproduce by laying eggs. Some lay millions of eggs. Many of them never get fertilized.

Frogs, toads, and salamanders are all amphibians. Amphibians can live both on land and in water. Amphibians live the early part of their lives in water and the latter parts of their lives on land. These vertebrates have moist, slimy skin. They are cold-blooded. Frogs usually reproduce in the spring. They lay their eggs in water or they would dry out. The fertilized eggs develop into little organisms called tadpoles. They have gills for getting oxygen out of the water. However, as the tadpole develops it loses it gills and develops lungs. A frog when adult can still breathe in the water. They absorb the oxygen through their moist skin.

Lizards, snakes, turtles, crocodiles, and alligators are all reptiles. These are cold-blooded animals that breathe air with lungs and live mostly on land. The skin of reptiles is made of dry scales. These scales help reptiles keep water in their bodies. The scales also protect the animals from rough surfaces such as sand and rocks. Except for snakes and many line lizards, reptiles have four legs. Most reptiles have clawed toes. In reproduction, reptiles fertilize eggs inside the female.

However, development of the young happens outside the female's body. Some reptiles lay leathery eggs on land. The soft shells protect the eggs. They keep the eggs from drying out. Some snakes bear offspring without laying eggs outside their bodies.

Birds are warm-blooded vertebrates. They have lungs for breathing air. They also have four appendages, two wings and two legs. Their bodies are covered with feathers. Feathers allow birds to keep constant body temperatures. They have hollow bones, which keeps their bodies, light so they can fly. Fertilization takes place inside the female bird. The female lays hard-shelled, fertilized eggs. Their young start out as a something called a zygote. The zygote grows and matures to become an embryo. The embryo continues growing till the new animal is formed. For all animals these are the basic stages of reproduction. Some animals change the names of steps, or include others.

Mammals are highly developed, hairy, warm-blooded animals that feed on their mother's milk when young. Humans, bears, giraffes, mice, bats, deer, cats, dogs, whales, and raccoons are all mammals. Mammals have two sets of appendages. Mammals that live in the sea have flippers. Mammals that walk have legs. People have arms. Many mammals have tails. All mammals breathe air through lungs.

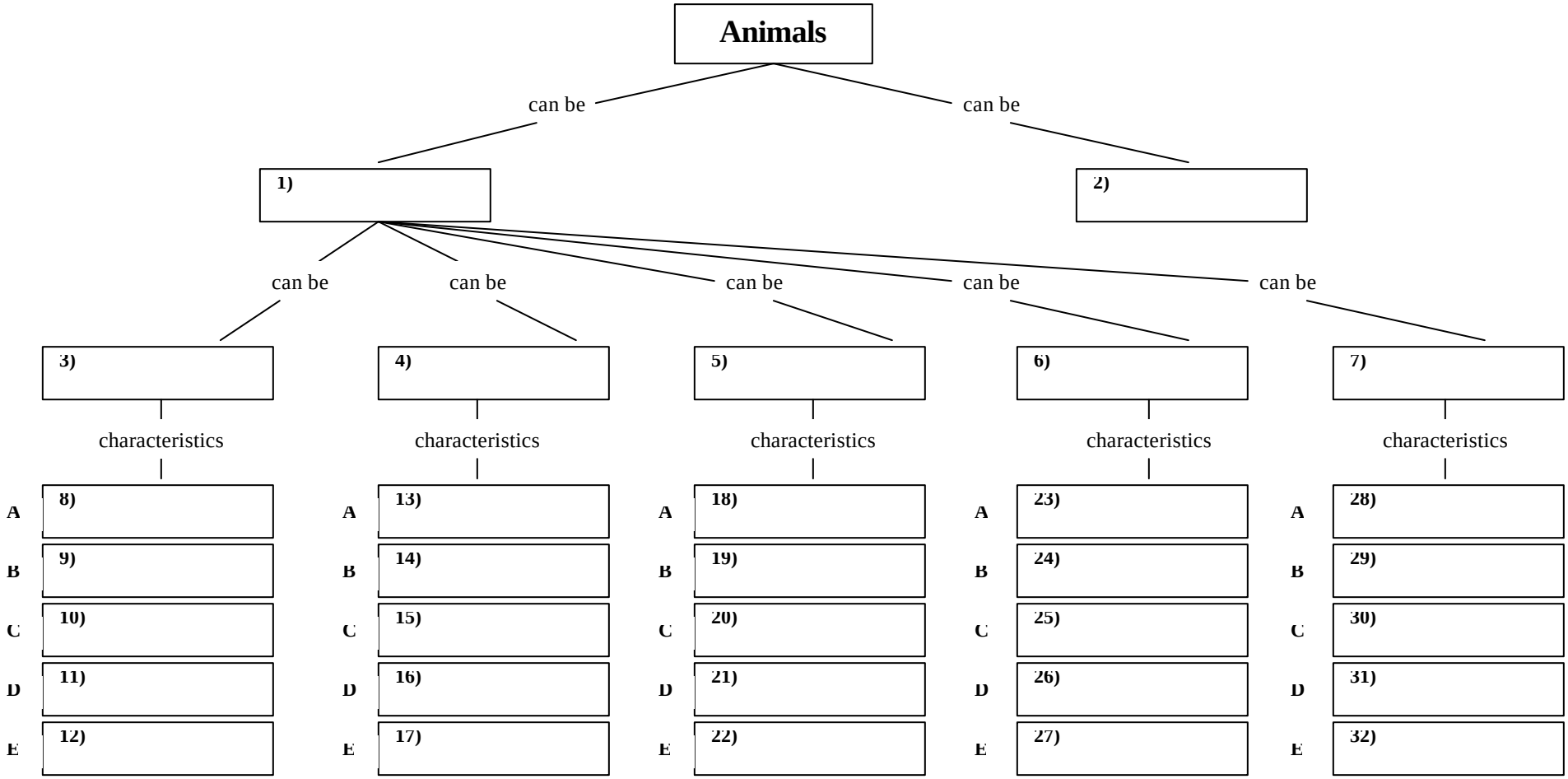
Mammals all share five important characteristics. Mammals have hair on their bodies. Even the sea mammals are born with a fuzz and as adults have whiskers. Most mammals give birth to live young. This means that they do not lay eggs. At birth, their babies are fully developed infant mammals. Mammals feed their young with milk from their mother's. All female mammals have mammary glands that produce milk. Mammals care for their young until they can care for themselves. Most newly born animals are on their own from the start. Mammals, however, feed and protect their young. Many teach their young how to hunt, clean and protect themselves. Mammals have big brains. They are the most intelligent group of animals on Earth.

There are a few unusual mammals. Bats because they can fly. Whales, porpoises, seals, and dolphins are unusual because they live in the sea. Others include the duck-billed platypus, anteater, and kangaroos. Even with their oddities these animals are all classified as mammals.

(Adapted from: Bledsoe, L.J. *Fearon's Biology Second Edition*. Upper Saddle River, New Jersey: Globe Fearon Educational Publisher, 1998. ISBN 0-835-93557-4.)

APPENDIX Q (3)

Name_____ Date_____



A. Live (land/water)
B. Born (live/egg)
C. Blooded (cold/warm)
D. Skin (covering)
E. Breathe (lung/gills)

APPENDIX Q (4)

1. Vertebrates 2. Invertebrates

All other answers will be under the headings because it doesn't matter which block they go under.

Fish

A- water
B- eggs
C- cold
D- scales
E- gills

Reptiles

A- land
B- eggs
C- cold
D- scales
E- lungs

Amphibians

A- both
B- eggs
C- cold
D- moist, slimy skin
E- both

Birds

A- land
B- eggs
C- warm
D- feathers
E- lungs

Mammals

A- both
B- live
C- warm
D- hair of fur
E- lungs

APPENDIX R (1)

Five Kingdom Test

Name _____ Date _____

Name the five kingdoms.

The plant kingdom includes two groups. What are they and how do they differ?

The fungi kingdom contains three groups. What are they?

The moneran kingdom was divided into two groups. What are they?

The protist group was divided into three groups. What are they?

The animal kingdom was divided into two groups. What are they and how do they differ?

The invertebrate group includes five smaller groups. What are they?

The vertebrate group includes two smaller groups. What are they and which of the five classes fit under each?

Define the following words:

Virus –

Host –

APPENDIX R (1), page 2

Parasite –

Monerans –

Heterotroph –

Autotroph –

Protist –

Fungus-

Photosynthesis-

Xylem-

Phloem-

Germination –

Pollination –

Fertilization –

Pollen –

Pistil –

Stamen -

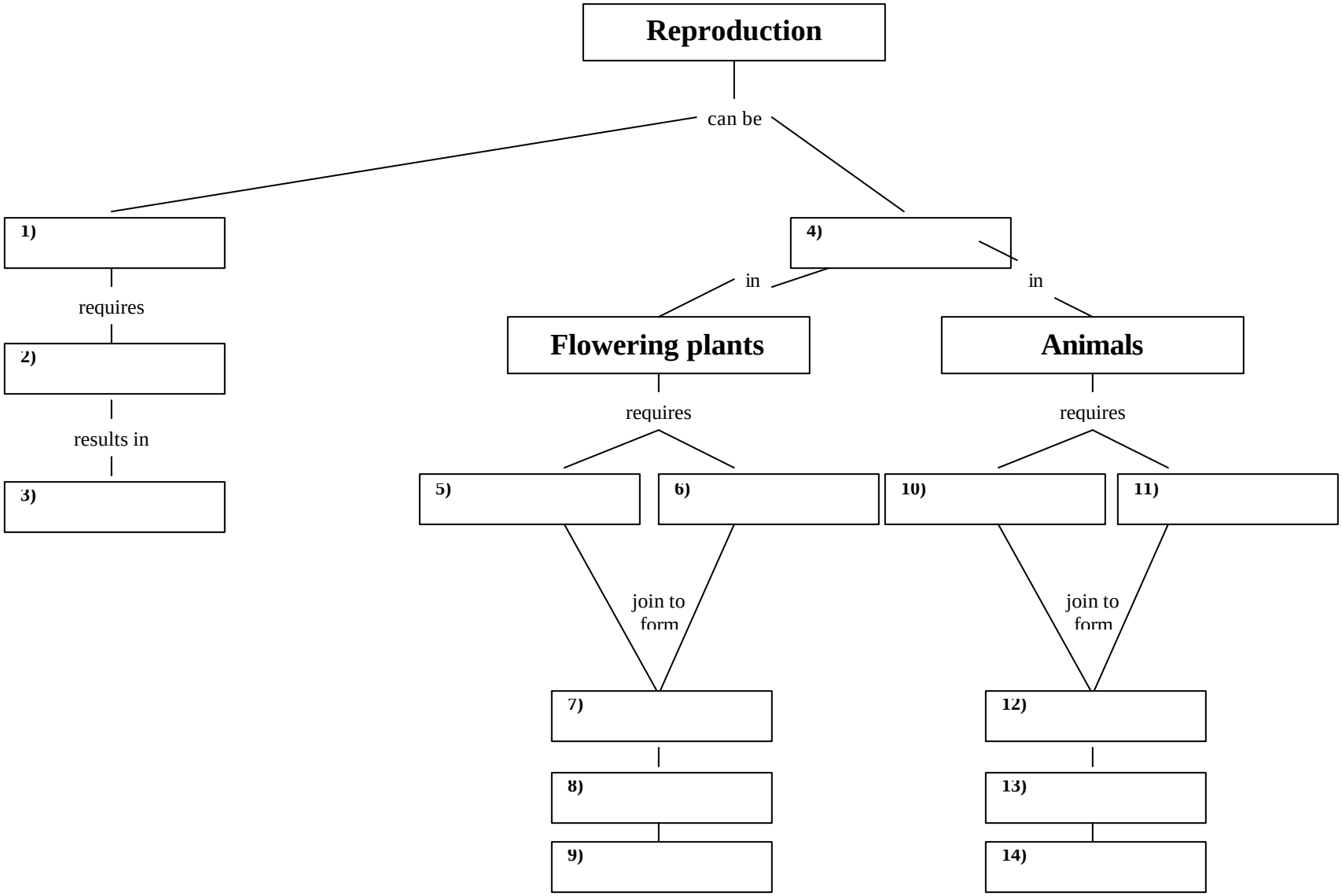
Annuals-

Biennial-

Perennial –

APPENDIX R (1), page 3

Name_____ Date_____



APPENDIX R (2)

Answer Key for Five Kingdom test.

Name the five kingdoms.
Plant, Animal, Fungi, Protist, Moneran

The plant kingdom includes two groups. What are they and how do they differ?

Vascular and Nonvascular Vascular have structures for transporting water and nutrients, nonvascular do not

The fungi kingdom contains three groups. What are they?
yeasts molds and mushrooms

The moneran kingdom was divided into two groups. What are they?

bacteria and viruses

The protist group was divided into three groups. What are they?

plantlike, animal like and fungus like protists

The animal kingdom was divided into two groups. What are they and how do they differ?
vertebrates (backbones) invertebrates (no backbones)

The invertebrate group includes five smaller groups. What are they?

sponges, worms, hollow-bodied animals, spiny-skinned animals, arthropods

The vertebrate group includes two smaller groups. What are they and which of the five classes fit under each?
Cold-blooded – reptiles, amphibians, fish Warm-blooded – bird, mammals

Define the following words:

Virus – **tiny particles that can invade living cells**

Host – **a living thing that provides a home and/or food for a parasite**

APPENDIX R (2), page 2

Parasite –**organism that survives on or in a host organism**

Monerans –**single celled organisms that lack a nucleus**

Heterotroph –**don't make own food**

Autotroph –**can make own food**

Protist – **one celled organism with a nucleus**

Fungus-**a heterotroph usually multicellular that releases chemicals that digests the substance on which it is growing**

Photosynthesis-**the process by which plant cells use sunlight energy to make food from water and carbon dioxide**

Xylem-**tissue in roots and stems that carries water up the plant**

Phloem-**tissue in roots and stems that carries food down the plant**

Germination –**the process by which a plant embryo develops**

Pollination –**the process by which pollen reaches an egg**

Fertilization –**the joining of sperm and egg cells**

Pollen – **yellow grain that holds sperm**

Pistil –**female part of the flower**

Stamen –**male part of the flower**

Annuals-**plants that complete their life cycle within one growing season**

Biennial-**plants that complete their life cycle in two years**

Perennial – **plants that live for many years**

1. Asexual
2. One organism
3. Two organisms
4. Sexual
5. Sperm
6. Egg
7. Seed
8. Sprout
9. New plant
10. Sperm
11. Egg
12. Zygote
13. Embryo
14. New animal

APPENDIX S

Grading Sheet for Kingdom Day

Name: _____ Kingdom: _____

Dressed their part	1	2	3	4	5
Group was well organized	1	2	3	4	5
Everyone in group spoke	1	2	3	4	5
Each member had a name tag with genus, species name	(10 points possible)				_____
Creativeness in costume design	(10 points possible)				_____
Display board of their kingdom	(10 points possible)				_____
Speech was memorized	(10 points possible)				_____
Speech was organized well	(10 points possible)				_____
Student showed knowledge of their organism	(10 points possible)				_____
	Total:				___/75
	Grade:				___

Comments: