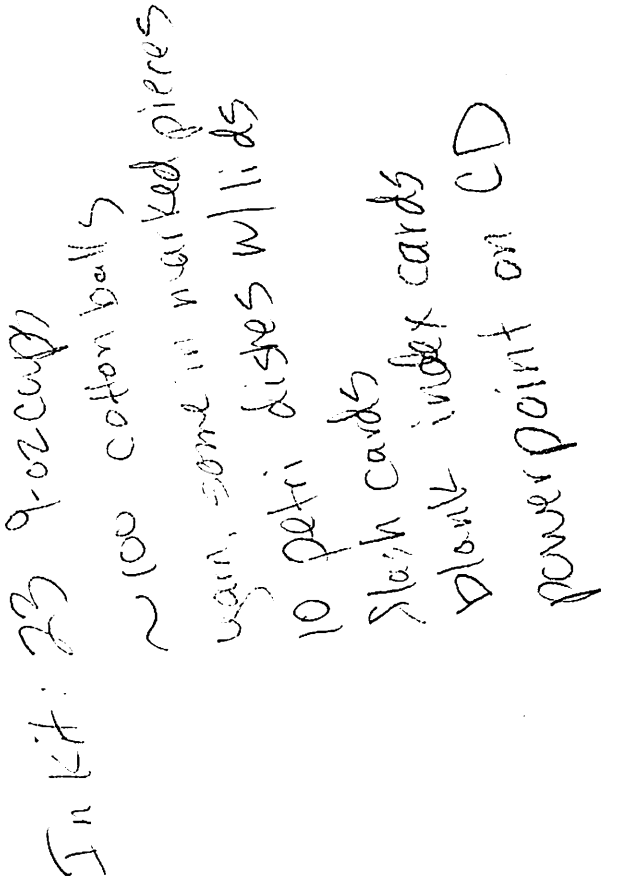
To put into Kit

Kit box labels

- Tape measure (meters) to mark grid
- Stakes (I used 3, but more may be necessary for hills — to stake yarn out for a grid)
- Mallet (to hammer stakes into ground)
- Scissors

* The yarn worked, but a better rope, or twine would be useful. Also, the post it markers worked, but more permanent (laminated) markers would last longer — maybe numbered flags to mark distance.



Biodiversity Lab Lesson Plan

Tennessee State Standard (Eighth Grade)
SPI 0807.5.4 Identify several reasons for the importance of maintaining the earth's biodiversity.

Introduction to Biodiversity
http://www.youtube.com/watch?v=3YhoOMX2BFo

Big Questions

What is "biodiversity" and why does it matter?
How can we measure biodiversity?
How do scientists interpret measurements of biodiversity, and how do these findings affect me?

Overview

This lab is a two-part lesson intended to be spread over two days that are not consecutive. The first part introduces the topic of biodiversity, giving a field experience to present students with an intuitive sense of the diversity of life in a seemingly uniform schoolyard. The second quantifies this biodiversity using Simpson's Reciprocal Index, all the while emphasizing the importance of biodiversity in maintaining the health of an ecosystem. Calculations are broken down into a table, but students may need assistance with remembering how to square a number and find its reciprocal.

Supplement to Lab 1: Bacterial Culture

The first lesson contains instructions for a supplemental bacteria growth lab. The idea is to have students culture bacteria from a swab of dirt to enhance their intuitive feel for biodiversity. About three days are needed for bacteria cultures to grow. At that time, the students will observe their plates, and count the number of different bacteria cultures they find. Although it is not possible to identify the type of bacteria strictly from macroscopic features, such as size, color, and texture of the bacteria culture; it can be determine the number of cultures that are different by comparing visible differences. In this manner, students can get a sense of how much biodiversity exists even in a grassy schoolyard at the microscopic level. It is possible to have a successful lab experience without the bacteria growth on nutrient-enriched agar plates.

To make nutrient-enriched agar plates, follow the instruction at the following website:
http://www.stevespanglerscience.com/lab/experiments/growing-bacteria

This page includes ideas for a separate lesson plan on bacteria in the classroom and science fair experiments.

Lab 1: Quadrat Sampling for Backyard Critters

For the Teacher: Read through the students' instructions. Explain the process and familiarize the students with the creatures they will identify before going outside. Keep a record of what quadrats were used so that one area is not sampled twice between classes. By not overlapping, the data will give a better estimate of the biodiversity.

	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Quantity	**Materials**
(2)	10-meter strings marked at each meter
(3)	Stakes to tie down strings
(1)	Draw Pile of ordered pairs for grid
(1 per pair of students)	1-square-meter quadrat strings
(20 per pair of students)	Numbered Markers (Pieces of paper, chips, golf tees, etc.)
(1 per pair of students)	Magnifying glass
(1 per pair of students)	Identification Key
(1 per pair of students)	Data Collection Chart
(1 per pair of students)	Agar Plate (*Optional – Bacterial Growth*)
(1 per pair of students)	Damp cotton ball (*Optional – Bacterial Growth*)

Set-up

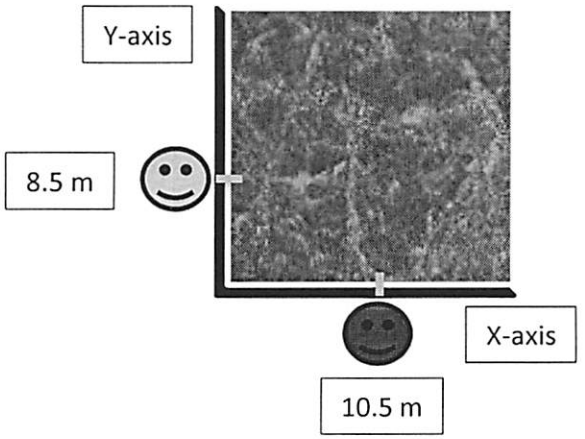
1. Select a 10x10-meter area in the school yard to layout grid. All features within this grid should be accessible to students, i.e. the grid may be near but should not include a ditch, trees, or other features students cannot easily search.
2. Layout the axes of your grid. The marked 10-meter strings should be perpendicular and tied down to stakes at each end. (The teacher may want to lay out quadrat squares before class.)
3. Have students prepare 20 markers (pieces of paper about the size of a quarter). The markers should be numbered.

Instructions for Students

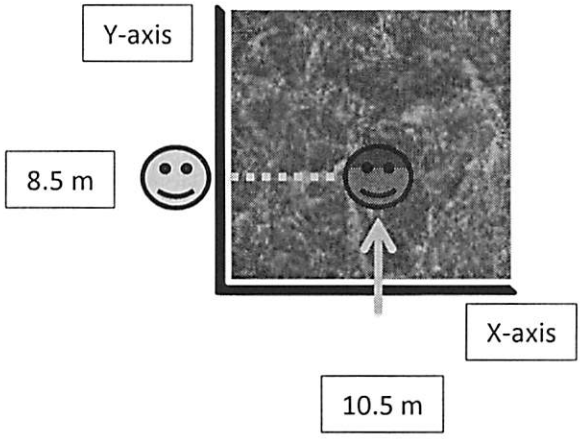
1. With your partner, draw an ordered pair of coordinates as a random selection for placement of your square quadrat.[1]

   Ex: (10.5, 8.5)

2. The taller student should stand on the x-coordinate at the appropriate mark on the string, while the other stands similarly at the y-coordinate.

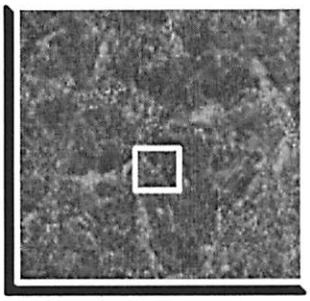


3. The student at the x-coordinate walks along a straight line parallel to the y-axis until they are at the same level as the y-coordinate student. This point is the center of the quadrat. The other student then meets the first.



[1] To save time, the teacher can set up random quadrat squares prior to class. In this case, have students skip steps 1-4.

4. Both students hold two corners of your quadrat string expanding it to make a regular square, and lay it down on the grass centered at the point found in the previous step.



5. Randomly spread the numbered markers over the entire quadrat.

6. With your partner, find the first marker. This is "Quadrat Subdivision 1." Set the marker aside and scan a small (10cm x 10cm) area where the marker was placed. Before disturbing the area, identify any life on your identification key. Use your magnifying glass if necessary. When you find something, put a tally mark in the correct row for each animal seen. Then, push back the grass and look around the roots on the surface of the dirt for more organisms. Tally up anything you find.

7. When you have marked everything for the 10cm x 10cm area under "Quadrat Subdivision 1," move onto the next marker: "Quadrat Subdivision 2."

8. Repeat steps 6-7 for all 20 quadrat subdivisions.

9. When finished tallying up organisms, add up totals for each type of organism separately and all organism types collectively in the chart. Look over the numbers and get a sense of the diversity you have discovered today.

Optional – Bacteria Culture

10. One student collects all markers, while the other student comes to the teacher to get an agar plate and a damp cotton ball.

11. Rub the damp cotton ball in the dirt. (You may need to pull the grass back.) Lightly rub the dirty cotton ball onto each partition of the agar plate.

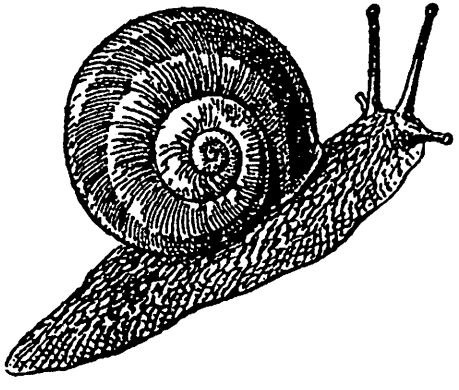
12. Collect all materials and trash before leaving your quadrat.

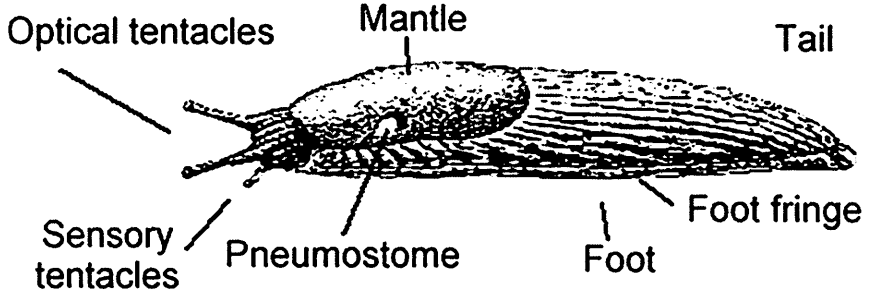
Type of Organism	**Number of Organisms Found in Quadrat Subdivision**																				**Total Of Each Type**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Mollusk (Snails, Slugs)																					
Segmented Worm																					
Arthropods																					
Crustacean ("Roly-Poly")																					
Arachnid (Spiders, Mites, Ticks)																					
Millipede																					
Centipede																					
Insect (See Key)																					
Other																					
Total of All Organisms																					

Identification Key

Mollusk

- Features
  - Single *foot* on animal's bottom
  - Soft, fleshy *body* above the foot containing all organs
  - *Mantle* covering body, sometimes in the form of a shell
- Common Examples
  - Slugs
  - Snails





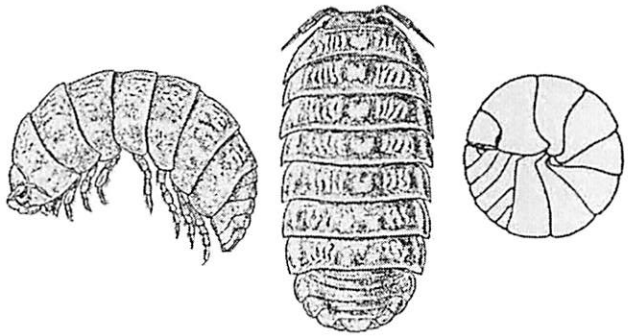
Segmented Worm

- Features
  - Long, segmented *body* containing all internal organs – often covered in mucus
  - No legs, antennae or other appendages
- Common Example
  - Earthworm

Arthropods

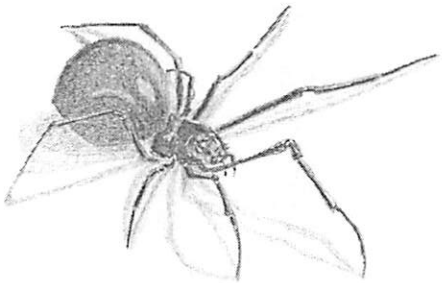
Crustacean

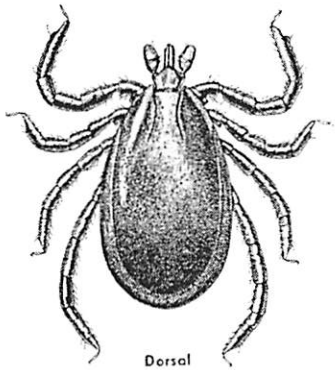
- Features
  - Hard segmented exoskeleton
  - Typically roll into a ball when disturbed
- Common Example
  - "Roly-Poly" (Pill Bug or Sow Bug)

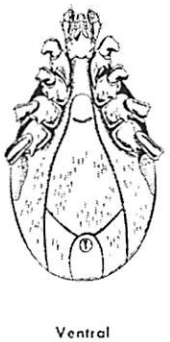


Arachnid

- Features
  - Only two body parts: *Head* and *Abdomen*
  - Eight Legs
- Common Examples
  - Spiders
  - Daddy-Longlegs ("Harvestmen")
  - Ticks
  - Mites

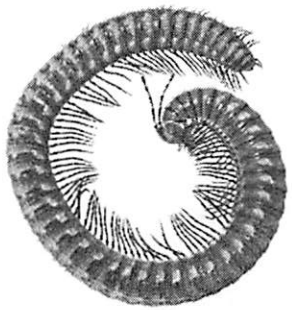






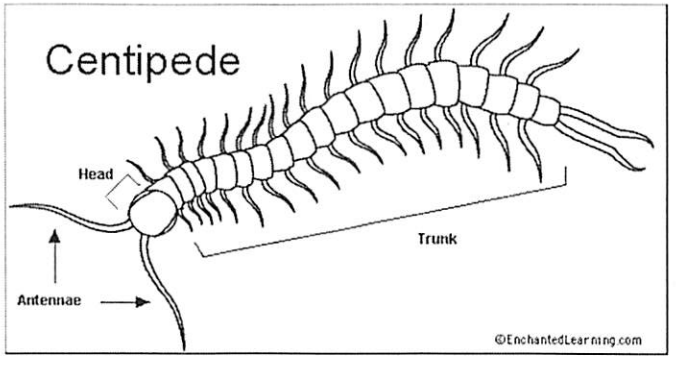
Millipede

- Features
  - "1000 Feet", each segment has four legs
  - Long, round, segmented body
  - Usually coil into spiral when disturbed



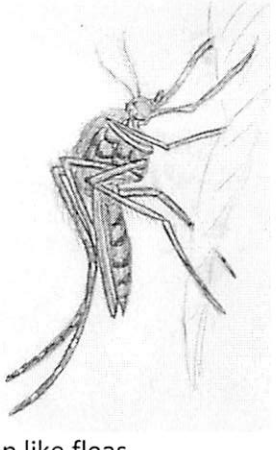
Centipede

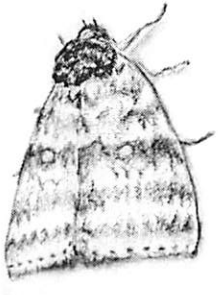
- Features
  - "100 Feet", each segment has two legs
  - Long, flat, segmented body
  - Usually have pinchers at end of body (Be careful!)

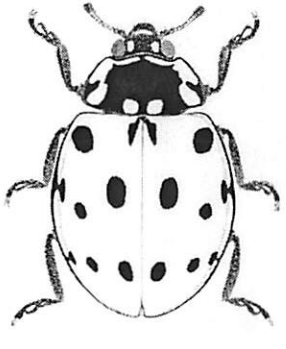


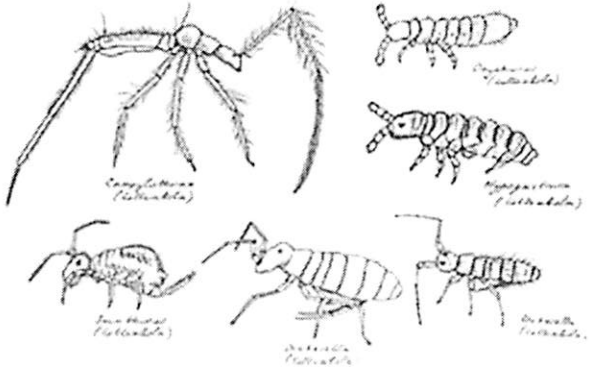
Insect

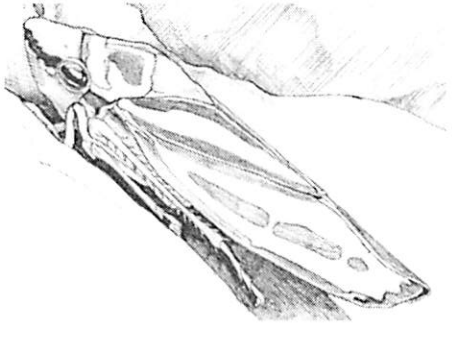
- Features
  - Three body parts: *Head*, *Thorax*, and *Abdomen*
  - Six Legs
  - Usually 2 antenna
  - Sometimes with wings, pinchers
- Common Examples
  - Ants, bees, wasps
  - Beetles, Young: grubs
  - Butterflies and Moths – Young: Inch worms, caterpillars
  - Dragonflies and Damselflies
  - Flies, mosquitos – Young: maggots
  - Leaf Hoppers, Tree Hoppers, Cicadas
  - Springtails – really small and very common in dirt, they hop like fleas

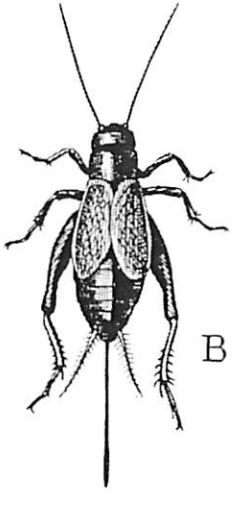












Lab 2: Understanding Biodiversity and Its Significance

Biodiversity describes the variety of plants, animals, bacteria, fungi and other living organisms in an ecosystem. Some environments need a large biodiversity to be healthy, while others do not. In order to know whether or not the grass outside has a "large" or "small" biodiversity, we must compare it to other environments. When scientists make comparisons, they often try to find a number that describes what they are comparing. One description of biodiversity is *Simpson's Reciprocal Index*. This number looks at all of the organisms counted, and tells us if one type of organism is more likely to be found than any other. If the Index is equal to 1, then only one type of organism was counted and the environment is not very diverse. A bigger Index means more types of organisms were counted, so the environment is more diverse.

Simpson's Reciprocal Index for Biodiversity

$$D = \Sigma\ (t / N)^2$$

1. Add up all tally marks in each row, and record that number in the far right column.
    a. Example: Add up all tally marks for Mollusk, then put the total in the column labeled "Total for Each Type."
    b. Do this for all types (Segmented Worm, Crustacean, Arachnid,…).
2. Add up everything in the column labeled "Total for Each Type," and record the number in the row "Total of All Organisms."

Example of Chart 1: Sampling Organisms (*Do this for your own chart.*)

Type of Organism	Number of Organisms Found in Quadrat Subdivision																				Total Of Each Type
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Mollusk (Snails, Slugs)	||						|			|						|				*5*
Segmented Worm																					*0*
Arthropods																					
Crustacean ("Roly-Poly")					||								|								*3*
Arachnid (Spiders, Mites, Ticks)			|															||			*3*
Millipede								||													*2*
Centipede																					*0*
Insect (See Key)						|							||				|			*4*
Other					||																*2*
Total of All Organisms																					*19*

3. Copy "Total of Each Type (**t**)" into Chart 2.
4. Copy "Total of All Organisms (**N**)" into Chart 2.
5. Divide "Total of Each Type (**t**)" by "Total of All Organisms (**N**)" to find the "Ratio (**t/N**)".
6. Multiply the "Ratio (**t/N**)" times itself to find "Ratio^2 (**t/N**)^2."
7. Add together every row in the column "Ratio^2 (**t/N**)^2," and record it in the row "SUM TOTAL." This number is called *Simpson's Index*, and it should be a decimal between 0 and 1.

Chart 2: Calculating *Simpson's Reciprocal Index*

Type of Organism	Total of Each Type (**t**)		Total of All Organisms (**N**)		Ratio (**t/N**)	Ratio^2 (**t/N**)^2
Mollusk		÷		=		
Segmented Worm		÷		=		
Arthropods						
Crustacean		÷		=		
Arachnid		÷		=		
Millipede		÷		=		
Centipede		÷		=		
Insect		÷		=		
Other		÷		=		
SUM TOTAL (**D**)						

8. To get a meaningful number out of *Simpson's Index*, take the reciprocal. This number should be between 1 and 8.

$$\text{Simpson's Reciprocal Index} = \frac{1}{D} = \frac{1}{\text{SUM TOTAL}}$$

Questions

1. What number do you get?

2. What would it mean if you got a Simpson's Reciprocal Index number of 1?

3. What would it mean if you got a Simpson's Reciprocal Index number of 8?

4. Is your number closer to 1 or to 8? Based on this answer, is the grass in the schoolyard a biologically diverse ecosystem?

5. Would you expect a desert ecosystem to have a Simpson's Reciprocal Index number closer to 1 or to 8?

6. Would you expect a tropical rainforest ecosystem to have a Simpson's Reciprocal Index number closer to 1 or to 8?

7. Look at the different types of organisms that you counted. Imagine that one of them did not exist. What do you think would happen to the schoolyard ecosystem if it vanished?

Type of Organism	**Number of Organisms Found in Quadrat Subdivision**																				**Total Of Each Type**
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Crustacean ("Roly-Poly")																					
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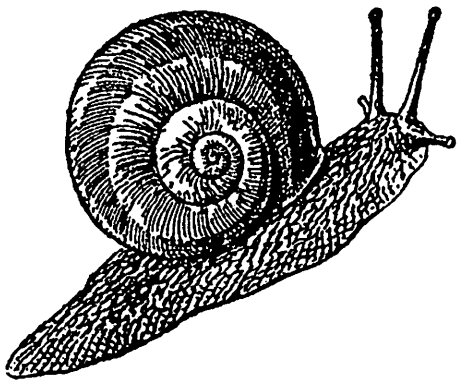
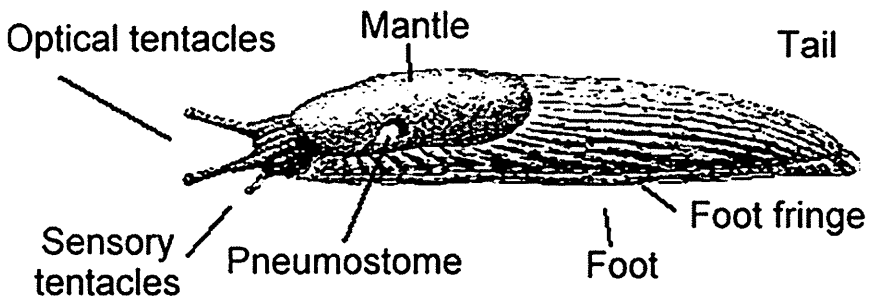
Millipede																					
Centipede																					
Insect (See Key)																					
Other																					
Total of All Organisms																					

Identification Key

Mollusk

- Features
  - Single *foot* on animal's bottom
  - Soft, fleshy *body* above the foot containing all organs
  - *Mantle* covering body, sometimes in the form of a shell
- Common Examples
  - Slugs
  - Snails





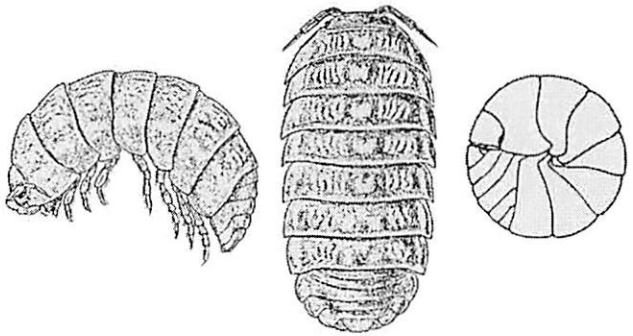
Segmented Worm

- Features
  - Long, segmented *body* containing all internal organs – often covered in mucus
  - No legs, antennae or other appendages
- Common Example
  - Earthworm

Arthropods

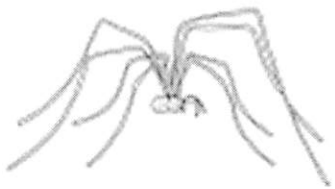
Crustacean

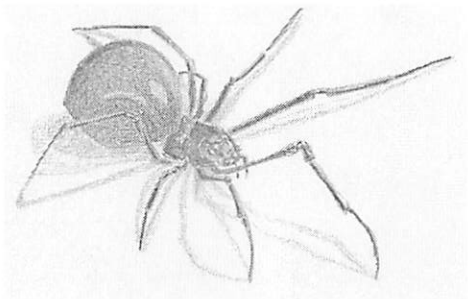
- Features
  - Hard segmented exoskeleton
  - Typically roll into a ball when disturbed
- Common Example
  - "Roly-Poly" (Pill Bug or Sow Bug)

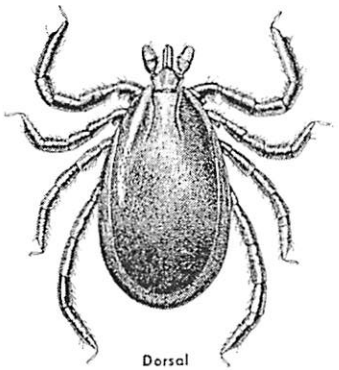


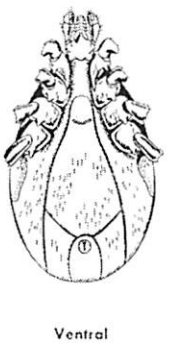
Arachnid

- Features
  - Only two body parts: *Head* and *Abdomen*
  - Eight Legs
- Common Examples
  - Spiders
  - Daddy-Longlegs ("Harvestmen")
  - Ticks
  - Mites



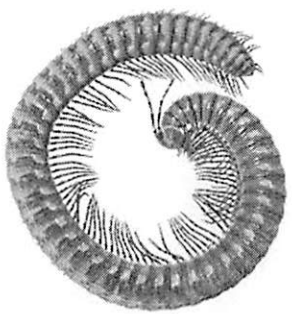






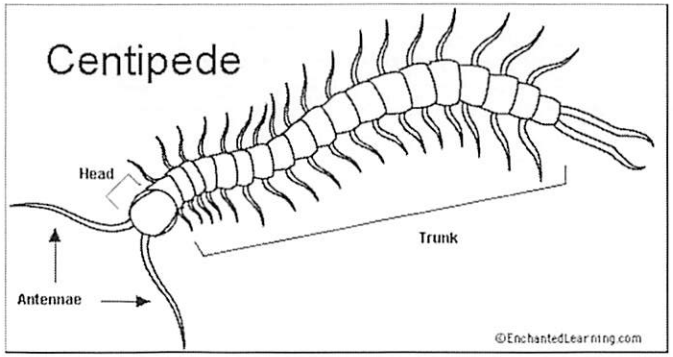
Millipede

- Features
  - "1000 Feet", each segment has four legs
  - Long, round, segmented body
  - Usually coil into spiral when disturbed



Centipede

- Features
  - "100 Feet", each segment has two legs
  - Long, flat, segmented body
  - Usually have pinchers at end of body (Be careful!)



Insect

- Features
  - Three body parts: *Head*, *Thorax*, and *Abdomen*
  - Six Legs
  - Usually 2 antenna
  - Sometimes with wings, pinchers
- Common Examples
  - Ants, bees, wasps
  - Beetles, Young: grubs
  - Butterflies and Moths – Young: Inch worms, caterpillars
  - Dragonflies and Damselflies
  - Flies, mosquitos – Young: maggots
  - Leaf Hoppers, Tree Hoppers, Cicadas
  - Springtails – really small and very common in dirt, they hop like fleas