Student Sheet 1.1: KWL Chart

**Topic:** ________________________________________________________________

<table>
<thead>
<tr>
<th><strong>K</strong></th>
<th><strong>W</strong></th>
<th><strong>L</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you <strong>Know?</strong></td>
<td>What do you <strong>Want to know?</strong></td>
<td>What did you <strong>Learn?</strong></td>
</tr>
</tbody>
</table>
Student Sheet 1.3: Observing Different Organisms

Directions: At each microscope you visit, do the following:

1. Provide the name of the slide.
2. Sketch what you see in the space provided below.
3. Record additional observations about the organism's body plan and body structures and predict how they help the organism survive.

Name of slide: ________________________
Body/structure description: ________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Name of slide: ________________________
Body/structure description: ________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Name of slide: ________________________
Body/structure description: ________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________

Name of slide: ________________________
Body/structure description: ________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Student Sheet 2.4: Embryonic Development (page 1 of 2)

You and your group will observe embryos of various animals during different stages of their development. The animals you will observe are a mouse, an alligator, a zebrafish, a chicken, and a human. The animals have not necessarily been placed in this order. Remember, these images are not to scale and have been enlarged so they can be viewed more easily.

**Early Development**

1. Predict: Which animal do you think each embryo will develop into?

   Embryo A  Embryo B  Embryo C  Embryo D  Embryo E

2. Observe: What patterns, or similarities, in appearance exist among these embryos at this stage?

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

**Intermediate Development**

3. Predict: Which animal do you think each embryo will develop into?

   Embryo A  Embryo B  Embryo C  Embryo D  Embryo E

4. What patterns in the appearance of the embryos do you notice at this stage?

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

5. How are these embryos starting to differentiate, or become different from one another?

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
6. Using knowledge from your previous investigations, what do you think is happening inside each organism’s body, even though you cannot see it?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Late Development

7. Predict: Which animal do you think each embryo will develop into?

<table>
<thead>
<tr>
<th>Embryo A</th>
<th>Embryo B</th>
<th>Embryo C</th>
<th>Embryo D</th>
<th>Embryo E</th>
</tr>
</thead>
</table>

8. Look back at your predictions. Did you predict the same letter for each animal for all three stages? If not, what made you change your mind?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Conclusion

9. Ask your teacher for the card titled “Adult” and follow the directions listed in Step 9 of your Student Guide. How many of your predictions were correct?

________________________________________________________________________

10. Look at the patterns of similarities you listed for the early stage of development. What structure(s) started out similar in the embryos but changed drastically during the organisms’ development?

________________________________________________________________________

________________________________________________________________________

11. Why would these structures need to change drastically as development continued?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Student Sheet 3.2: Exploring Plant Cells (page 1 of 2)

Follow the directions in your Student Guide as you perform the investigations. Your observations and answers to the questions will be recorded on this sheet.

Name of slide: _______________________________  Name of slide: _______________________________

Length of cell: _______________________________  Length of cell: _______________________________
Total magnification: ___________________________  Total magnification: ___________________________

1. Carefully observe the structures within a leaf cell. With your partner, make a prediction about what you think each structure, or organelle, does to help the plant cell survive. Record your predictions in the space below.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

2. Do you think your illustrations and what the microscope is showing you are accurate representations of the internal structures of a plant cell? How might this microscope be limiting what you see?

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

3. After observing the cells in salt water, you should see an additional structure inside the cell. What do you think this additional structure is?

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
Student Sheet 3.2: Exploring Plant Cells (page 2 of 2)

4. Predict: What is this structure’s function within the plant cell?

________________________________________________________________________________________________________________________________________________________

5. After completing your reading selection, look back at the cells you drew in the circles. Label the organelles with their real names directly on your illustrations.

6. Were your initial predictions about these organelles’ functions correct? ____________________________

7. Could a plant cell survive without a cell wall? Explain your reasoning.

________________________________________________________________________________________________________________________________________________________


________________________________________________________________________________________________________________________________________________________

9. Even though you did not observe mitochondria due to the limitations of your technology, they are inside each plant cell. Do you think a plant cell could survive without them? Explain your reasoning.

________________________________________________________________________________________________________________________________________________________

10. Based on what you learned today, what conclusion can you draw about the organelles found inside a plant cell?

________________________________________________________________________________________________________________________________________________________
Student Sheet 3.4a: Animal Cell Model
Student Sheet 3.4b: Plant Cell Model

[Diagram of a plant cell with labeled parts]
Student Sheet 3.6: Cell Comic Rough Draft (page 1 of 2)

This sheet is to help you brainstorm ideas for your comic on cells. Remember, you must have a central location that will represent the cell and clear identifiers and descriptions for the people, places, or things within your location that represent different structures within the cell. For example, “Our mayor is Nancy Nucleus and she is in charge of the whole city.”

My comic is taking place ______________________________________________________.

The cell structures below will be represented by people, places, or things in your comic. Pick a sixth organelle of your choice from the ones you learned about during this lesson. In the chart below, list what person, place, or thing will represent each organelle.

<table>
<thead>
<tr>
<th>Organelle</th>
<th>How the organelle is represented in my comic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cell membrane</td>
<td></td>
</tr>
<tr>
<td>2. Cell wall</td>
<td></td>
</tr>
<tr>
<td>3. Nucleus</td>
<td></td>
</tr>
<tr>
<td>4. Mitochondria</td>
<td></td>
</tr>
<tr>
<td>5. Chloroplasts</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
</tbody>
</table>

Here is a summary of my idea for the story:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

On the back of this sheet, sketch a rough draft of your comic. Include a title, introduction, clear story line, and a conclusion. You may create your own layout on a separate sheet of paper as well. Remember, you must identify the people, places, or things within your story and apply their functions.
Student Sheet 6.2: Levels of Organization

Follow the directions in your Student Guide as you illustrate the levels of organization.

Organism: __________________________

Organ System: __________________________

Organs: __________________________

Tissue: __________________________

Cell: __________________________
Follow the directions outlined in your Student Guide when performing your research. Be sure to ask your teacher if you have any questions.

**Organ system:**

Function(s) of organ system:

Organs involved and their functions:

Specialized tissues and their functions associated with organ system:

Specialized cells and their functions associated with organ system:
Describe how the cells, tissues, and organs all work together in this system:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Any additional information you uncover about the organ system:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Sources used (minimum of three):

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Student Sheet 6.4: Frog Dissection (page 1 of 4)

Follow the directions outlined in the Student Guide and record all of your observations and answers in the spaces below.

External Structures
1. Initial observations: _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

2. What is the function of the third eyelid? ___________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

Extremities
3. Number of digits on each: Upper extremity: _______ Lower extremity: _______

4. How are the upper and lower extremities of a frog similar to a human? How are they different?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

Mouth
5. How does the front attachment in a frog’s tongue aid in its survival? ___________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

6. What is the function of the vomerine teeth? _______________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
7. Using your observations, what evidence suggests that this animal is adapted to an aquatic environment? What evidence suggests that the frog is adapted to life on the land?

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Internal Structures
8. Initial observations: _______________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

9. The “strings” that connect the organs to each other or to the body cavity are examples of what level of cellular organization?

___________________________________________________________________________

Reproductive System
10. What sex is your frog? ____________________________

11. What evidence do you have to support this claim? ______________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

12. Why would both the oviduct in females and seminal vesicle in males need to connect to the cloaca, or the opening where materials are expelled from the frog’s body?
Student Sheet 6.4: Frog Dissection (page 3 of 4)

Digestive System

13. Which internal organs work together in a frog’s digestive system? ________________

14. What evidence do you have to support your claim about the organs used? ________________

15. Create an explanation, based on the evidence that you have collected, that follows the path that food takes once it enters the frog’s mouth.

Circulatory System

16. What structures would you expect the frog to have in its circulatory system?

17. How is the circulatory system of a frog similar to a human’s? What evidence do you have to support your claim?
Respiratory System

18. Based on your knowledge of the respiratory system, what structures would you expect to find in a frog?


19. Using evidence from your investigation, create an explanation that describes how the respiratory and circulatory systems depend on one another.


20. Human lungs take up a larger portion of our bodies than do a frog’s lungs. Why do you think our lungs take up so much more room?


The dissection is now complete. Follow your teacher's directions for disposing of your specimen and cleaning up your work area. Be sure to wash your hands thoroughly after cleanup. Return to your seat and complete Step 6 in your Student Guide.
Student Sheet 6.5: Skeletal Similarities

- **Humerus**
- **Radius**
- **Ulna**
- **Carpal**
- **Metacarpals**
- **Phalanges**

**Species:**
- Human
- Cat
- Whale
- Bat
- Bird
- Horse
- Zebra
Student Sheet 6.6: Developing a Cladogram

Create a cladogram, using the information you brainstormed in your science notebook, that displays the evolutionary relationships among six organisms. Remember, the long, perpendicular lines are to identify the animals, while the small, horizontal lines are for the characteristics you use.
Student Sheet 7.3: Information Processing (page 1 of 3)

Follow the directions and safety warnings while completing the activity at each station. Be sure to ask your teacher if you have any questions.

Station 1: Temperature Receptors (Thermoreception)

What did you observe as you switched from cups of warm and cold water to the cup of room-temperature water?

________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________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### Station 3: Locating Your Blind Spot

<table>
<thead>
<tr>
<th></th>
<th>Right Eye</th>
<th>Left Eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance at which the dot disappeared</td>
<td>______ cm</td>
<td>______ cm</td>
</tr>
</tbody>
</table>

### Station 4: Taste Receptors

<table>
<thead>
<tr>
<th>Subject Name</th>
<th>PTC</th>
<th>Thiourea</th>
<th>Sodium Benzoate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Station 5: Olfactory Receptor Fatigue (Smell)

<table>
<thead>
<tr>
<th></th>
<th>Right Nostril Fatigue Time</th>
<th>Left Nostril Fatigue Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clove Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peppermint Oil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Could you smell the peppermint oil immediately after sniffing the clove oil? What does this tell you about the nose’s ability to detect new or different odors?

### Station 6: Do You Hear What I Hear?

<table>
<thead>
<tr>
<th></th>
<th>Left Ear</th>
<th>Right Ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance at which sound no longer is heard</td>
<td>______ cm</td>
<td>______ cm</td>
</tr>
</tbody>
</table>
**Station 7: Taste Test**

<table>
<thead>
<tr>
<th></th>
<th>Dry Tongue</th>
<th>Moist Tongue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salty Snack</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plugged Nose</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unplugged Nose</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sweet Snack</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Your taste receptors allow your body to determine if foods are bitter, salty, sour, sweet, or umami (savory). What other structures work with your taste receptors to create the variety of flavors we experience throughout a meal? What evidence do you have to support your claim?

---

**Station 8: Afterimages**

What color is the afterimage for the orange paper strip?

What color is the afterimage for the green paper strip?
Multiple Choice

1. __________   3. __________   5. __________
2. __________   4. __________   6. __________

Constructed Response

7. ____________________________________________
8. ____________________________________________
9. ____________________________________________
10. ____________________________________________
Student Sheet 8.WA: Structure and Function Written Assessment Answer Sheet (page 2 of 2)

11. ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________

12. ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________

13. ____________________________________________________________________________________________
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    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________

14. ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________

15. ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
    ____________________________________________________________________________________________
Lesson Master 3.6: Cell Comic Rubric

<table>
<thead>
<tr>
<th>Comic Components</th>
<th>Possible Points</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Story Line</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The title is visible and clearly identifiable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• An effective, real-life setting represents a cell.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The story line is easy to follow and understand.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cell Structures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• At least six cellular structures are represented within the comic story line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cell structures are accurately applied to various people, places, or things within the chosen setting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Functions are accurately applied to each item chosen to represent a cell structure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Clear identifiers in the story line alert the reader to which cell structures are being represented.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The layout and design were effective for the presentation of the comic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The illustrations and/or images presented in the story line were relevant to the comic and enhanced the story overall.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson Master 4.GS: Photosynthesis Cards

Cut out the cards below. Then, using what you and your partner already know about photosynthesis, use the cards to construct a formula for photosynthesis. All the cards should be used in your model.

<table>
<thead>
<tr>
<th>Oxygen</th>
<th>→</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>Sugar (Glucose)</td>
<td>Light Energy</td>
</tr>
</tbody>
</table>

+ + +
<table>
<thead>
<tr>
<th></th>
<th>Exemplary</th>
<th>Proficient</th>
<th>Developing</th>
<th>Beginning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obtaining Information</strong></td>
<td>Students have thoroughly gathered information on a particular organ system and its subsystems.</td>
<td>Students have gathered information on a particular organ system and its subsystems.</td>
<td>Students have partially gathered information on a particular organ system and its subsystems.</td>
<td>Students have not gathered information on a particular organ system and its subsystems.</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Students have thoroughly explained the function of the organ system and how it relates to survival.</td>
<td>Students have explained the function of the organ system and how it relates to survival.</td>
<td>Students have partially explained the function of the organ system and how it relates to survival.</td>
<td>Students have not explained the function of the organ system and how it relates to survival.</td>
</tr>
<tr>
<td><strong>Subsystems: Organs</strong></td>
<td>Students have thoroughly described the organs, their functions, and how they work together to create this organ system.</td>
<td>Students have described the organs, their functions, and how they work together to create this organ system.</td>
<td>Students have partially described the organs, their functions, and how they work together to create this organ system.</td>
<td>Students have not described the organs, their functions, and how they work together to create this organ system.</td>
</tr>
<tr>
<td><strong>Subsystems: Tissues and Cells</strong></td>
<td>Students have thoroughly explained some examples of tissues and cells associated with this system.</td>
<td>Students have explained some examples of tissues and cells associated with this system.</td>
<td>Students have partially explained some examples of tissues and cells associated with this system.</td>
<td>Students have not explained some examples of tissues and cells associated with this system.</td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td>Students have used three or more credible sources of information for investigating their organ system.</td>
<td>Students have used three or more sources of information for investigating their organ system, but only some are credible. OR Students have used fewer than three resources and all resources were credible.</td>
<td>Students have used three or more sources of information for investigating their organ system, but they are not credible.</td>
<td>Students have not used three or more sources of information for investigating their organ system.</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>Presentation was well organized and informative.</td>
<td>Presentation was fairly organized and informative.</td>
<td>Presentation was disorganized but informative.</td>
<td>Presentation was not informative.</td>
</tr>
<tr>
<td><strong>Visual Aids</strong></td>
<td>Visual aids were relevant and effective for the presentation of information.</td>
<td>Visual aids were relevant and partially effective for the presentation of information.</td>
<td>Visual aids were relevant for the presentation of information.</td>
<td>There were no visual aids or visual aids were not relevant.</td>
</tr>
</tbody>
</table>
Lesson Master 6.4a: Frog Dissection Directions (page 1 of 3)

External Structures

1. Your teacher will provide both you and your partner with a frog. At any time during this investigation, you may use your hand lens to explore the structures associated with your frog. Once you receive your frog, carefully set down the frog and begin making observations. As the frog lies on its underside, you can observe its top half, which is called the dorsal surface. If you lay the frog on its back, you can observe its underside, which is referred to as its ventral surface.

2. Carefully observe the frog’s external structures. Record the structures that you observe and their functions on your student sheet.

3. Observe the frog’s eyes. As you examine the eyes, locate the frog’s third eyelid, known as a nictitating membrane. This structure is transparent when a frog is alive but might appear milky white now that the frog has been preserved. What do you think would be the function of this third eyelid? **Hint:** Consider the environment frogs live in.

4. Look behind the eyes on the side of the head and observe the circular tympanic membranes, or eardrums. Humans also have these types of membranes, but ours are inside the body. The function of these membranes is to transmit vibrations to the auditory nerves, which allow the frog to respond to its surrounding environment.

Extremities

5. Observe the upper extremities (the “arms”) of the frog. Compare the extremities to your own arms. Count the digits on each forelimb and record this number on your student sheet. In some frogs, the innermost digit might have a swollen pad. Male frogs have this structure during the breeding season.

6. Observe the lower extremities (the “legs”) next. Count the digits on each hind limb and record that number on your student sheet. How are the upper and lower extremities similar to your own arms and legs? How are they different? Record your answer on your student sheet.

7. Near the end of the body is the opening of the cloaca. Locate this structure. This opening is where feces, urine, and reproductive cells are expelled from the frog’s body and into the environment.

Mouth

8. Gently pry the frog’s mouth open and use the dissection scissors to cut the jaws at the joints. Examine the inside of the mouth. Observe the tongue and gently move it around. You should notice that the tongue is attached in the front of the frog’s mouth, while a human’s tongue is attached in the back. Why would having this front attachment better aid in the survival of a frog? Record your ideas on your student sheet.

9. Look at the roof of the frog’s mouth. On either side, you should observe two openings known as internal nares. If you look on the outside of the frog, you’ll see corresponding external nares. Use your Dissection Mat to determine their functions.

10. Place your index finger on the roof of the frog’s mouth and gently move it around. You should feel two bony bumps. These structures are called vomerine teeth. What do you think is their function? Record your idea on your student sheet.

11. Run your finger along the edge of the jaw. You should feel more teeth. These teeth are called maxillary teeth and are more similar to human teeth. If you look toward the back of the mouth, you should observe a round opening called the gullet opening. This connects the mouth and the stomach and directs the food to the esophagus. As the frog eats, the food is pushed down the esophagus to begin the digestion process.

12. Based on your observations so far, what evidence suggests that this animal is adapted to an aquatic environment? What evidence suggests that this frog is also adapted to a land environment? Answer these questions on your student sheet.

13. If you need to stop for the day, wrap your frog in a wet paper towel and place it back on your tray. This will help prevent your frog from drying out. Place the frog and tray in a large, resealable bag and close it. Write your names on the resealable bag with a permanent marker and place your frog in the designated storage area of the classroom. Be sure to wash your hands before leaving class.
Lesson Master 6.4a: Frog Dissection Directions (page 2 of 3)

Internal Structures

1. Place your frog ventral surface up (on its back) on the foam tray. Use the forceps to pinch the loose skin and insert the point of the scissors. Make a cut midway between the back legs all the way to the neck, as shown in Figure 1. At the neckline, cut across from one front leg to the other. Then, cut across the bottom of the frog from one hind limb to the other, as shown in Figure 1.

2. Pull back the flaps of skin to expose a thin layer of muscle. Observe the muscle and the inner layer of the skin. You may also notice some blood vessels in the skin and in the muscle. If the flaps of skin will not stay back on their own, carefully remove the flaps of skin using your scissors. Use your hand lens to explore the skin and muscle layers.

3. Carefully lift the muscle layer with your forceps and make an incision with the scissors. Follow the pattern of cuts in Figure 2. Do not cut too deep or you could damage the organs underneath. Carefully cut down the sides as well to remove the muscle completely.

4. You will also need to cut the bones of the pectoral girdle, as shown in Figure 2. This will allow you to easily navigate and explore the internal structures of the frog.

5. Gently use the forceps to explore the exposed organs. Explore the organs briefly and record your observations on your student sheet.

6. As you gently move the organs around, you should notice “strings” that connect the organs to each other and to the wall of the body cavity. To what level of cellular organization do these “strings” belong?
Lesson Master 6.4a: Frog Dissection Directions (page 3 of 3)

Reproductive System
1. Determine if your frog is a male or female with the aid of your Dissection Mat. Record your frog's sex on your student sheet and explain what evidence you have to support your claim.

2. If you have a female frog, locate the ovary and oviduct. If you have a male frog, locate the testis and seminal vesicle. Both the oviduct and seminal vesicle are connected to the cloaca. Why would both of these structures need to connect to the cloaca, the opening where materials are expelled from the frog's body? Record your ideas on your student sheet.

3. With your teacher's permission, find another group whose frog has the opposite sex as your frog. Observe the different reproductive structures in their frog.

4. If you have a female frog, remove the ovaries and oviduct and set them aside before continuing.

Digestive System
1. You now know that animals require food in order to survive. For many animals, food is broken down and absorbed into the body with the help of the digestive system. Explore the frog's internal structures and locate the organs that work together in the digestive system. Record the organs that you observe on your student sheet.

2. What evidence do you have that supports your claim about the organs that you chose? Record your answer on your student sheet.

3. Create an explanation, based on the evidence that you have collected, that follows the path that food takes once it enters the frog's mouth. Record your explanation on your student sheet.

Circulatory System
1. You learned about the circulatory system throughout this unit. Based on your knowledge, what structures would you expect the frog to have in its circulatory system? Locate these structures and then record your claim on your student sheet.

2. How is the circulatory system of a frog similar to a human's? What evidence do you have to support your claim? Record your answer on your student sheet.

Respiratory System
1. Based on your knowledge of the respiratory system, what structures would you expect to find in a frog? Record your answer on your student sheet.

2. Using evidence from your investigation, create an explanation that describes how the respiratory and circulatory systems depend on one another.

3. Human lungs take up a larger portion of our bodies than do a frog's lungs. Why do you think our lungs take up so much more room?

4. The dissection is now complete. Follow your teacher's directions for disposing of your specimen and cleaning up your work area. Be sure to wash your hands thoroughly after cleanup. Return to your seat and complete Step 6 in your Student Guide.
Lesson Master 7.3a: Station Procedures

Station 1: Temperature Receptors (Thermoreception)

Materials
■ 1 Cup of cold water
■ 1 Cup of room-temperature water
■ 1 Cup of warm water
■ Stopwatch (or a clock with a second hand)

Background
The skin is not only the largest organ but also the largest sensory organ of the body. The skin has many receptors that activate sensory neurons, allowing you to sense and respond to your environment. The skin responds to touch, pressure, temperature, and pain stimuli. During this activity, you will explore the skin’s sensitivity to temperature.

Procedure
1. Check and make sure that you have a cup of warm water, a cup of cold water, and a cup of room-temperature water at the station. If you do not, alert your teacher.
2. Select one person to perform the activity first. They will be the subject.
3. The subject must hold the cup of warm water in one hand and the cup of cold water in the other hand for 60 seconds.
4. After 60 seconds, have the subject set the two cups down and hold the cup of room-temperature water with both hands.
5. After completing the activity, the subject should record what they experienced on their student sheet.
6. Switch roles and repeat the process until everyone in the group has been tested.
7. Return all materials to their original location and clean up any spills that may have occurred.
8. After everyone has recorded their observation, discuss and answer the additional question on your student sheet.
Station 2: How Sensitive Are You?

Materials
- 2 Two-point discriminators

Background
The skin is not only the largest organ but also the largest sensory organ of the body. The skin has many receptors that activate sensory neurons, allowing you to sense and respond to your environment. The skin responds to touch, pressure, temperature, and pain stimuli. During this activity, you will explore pressure receptors in your skin.

Procedure
1. Divide your group into pairs. Each pair will need one of the two-point discriminators.
2. Decide which partner will go first. Have them place their hand palm-up on a flat surface like a table. Explain that you will be gently touching them with the two-point discriminator and they will need to let you know if they feel one or two points of contact.
3. Have your partner close their eyes to begin the investigation. Start with both points on the tool closed and at 0 mm. Touch your partner’s fingertip and they should only feel one point.
4. Create a 2 mm gap between the two points by moving the indicator to the 2 mm mark. Touch your partner’s fingertip with both points again and ask how many points of contact they feel this time.
5. Repeat Step 4, increasing the distance between both points until your partner reports feeling both points of contact from the tool. Record the distance between the two points on your student sheet in millimeters under “Fingertip/Trial 1.”
6. Repeat Steps 3–5 for the following parts of the body: back of the neck and mid-calf. Record each result in the “Trial 1” column of the table.
7. Repeat Steps 3–6 until you have conducted three trials at each location. Record the data collected under the appropriate section of the table.
8. Switch roles and repeat the process until everyone in the group has been tested.
9. Return all materials to their original location.
10. Determine the average for each location and record the information on your student sheet. Analyze the data and answer the remaining question for this station.
Lesson Master 7.3c: Station Procedures

Station 3: Locating Your Blind Spot

Materials
- Blind Spot Diagram
- Metric ruler

Background
Your eyes have the ability to sense and respond to light because of specialized neurons called photoreceptors. These photoreceptors are known as rods and cones. Both of these structures are part of the retina of your eye. Rods function well in dim light and perceive shades of gray, while cones work together to help humans see color. Rods are found in the front of the retina, while cones are more concentrated in the center of the retina. Nerve fibers from the rods and cones cluster together in a small area that forms the optic nerve. The optic nerve carries messages from your eye to your brain, allowing you to process what you see in your environment and then react. In this spot where the optic nerve is located, there are no photoreceptors and you cannot see any images. We call this area the “blind spot.” During this activity, you will locate the blind spot in both your right and left eyes.

Procedure
1. Select one person to perform the investigation first. They will be the subject.

2. Have the subject close their left eye and hold the Blind Spot Diagram at arm’s length. The plus sign should be directly in front of their right eye with the dot oriented away from the face.

3. The subject must stare directly at the plus sign. As they stare, have the subject begin to move the diagram very slowly toward them until the dot disappears.

4. Have the subject alert you when the dot disappears. Have one person in the group measure the distance (in centimeters) from the subject’s face to the diagram and record the distance on the subject’s student sheet.

5. Test the left eye next. Flip the diagram so that the plus sign is directly in front of the left eye and the dot is oriented away from the face. Have the subject close their right eye and repeat Steps 3–4 to find the blind spot in their left eye.

6. Switch roles and repeat the process until everyone in the group has been tested.

7. Return all materials to their original location.
Station 4: Taste Receptors

Materials
- 4 Cups
- 4 Paper towels
- Control taste paper
- Pitcher of water
- PTC taste paper
- Sodium benzoate taste paper
- Thiourea taste paper

Background
Humans have taste receptor cells located on their taste buds. Taste receptors respond to chemicals dissolved in saliva, allowing us to detect five taste qualities: bitter, salty, sour, sweet, and umami (savory). In order to taste something, the taste molecules in your mouth bind with a specific taste receptor on the tongue. This generates a signal that is sent from the cell to the brain, allowing you to detect a bitter, sweet, salty, sour, or umami taste. The shape of the person’s taste receptor determines the binding strength between the taste molecule and the receptor. The shape of each person’s receptors is influenced by their genes, or pieces of DNA, inherited from their parents. During this activity, you will taste four different taste papers in an attempt to activate different taste receptors. Keep in mind that some group members may not be able to taste some of the chemicals on the paper.

Procedure
1. Follow your teacher’s directions to properly clean your hands before beginning this activity.

2. Divide your paper towel into four sections. Label the four areas “Control,” “PTC,” “Sodium Benzoate,” and “Thiourea.”

3. Fill your cup halfway with water and place it near your paper towel. You will need to rinse your mouth after each taste paper. Be sure to swallow the water each time you rinse your mouth.

4. Test the control taste paper first. Each person should place the untouched end of the control taste paper on their tongue, and then move the paper around to ensure that it mixes with the saliva and comes into contact with numerous taste receptors. The control paper should be tasteless. Place the used taste paper on the “Control” section of your paper towel.

5. Rinse your mouth with some of the water from your cup.

6. Taste the PTC paper next. At the same time, have each person in your group place the untouched end of the PTC taste paper on their tongue. Move the paper around to ensure that it mixes with the saliva and comes into contact with numerous taste buds. Place the used PTC paper on the paper towel and record whether or not your receptors could taste the chemical on the table in your student sheet. If you could taste it, record what it tasted like in the same box.

7. Rinse your mouth with water and prepare for the next taste paper.

8. Repeat Steps 5–6 for the remaining taste papers.

9. Follow your teacher’s directions to properly dispose of the used taste papers, paper towels, and cups of water before going to your next station.
Lesson Master 7.3e: Station Procedures

Station 5: Olfactory Receptor Fatigue (Smell)

Materials
- Bottle of clove oil
- Bottle of peppermint oil
- Cotton swabs
- Erlenmeyer flask
- Resealable plastic bag
- Safety goggles
- Stopwatch (or a clock with a second hand)

Background
The olfactory receptors are a type of chemoreceptor that respond to chemicals, resulting in the variety of odors that humans can smell. These receptors are located high in the nasal cavity in the olfactory epithelium. This sensory organ is a tissue the size of a postage stamp. Odor molecules dissolve in a mucus layer around the receptor cells and then bind to the cell membrane. The axons of these cells carry the message to the brain for the smell to be processed.

In this activity, you will explore how long it takes for the phenomenon known as olfactory fatigue to occur. Olfactory fatigue is a temporary inability to distinguish an odor due to constant exposure to that smell.

Procedure
1. Each person in the group must put on a pair of safety goggles. Place a cotton swab in a flask. The head of the swab should be above the rim of the flask.
2. Select one person to perform the investigation first. They will be the subject. The subject should stand approximately 30 centimeters (1 foot) away from the flask. Have the test subject press on their left nostril with their left index finger to close it.
3. Place two drops of clove oil on the head of the cotton swab. Start the stopwatch or note the time on the clock. At the same time, have the subject gently waft the odor toward their nose by gently fanning the air with their right hand while inhaling through the right nostril only. The subject should breathe in through their right nostril and out through their mouth.
4. Have the subject continue to sniff the odor at a normal rate until the smell is no longer detectable or has greatly diminished. Record the elapsed time on their student sheet under “Right Nostril Fatigue Time.”
5. Have the subject release the left nostril and close the right nostril with their right index finger. They should waft the odor from the clove oil toward their nose with the left hand. Be sure to reset the stopwatch or note the time on the wall clock.
6. Have the subject continue to sniff the odor at a normal rate until the smell is no longer detectable or has greatly diminished. Record the elapsed time on their student sheet under “Left Nostril Fatigue Time” and place the used swab in the resealable plastic bag and seal it.
7. Repeat Steps 1–6 using the peppermint oil and record the results on the subject’s student sheet.
8. Switch roles and repeat the process until everyone in the group has been tested.
9. Analyze the data collected and discuss and answer the remaining question for this activity on your student sheet.
Lesson Master 7.3f: Station Procedures

Station 6: Do You Hear What I Hear?

Materials
- Meterstick
- Tuning fork

Background
The ear is divided into three sections, which aid in our ability to hear the world around us. The outer ear gathers the incoming sound waves and funnels them to the eardrum. The middle ear consists of three tiny bones called the malleus, the incus, and the stapes, which work together to transmit sound vibrations from the eardrum to the inner ear. The inner ear contains a structure called the cochlea, which is responsible for sound reception. The cochlea is a fluid-filled organ that looks like a snail’s shell, containing motion-sensitive hairs that are the nerve receptors for hearing. The vibrations transferred from the middle ear stimulate the hair cells. The signals from the stimulated hair cells are changed into nerve impulses. These impulses travel to the acoustic nerve and eventually to the brain to be processed.

Procedure
1. Select one person to perform the investigation first. They will be the subject. Instruct the subject to close their eyes and plug one ear with a finger.

2. Grip the tuning fork by the handle and strike the prongs of the tuning fork against the edge of the table to set the fork in motion. Be careful not to touch the prongs while the fork is vibrating.

3. Immediately place the tuning fork close to the subject’s open ear. Move the tuning fork outward, away from the ear in a straight line, until the subject no longer can hear the sound.

4. Use the meterstick and record the distance, in centimeters, between the ear and the distance at which the subject no longer can hear the sound.

5. Repeat the experiment with the subject’s other ear and compare the distances. Note: Be sure to strike the tuning fork with equal force and to move the fork away from the subject at the same speed each time.

6. Switch roles and repeat the process until everyone in the group has been tested.
Station 7: Taste Test

Materials
- 4 Cups of water
- Paper towels
- Pitcher of water
- Salty snacks
- Sweet snacks

Background
Humans have taste receptor cells located on their taste buds. Taste receptors respond to chemicals dissolved in saliva, allowing us to detect five taste qualities: bitter, salty, sour, sweet, and umami (savory). In order to taste something, the taste molecules in your mouth bind with a specific taste receptor on the tongue. This generates a signal that is sent from the cell to the brain, allowing you to detect a bitter, sweet, salty, sour, or umami taste. Other factors play a role in “tasting” food as well. During this activity, you will be tasting two different types of foods to determine other factors that assist our taste buds in determining flavors.

Procedure
1. Follow your teacher’s directions to properly clean your hands before beginning this activity.

2. You will use your cup of water to rinse your mouth after each taste activity. Be sure to swallow the water each time you rinse your mouth. Fill your cup half halfway with water and place it somewhere close to you.

3. Have each person in the group take a paper towel and dry their tongues.

4. Once your tongue is dry, take a bite of your salty snack and note the flavor of the food. Record your observations on your student sheet.

5. Take a sip of water from your cup to rinse your mouth. Taste the remaining part of the salty snack. Did the flavor change? Record your observations on your student sheet.

6. Take a sip of water to remove any flavor from the salty snack.

7. Close both nostrils by pressing down on them with your index finger and thumb.

8. Place the sweet snack in your mouth and begin chewing. Observe how the food tastes.

9. After a second or two, unplug your nose but continue chewing. How does the food taste now? Record your observations on your student sheet and then answer the remaining question for this station.

Safety Warning
- If you have any food allergies, let your teacher know immediately.
Lesson Master 7.3h: Station Procedures

Station 8: Afterimages

Materials

- 1 Green paper strip
- 1 Orange paper strip
- 1 Sheet of white paper
- Stopwatch (or a clock with a second hand)

Background

Your eyes have the ability to sense and respond to light because of specialized neurons called photoreceptors. These photoreceptors are known as rods and cones and are named for their shape. Both of these structures are part of the retina of your eye. The human eye contains about 125 million rods, which function well in dim light and perceive shades of gray, and approximately 6 million cones, whose function is to detect color.

Each rod or cone contains a visual pigment that detects a range of light wavelengths and shades of color. As the visual pigments absorb light energy, the molecules change shape and they no longer are able to detect light. This causes the pigments to become temporarily unresponsive. It can take a few minutes for the visual pigments to return to their original shape, eventually detecting light again. Each night when you turn off the light, your eyes need time to adjust from the bright light to darkness. The same is true when you turn on the bathroom light during the middle of the night. Your eyes must adjust from darkness to bright light.

During this activity, you will investigate the effects of how the cones of the retina can become fatigued and unresponsive for short periods of time.

Procedure

1. Select one person to perform the activity first. They will be the subject. Place an orange paper strip on a sheet of white paper.

2. Have the subject stare at the color strip for 30 seconds without moving their eyes. This intense color will begin to degrade the cones reacting to this color. After 30 seconds, remove the color strip while the subject still stares at the area where the color strip was.

3. The retina is unable to respond immediately to the change in the intensity of color, and the subject should see a rectangular afterimage where the color strip was. What color is the afterimage? Record the subject’s answer on their student sheet.

4. Repeat Steps 1–3 with the green paper strip.

5. Switch roles and repeat the process until everyone in the group has been tested.

6. Return all materials to their original location.
Lesson Master 7.3i: Blind Spot Diagram

Blind Spot Diagram (Station 3)

+  ●

Blind Spot Diagram (Station 3)

+  ●

Blind Spot Diagram (Station 3)

+  ●
<table>
<thead>
<tr>
<th></th>
<th>Exemplary</th>
<th>Proficient</th>
<th>Developing</th>
<th>Beginning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtaining Information</td>
<td>Students have thoroughly gathered information on their animal.</td>
<td>Students have gathered information on their animal.</td>
<td>Students have partially gathered information on their animal.</td>
<td>Students have not gathered information on their animal.</td>
</tr>
<tr>
<td>Animal Structures</td>
<td>Students have identified six structures associated with their animal.</td>
<td>Students have identified four structures associated with their animal.</td>
<td>Students have identified two structures associated with their animal.</td>
<td>Students have identified one structure associated with their animal.</td>
</tr>
<tr>
<td>Function of Structures</td>
<td>Students have thoroughly described the functions of all structures listed and how each relates to the animal’s survival.</td>
<td>Students have described the functions of most of the structures listed and how each relates to the animal’s survival.</td>
<td>Students have described the functions of some of the structures listed and how each relates to the animal’s survival.</td>
<td>Students have not described the functions of any structures listed or how they relate to the animal’s survival.</td>
</tr>
<tr>
<td>Unique Structure</td>
<td>Students have identified and thoroughly explained at least one unique structure and its function associated with their animal.</td>
<td>Students have identified and explained at least one unique structure and its function associated with their animal.</td>
<td>Students have identified one unique structure associated with their animal but did not explain the structure’s function.</td>
<td>Students have not identified one unique structure associated with their animal.</td>
</tr>
<tr>
<td>Unique Structure’s Connection to Body Systems</td>
<td>Students have thoroughly described the body system(s) involved with the animal’s unique structure.</td>
<td>Students have described the body system(s) involved with the animal’s unique structure.</td>
<td>Students have partially described the body system(s) involved with the animal’s unique structure.</td>
<td>Students have not described the body system(s) involved with the animal’s unique structure.</td>
</tr>
<tr>
<td>The Nervous System’s Role</td>
<td>Students have thoroughly explained the relationship between the nervous system and the animal’s unique structure.</td>
<td>Students have explained the relationship between the nervous system and the animal’s unique structure.</td>
<td>Students have partially explained the relationship between the nervous system and the animal’s unique structure.</td>
<td>Students have not explained the relationship between the nervous system and the animal’s unique structure.</td>
</tr>
<tr>
<td>Sources</td>
<td>Students have used three or more credible sources of information in researching their animal.</td>
<td>Students have used three or more sources of information in researching their animal, but only some are credible. OR Students have used fewer than three resources and all resources were credible.</td>
<td>Students have used three or more sources of information in researching their animal, but they are not credible.</td>
<td>Students have not used three or more sources of information in researching their animal.</td>
</tr>
<tr>
<td>Presentation</td>
<td>Presentation was well organized and informative.</td>
<td>Presentation was fairly organized and informative.</td>
<td>Presentation was disorganized but informative.</td>
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<tr>
<td>Poster</td>
<td>The poster was relevant and effective for the presentation of information.</td>
<td>The poster was relevant and partially effective for the presentation of information.</td>
<td>The poster was relevant for the presentation of information.</td>
<td>There was not a poster or the poster was not relevant.</td>
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</tbody>
</table>
Directions: Use Student Sheet 8.WA: Structure and Function Written Assessment Answer Sheet to record your answers to the questions on this assessment. Make no marks on this sheet.

Multiple Choice

1. The structure most commonly associated with eukaryotic cells is
   a. a cell membrane.
   b. a nucleus.
   c. cytoplasm.
   d. a cell wall

2. Which of the following statements describes cellular respiration?
   a. Autotrophs, such as plants, use energy from the Sun along with oxygen and water from their environment to produce the sugar needed for survival. At the same time, autotrophs release carbon dioxide back into the environment.
   b. Heterotrophs, such as animals, break down food with the help of carbon dioxide in order to release energy needed for survival.
   c. Both heterotrophs and autotrophs produce food by using the Sun’s energy.
   d. Both heterotrophs and autotrophs break down food with the help of oxygen in order to release energy needed for survival.

3. Which of the following statements describes cells?
   (1) All cells look the same and contain the same organelles.
   (2) All living things are composed of one or more cells.
   (3) There are two types of cells: plant cells and animal cells.
   (4) An organism made of more than one cell also has varied, or different, cells that enable them to survive.
   a. 1 and 3
   b. 2 and 3
   c. 2 and 4
   d. 2, 3, and 4

4. All cells have this structure, which regulates what can come into and pass out of the cell.
   a. Cell membrane
   b. Cell wall
   c. Nucleus
   d. Cytoplasm

5. Which term best describes organs working together to perform a particular function?
   a. Tissue
   b. Organ
   c. Organ system
   d. Organism

6. Which of the following organisms are considered unicellular?
   (1) Euglena (2) Bacteria (3) Venus flytrap (4) Paramecium
   a. 1 and 3
   b. 1, 2, and 3
   c. 2, 3, and 4
   d. 1, 2, and 4
Lesson Master 8.WA: Structure and Function Written Assessment (page 2 of 3)

**Constructed Response**

7. Draw a model that displays how matter and energy move through an autotroph and its environment during photosynthesis.

8. Explain how the human body is a system of interacting subsystems that depend on one another for survival.

9. You notice that you have a new soccer coach and walk over to introduce yourself. Explain how the nervous system allowed you to process information and accomplish this task as well as remember your new coach’s name at the next practice.

10. Analyze the cladogram below. Provide evidence to support whether a fish is more closely related to an insect or to an amphibian.

---

**Cladogram**

- **Insects**
- **Fish**
- **Amphibians**
  - **Birds**
  - **Prosimians**
  - **Humans**

- **Hair**
- **Bipedal** (walk on two feet)
- **Endothermic**
- **Tetrapod**
- **Vertebrate**
- **Eukaryotic**

CREDIT: Margaret Baxter/© Carolina Biological Supply Company
11. Explain how plant cells and animal cells are similar and how they are different from one another.

12. Describe five structures and their functions that help a lion to better survive in its environment.

13. Analyze the animal embryos below. Observe the similarities and differences among the body structures evident at the beginning of development.
   a. What patterns of similarities do you observe among these four animal embryos?
   b. What happens to structures in these embryos as they continue to grow and develop?
   c. What evidence do the early structures in the developing embryos provide?

[Images of four animal embryos: Fish, Reptile, Bird, Human]

14. A whale is larger than sea otter. Does this mean the whale has larger cells? Explain your answer.

15. Explain how the processes of photosynthesis and cellular respiration relate to one another.