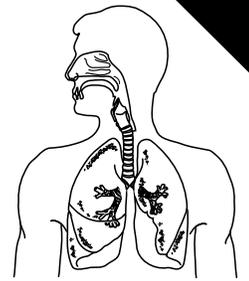


Fish vs. Human Respiration:

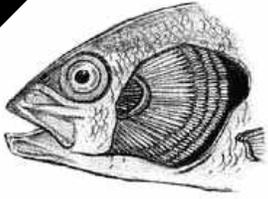
External, Internal and Cellular



Teacher's Instructions:

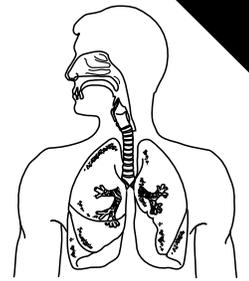
- 1) Pre-read pages 1 and 2 to become familiar with the teacher's instructions, objectives, student tasks and references.
- 2) Activate students' prior knowledge of respiration by guiding a class discussion as follows:
 - ask students to breathe in and out deeply,
 - ask "Why do we breathe?" (answer: to get oxygen),
 - ask "Why do we need oxygen?" (answer: to live),
 - help students arrive at the understanding that our bodies and cells need oxygen to convert the food that we eat into energy and use this energy to carry out our life processes,
 - ask "What is respiration" (answer: from 'breathing' to 'the process by which living organisms take up oxygen, release carbon dioxide and produce energy').
- 3) Inform students that they will be learning the different parts of respiration (external, internal and cellular) while learning how fish and humans breathe.
- 4) Hand out copies of pages 2-15 to each student. Have students read page 2 to 4 (Objectives, Tasks and Key Terms).
- 5) Read the Background on pages 5-9 as a class pausing whenever necessary to clarify points or draw diagrams on the board.
- 6) Have students complete Activity A (pages 10, 11, 12) and Activity B (pages 10, 13, 14).
- 7) Have students complete the assignment on page 15.
- 8) Correct the activities and assignment using the Answer Keys on page 16-18.





Fish vs. Human Respiration:

External, Internal and Cellular



Objectives:

- to distinguish between cellular, internal and external respiration.
- to identify major structures and functions of fish and human respiratory systems from a diagram, model or specimen.

Student Tasks:

- 1) Participate in the class discussion.
- 2) Read the background on pages 5-9 as a class and ask questions as necessary.
- 3) Complete activities A and B on pages 10-14.
- 4) Complete the assignment on page 15.

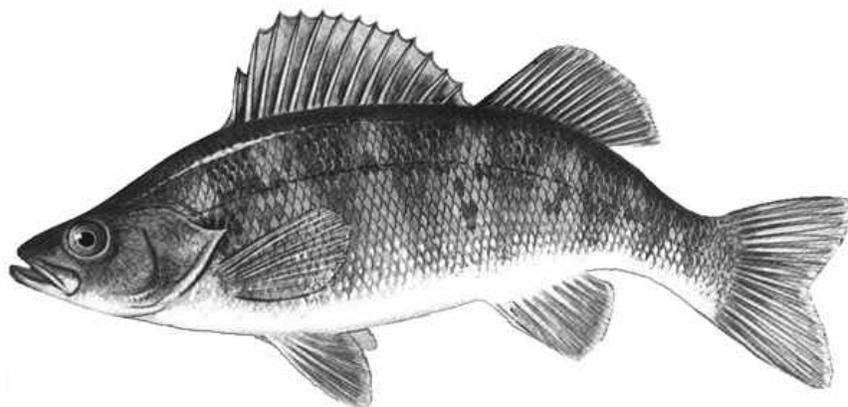
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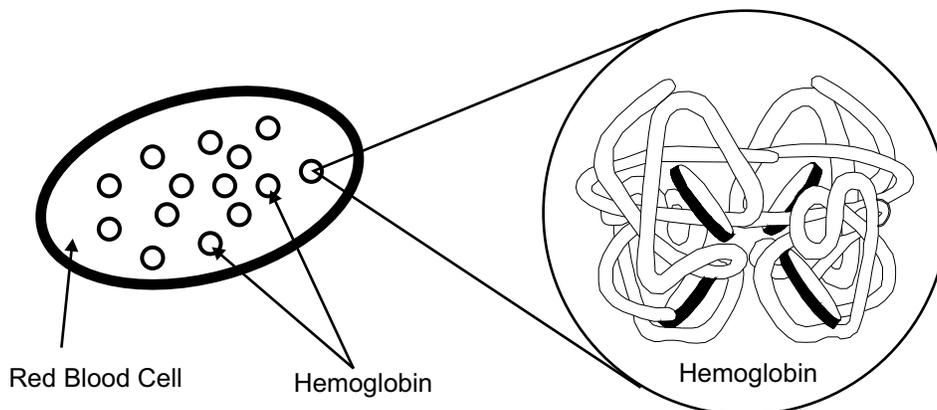
Taylor, M. (2002). Understanding Cellular Respiration. Retrieved August 4, 2004 from:
http://tx.essortment.com/cellularrespira_rmpr.htm



Fish vs. Human Respiration: External, Internal and Cellular

Key Terms:

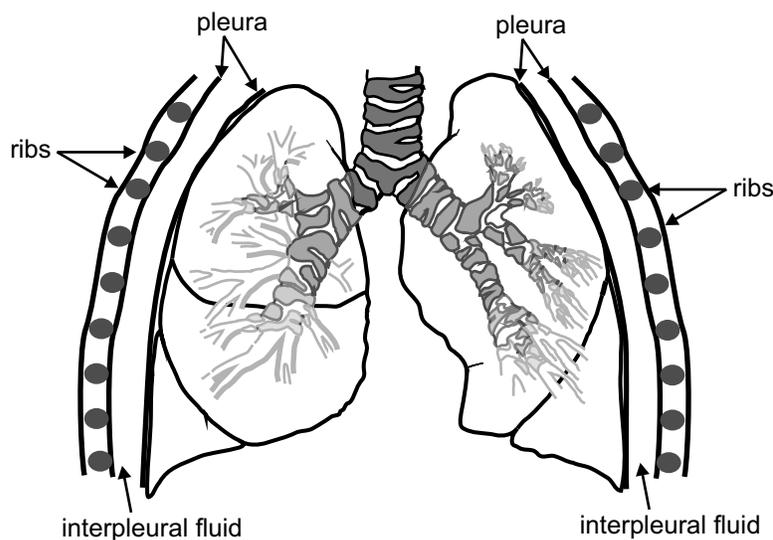
KEY TERM	DEFINITION
affinity	natural attraction
alveoli	tiny, thin-walled air sacs at the end of the bronchiole branches where gas exchange occurs.
bronchiales	numerous small tubes that branch from each bronchus into the lungs and lead air into the lungs.
bronchioles	numerous small tubes that branch from each bronchiale and lead air into the lungs.
bronchi	branches of the trachea that lead air from the trachea into the lungs.
capillary	a minute blood vessel.
diaphragm	muscle at the base of the chest cavity that is responsible for breathing. It contracts and relaxes during breathing.
epiglottis	a flap of tissue that closes over the trachea when you swallow so that food does not enter your airway.
filaments	threadlike structures on a gill.
gills	the respiratory organs of most aquatic animals, including fish.
gill cover (opercullum)	a hard flap that covers a fish's gill.
hemoglobin	part of red blood cells that transports oxygen.
intercostal muscles	muscles along the rib cage that assist in breathing.



Fish vs. Human Respiration: External, Internal and Cellular

Key Terms: (continued...)

KEY TERM	DEFINITION
interpleural fluid	the fluid in between the pleural membranes of the lungs.
lamella	a thin layer of bone or tissue in the gills.
larynx	voice box where the vocal chords are located.
lungs	elastic structures that bring air into the body.
nasal cavity	a chamber located above the mouth and below the floor of the cranium that is enclosed by bone or cartilage.
pharynx	section of the respiratory system that extends from the mouth and nasal cavity to the larynx.
pleura (pleural membranes)	a thin membrane in mammals that surrounds each lung and folds back to make a lining for the chest cavity.
pulmonary capillaries	small blood vessels that surround the alveoli.
respiratory system	lungs, airways leading to lungs and chest, and structures responsible for the movement of air into and out of them.
ribs	a series of long curved bones that extend from the spine to the sternum.
trachea	rigid tube that connects the mouth with the bronchi, also called "windpipe".
uvula	a small, conical, fleshy mass of tissue suspended at the back of the mouth (the "hangy thing" at the back of your mouth).



Fish vs. Human Respiration: External, Internal and Cellular

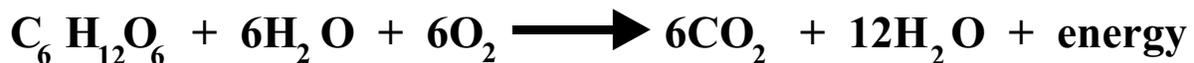
Background: Refer to the diagrams below and on page 6.

Respiration is a biochemical process by which living organisms take up oxygen, release carbon dioxide and produce energy. There are three main stages of respiration: external, internal and cellular.

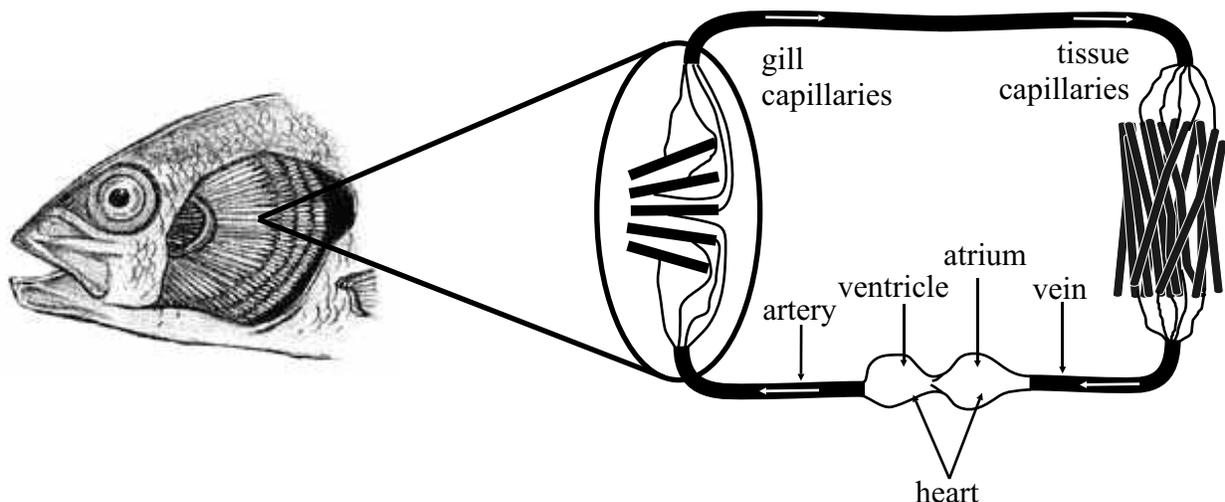
For a yellow perch (or any species of fish), respiration begins when it opens its mouth to take in water. The water passes over a set of gills and the lamella direct the water over filaments. These filaments are attached to the gills and supplied with blood. The concentration of oxygen is higher in the water than in the blood so oxygen enters the blood and carbon dioxide leaves it. This is called **external respiration**.

The newly oxygenated blood is carried throughout the fish's body. As this blood comes into contact with tissues that are low in oxygen, **internal respiration** occurs. Oxygen leaves the blood and enters the tissue. At the same time, carbon dioxide leaves the tissue and enters the blood.

Cells in the tissue use the oxygen to produce energy through **cellular respiration**. The energy produced is in the form of ATP (adenosine triphosphate) molecules. The balanced equation of cellular respiration is:

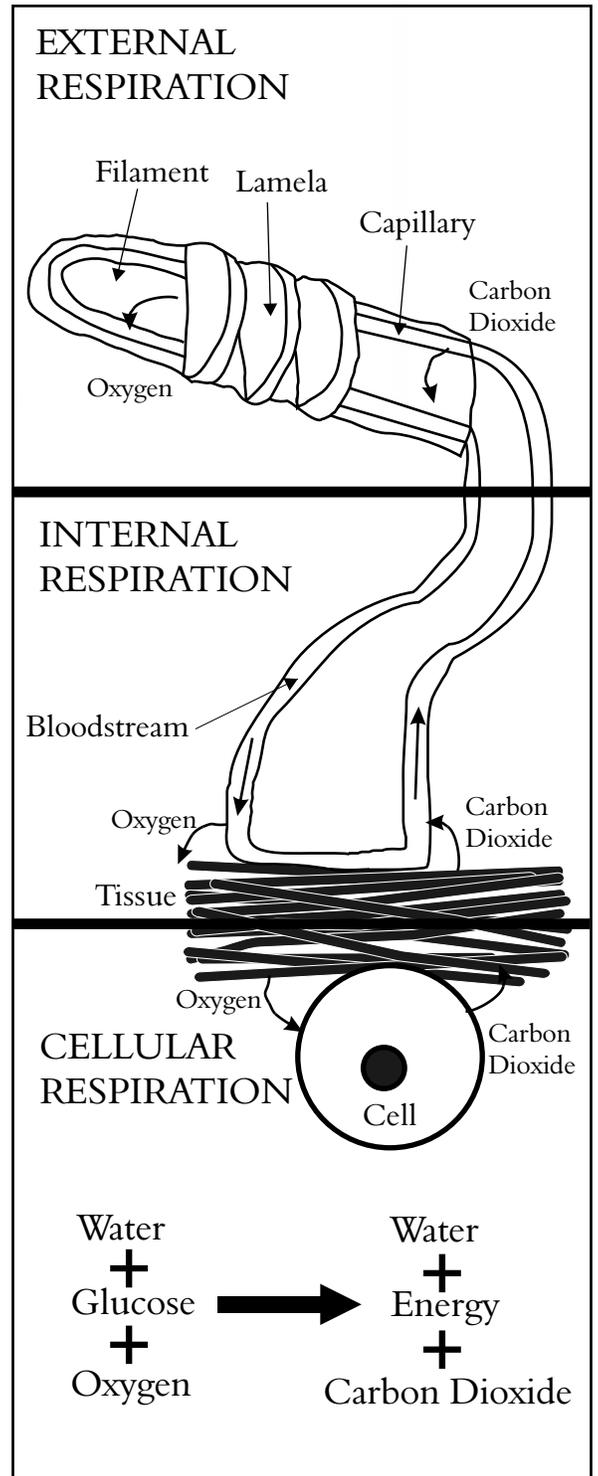
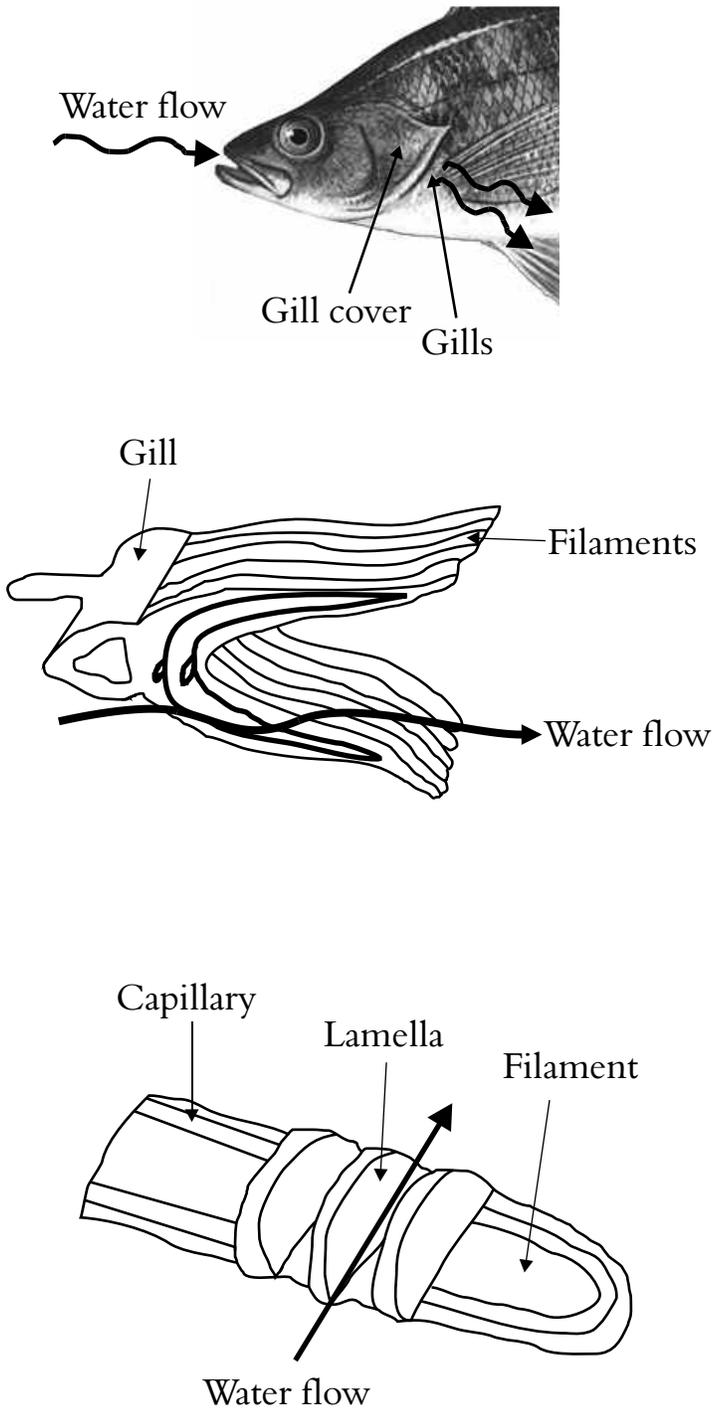


The carbon dioxide produced by cellular respiration enters the blood during internal respiration. The blood carries it to the filaments in the gills. Carbon dioxide leaves the blood during external respiration and is expelled in the water.



Fish vs. Human Respiration: External, Internal and Cellular

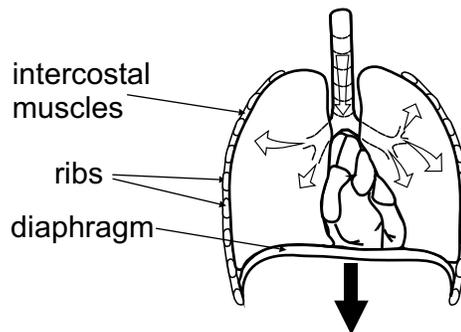
Diagram:



Fish vs. Human Respiration: External, Internal and Cellular

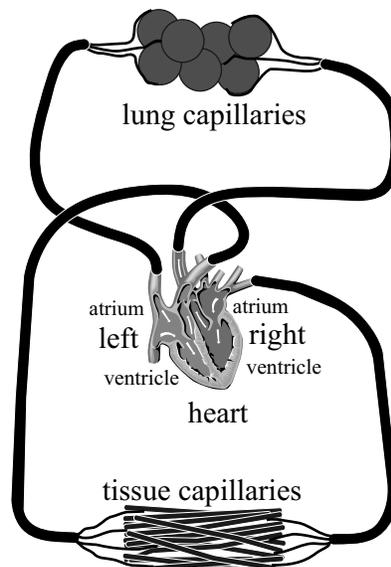
Background: Refer to the diagrams below and on page 9.

For humans, respiration begins when we inhale. The chest cavity expands as the diaphragm and intercostal muscles contract. Air enters the lungs since the air pressure inside the lungs is less than the air pressure of the atmosphere. The chest cavity and lungs are surrounded with membranes called pleura. In between these membranes is a substance called interpleural fluid. These membranes and fluid preserve a vacuum in the chest and enables us to breathe. This vacuum ensures that our lungs inflate and deflate as the chest cavity expands and contracts.



Air enters the body and is warmed, moistened and filtered through the nasal cavity. Then it moves past the uvula and epiglottis. The exact function of the uvula is unknown. Some specialists say it plays a role in speech, swallowing and snoring. It may prevent food from going back up into your nose when you swallow and/or help prevent choking as it triggers the “gag reflex” when something touches it. The epiglottis is a flap of tissue that covers the larynx and trachea when you swallow so that you don’t choke.

Next the air travels through the pharynx, larynx and into the trachea. The pharynx is located at the back of the throat and leads to the larynx. The larynx contains the vocal chords and leads to the trachea. The trachea is lined with fine hairs called cilia which filter the air before it enters the lungs.



Fish vs. Human Respiration: External, Internal and Cellular

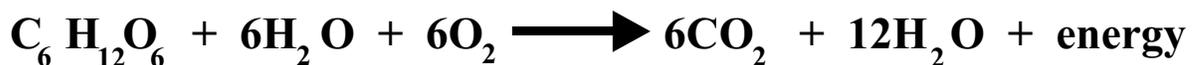
Background: (continued...)

After the trachea, the air passes through the bronchi and into the lungs. In the lungs, it follows narrower and narrower bronchioles until it reaches the alveoli. Alveoli are grape-like clusters that enable gas exchange to take place.

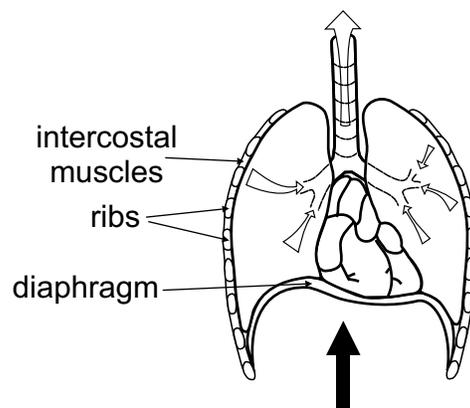
As air enters the alveoli, the oxygen concentration of the alveoli becomes higher than the oxygen concentration of the blood in the pulmonary capillaries. This allows the oxygen to pass or diffuse across the membrane of the alveoli into the blood. This is called **external respiration**. The hemoglobin in these capillaries has very little oxygen and a lot of carbon dioxide bound to it. Hemoglobin has an affinity for oxygen so it releases carbon dioxide and takes up the oxygen.

The newly oxygenated hemoglobin is transported in the blood throughout the body. Body tissues that are low in oxygen and high in carbon dioxide will take oxygen from and give carbon dioxide to the hemoglobin. This is called **internal respiration**.

The oxygen is used by the cells in the tissue to produce energy. This is called **cellular respiration**. The energy produced is in the form of ATP (adenosine triphosphate) molecules. The balanced equation of cellular respiration is:

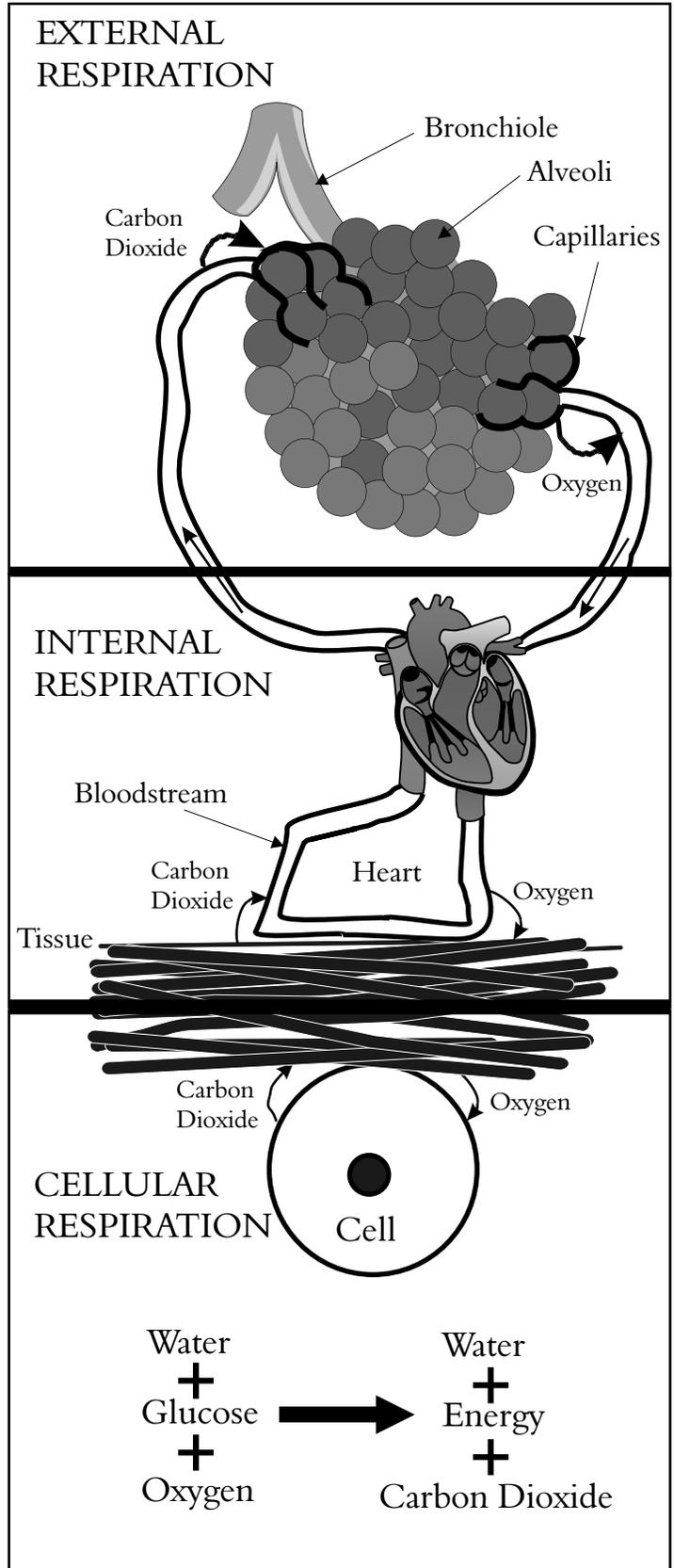
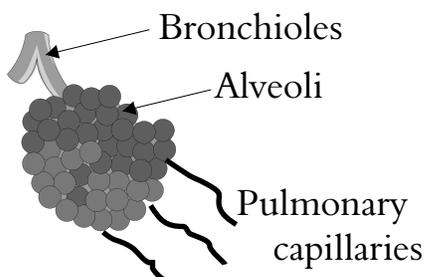
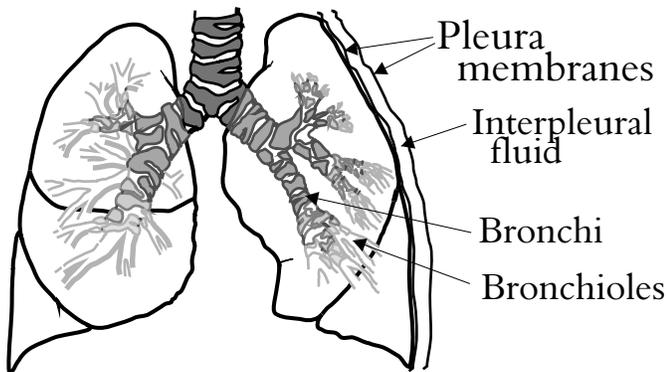
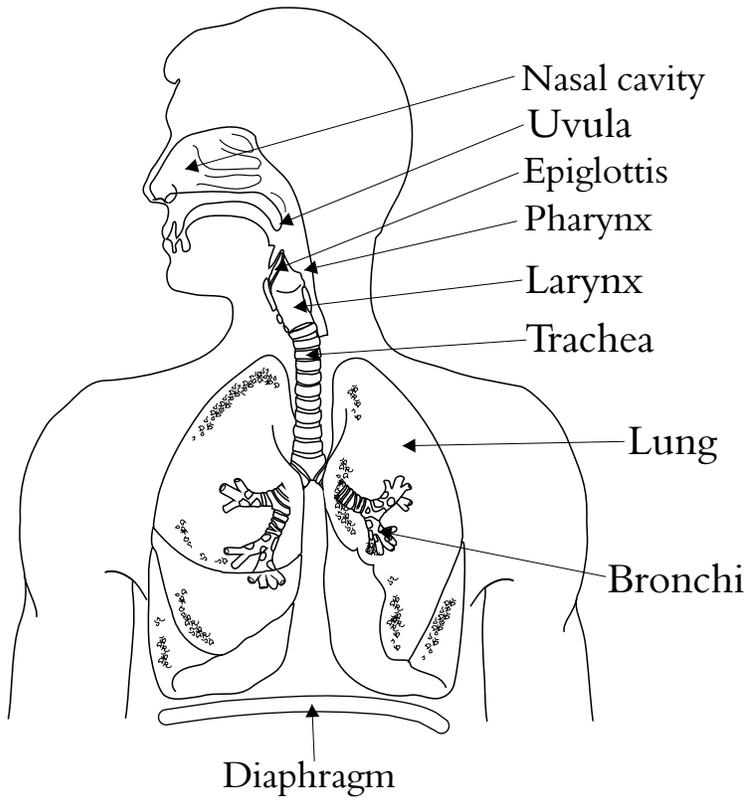


The carbon dioxide produced by cellular respiration attaches to hemoglobin in the blood during internal respiration. The blood carries it to the alveoli in the lungs. Carbon dioxide leaves the blood and enters the alveoli during external respiration and is expelled when humans exhale. To exhale, the diaphragm moves up and the intercostal muscles relax. This chest cavity becomes smaller and air is forced out. The entire process of respiration happens very quickly - within seconds.



Fish vs. Human Respiration: External, Internal and Cellular

Diagram:



Fish vs. Human Respiration: External, Internal and Cellular

Activity A:

Follow these steps to build models of the different parts of a fish's respiratory system.

- 1) Cut along all dotted lines on page 11.
- 2) Cut out the hole for the gill (the white area on the fish).
- 3) Glue or tape the gill on the spot indicated on the fish. Be sure to only glue part of the gill and leave part of it unglued so that it can move.
- 4) Glue or tape the gill cover (operculum) on top of the gill. Be sure to only glue part of the gill cover and leave part of it unglued so that it can move.
- 5) Arrange the stream water with the fish and gill so that it corresponds to the direction of water flow in the diagram on page 6.
- 6) Fold the lamella on the dots so that they stand at a right angle to the filament, glue them together and arrange the stream of water so that it corresponds to the direction of water flow on the diagram on page 6.
- 7) Use page 12 to glue down the fish and filament.
- 8) Arrange the tissue, blood stream and cell on the paper and glue them down.
- 9) Place oxygen and carbon dioxide arrows at the sites of external respiration, internal respiration and cellular respiration and label each site accordingly.

Activity B:

Follow the steps to build models of the different parts of a human's respiratory system.

- 1) Cut along all dotted lines on page 13.
- 2) Glue or tape the pieces in the correct order and location on the body outline or in the appropriate box on page 14.
- 3) Label all the structures and write a brief description of their function on the back of the paper:

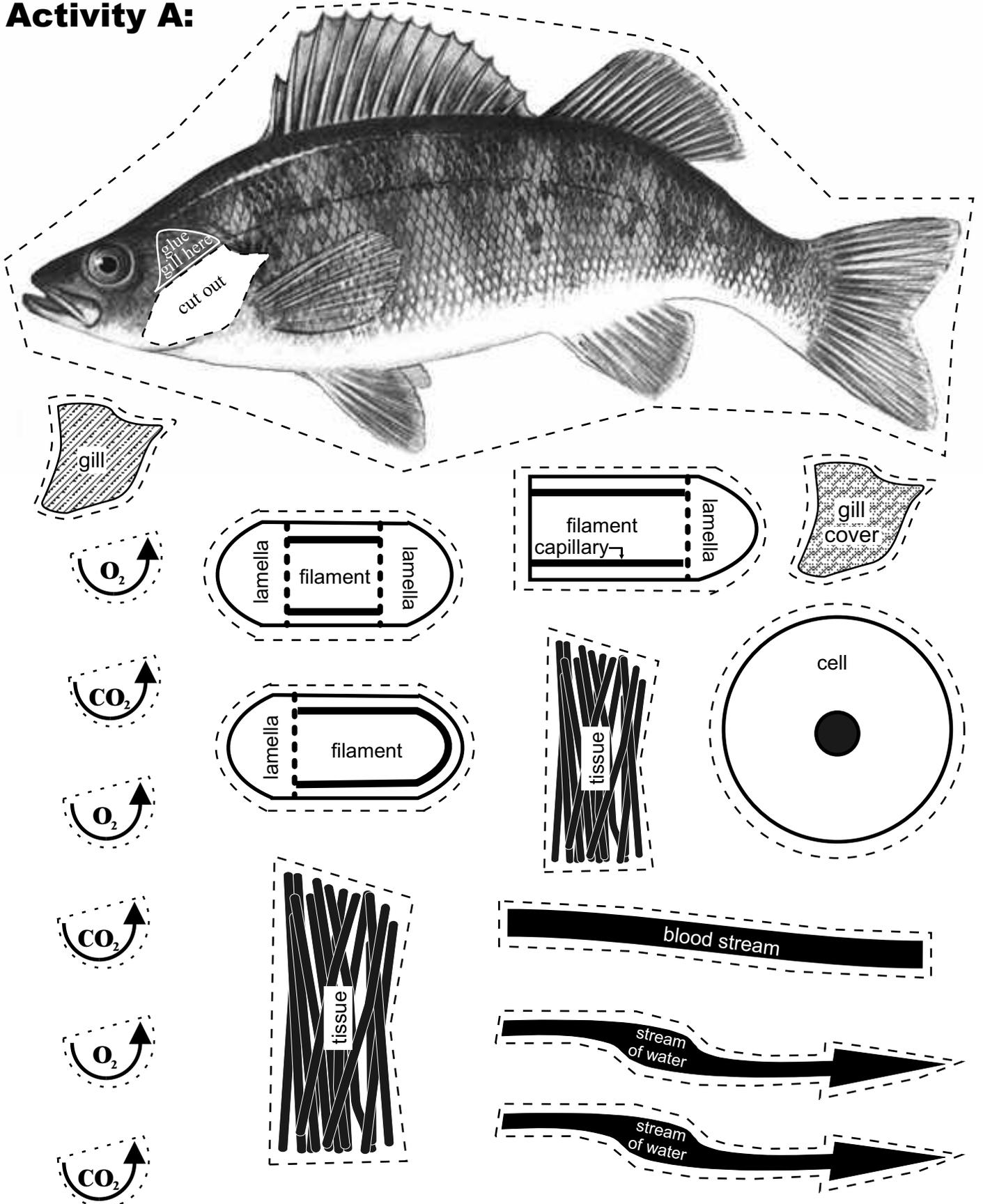
- | | | | |
|-----------|--------------|----------------|-------------------------|
| - lungs | - ribs | - nasal cavity | - bronchioles |
| - pleura | - epiglottis | - bronchi | - interpleural fluid |
| - alveoli | - pharynx | - diaphragm | - pulmonary capillaries |
| - uvula | - trachea | - larynx | - intercostal muscles |

- 4) Draw a 'flow of air' arrow and label the direction of oxygen and carbon dioxide flow.
- 5) Place oxygen and carbon dioxide arrows at the sites of external respiration, internal respiration and cellular respiration and label each site accordingly (hint: one site of respiration will be in the body diagram and the other two sites will be in the boxes).



Fish vs. Human Respiration: External, Internal and Cellular

Activity A:



Activity A:

FISH

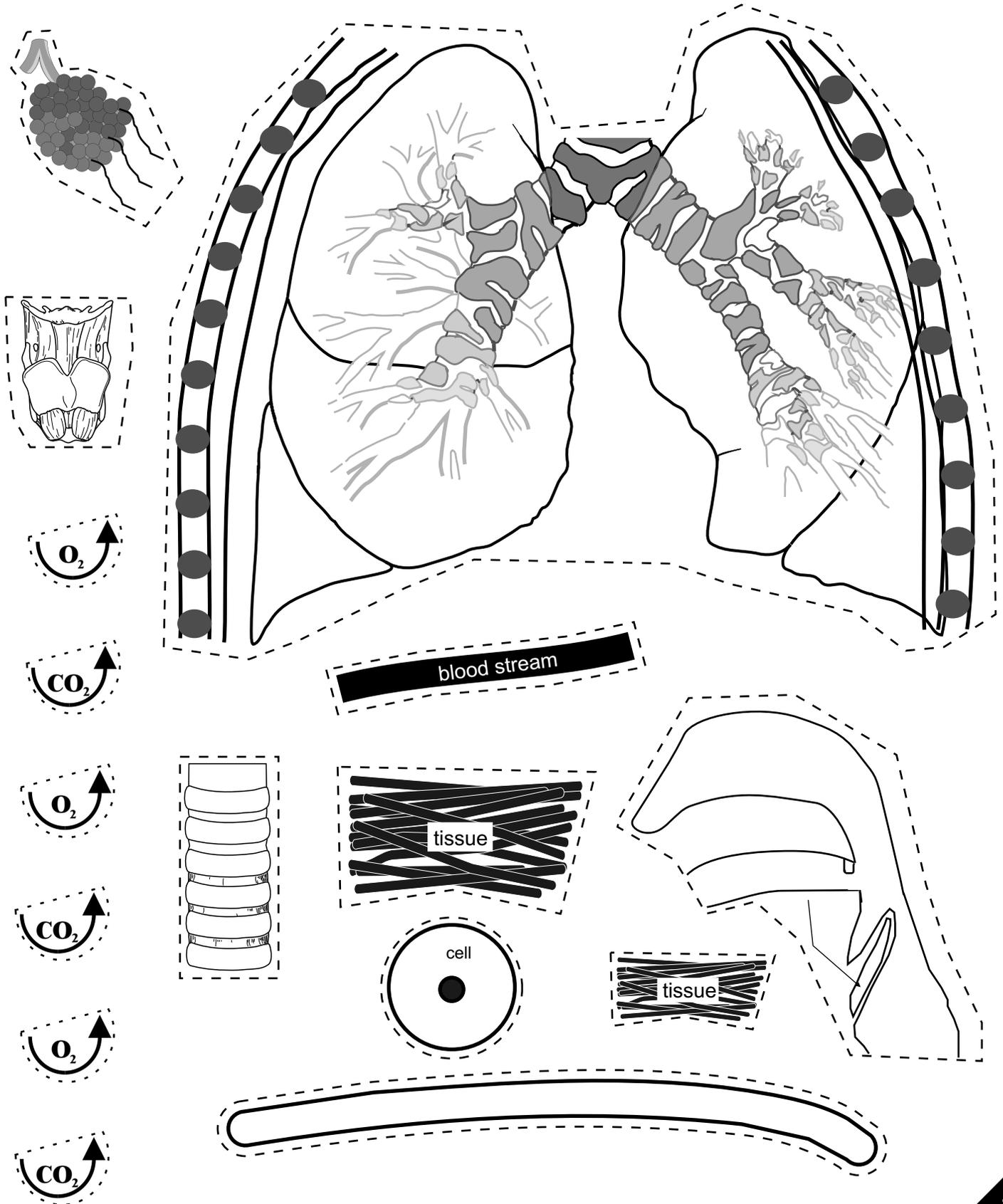
_____ Respiration

_____ Respiration

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Fish vs. Human Respiration: External, Internal and Cellular

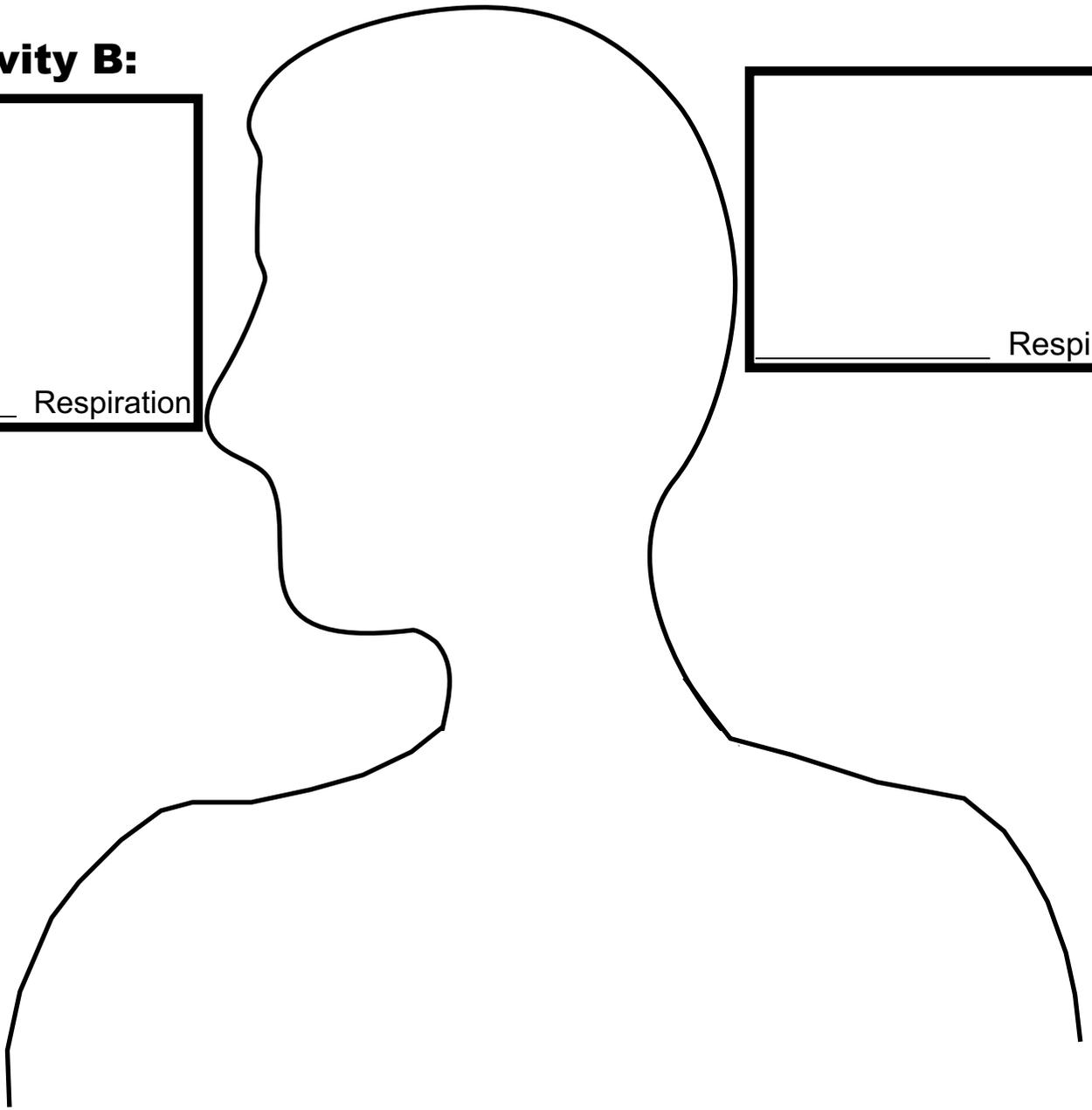
Activity B:



Activity B:

_____ Respiration

_____ Respiration

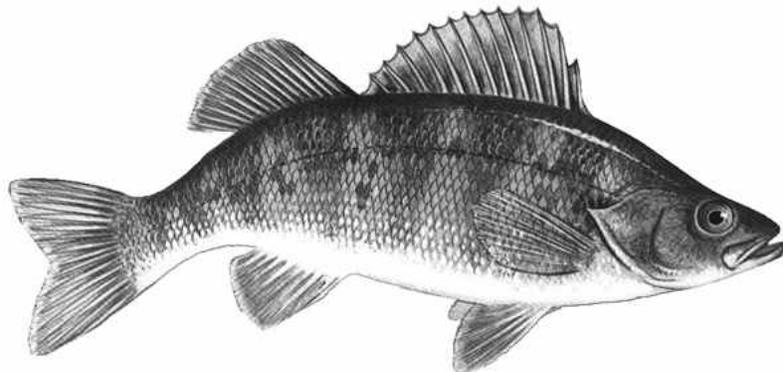


Fish vs. Human Respiration: External, Internal and Cellular

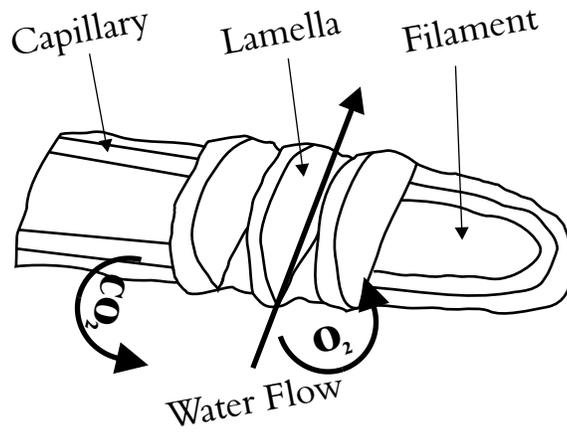
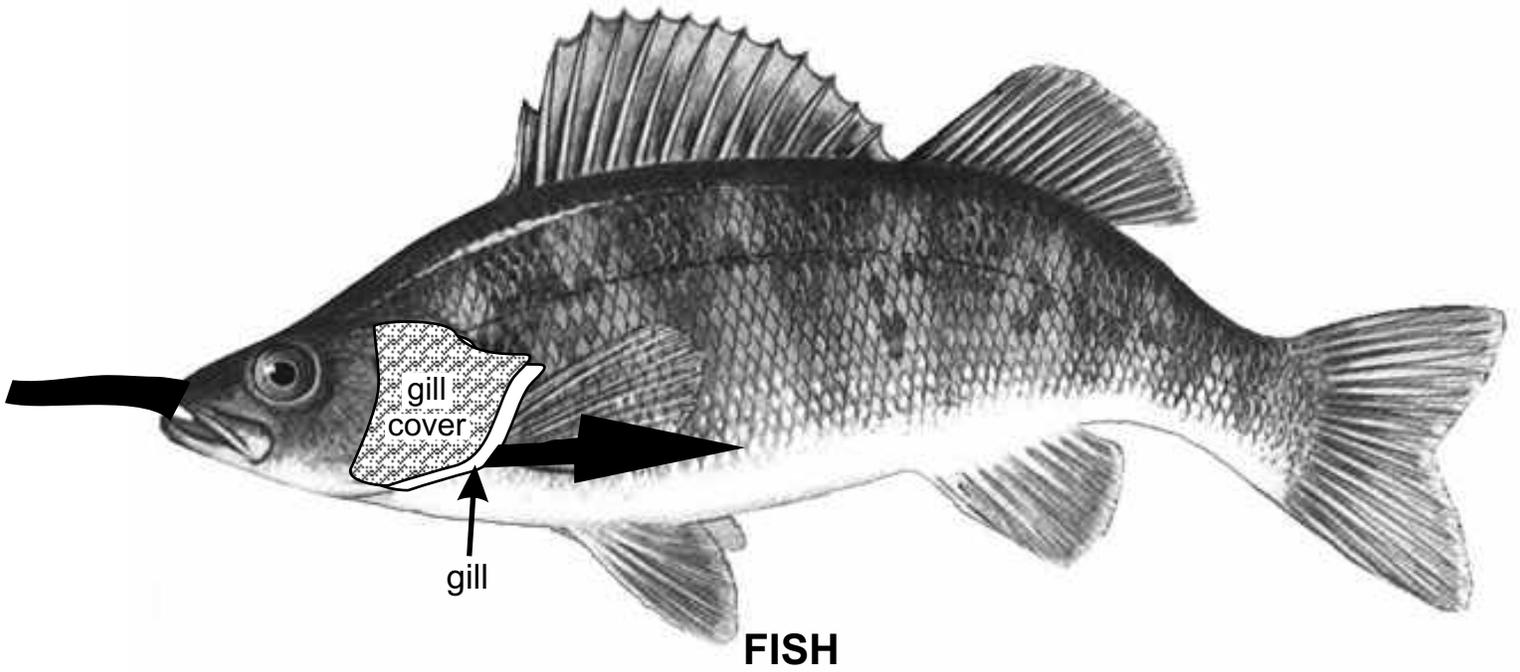
Assignment:

Fill in each blank with one of the following phrases:
“external respiration”, “internal respiration” or “cellular respiration”.

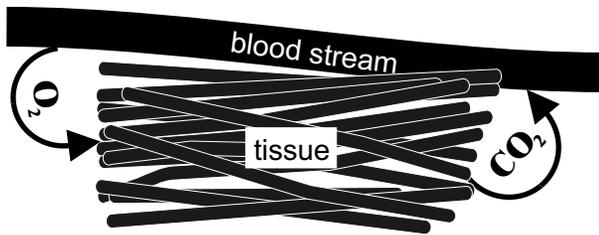
- 1) _____ occurs when water passes over a fish's gills and oxygen enters the blood.
- 2) _____ occurs when cells in the body take up oxygen and produce energy.
- 3) _____ occurs when carbon dioxide enters the bloodstream and oxygen enters tissue.
- 4) _____ occurs when oxygen leaves alveoli and enters capillaries as carbon dioxide enters the alveoli and leaves the bloodstream.
- 5) _____ occurs when hemoglobin releases carbon dioxide and takes up oxygen.
- 6) _____ occurs when gas exchange between the lungs and blood takes place.
- 7) _____ releases energy from glucose molecules.
- 8) _____ is the process of gas exchange between cells and tissues.
- 9) _____ occurs when hemoglobin takes up carbon dioxide and releases oxygen.
- 10) _____ occurs when gas exchange between the blood and tissues takes place.



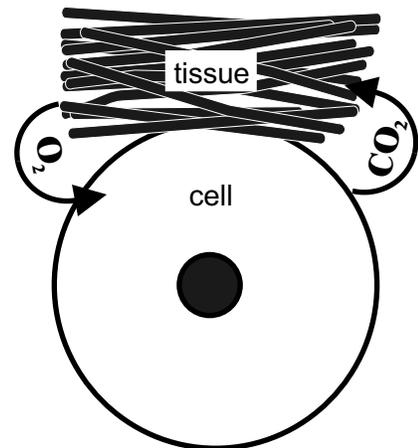
Answer Key: Activity A



External Respiration

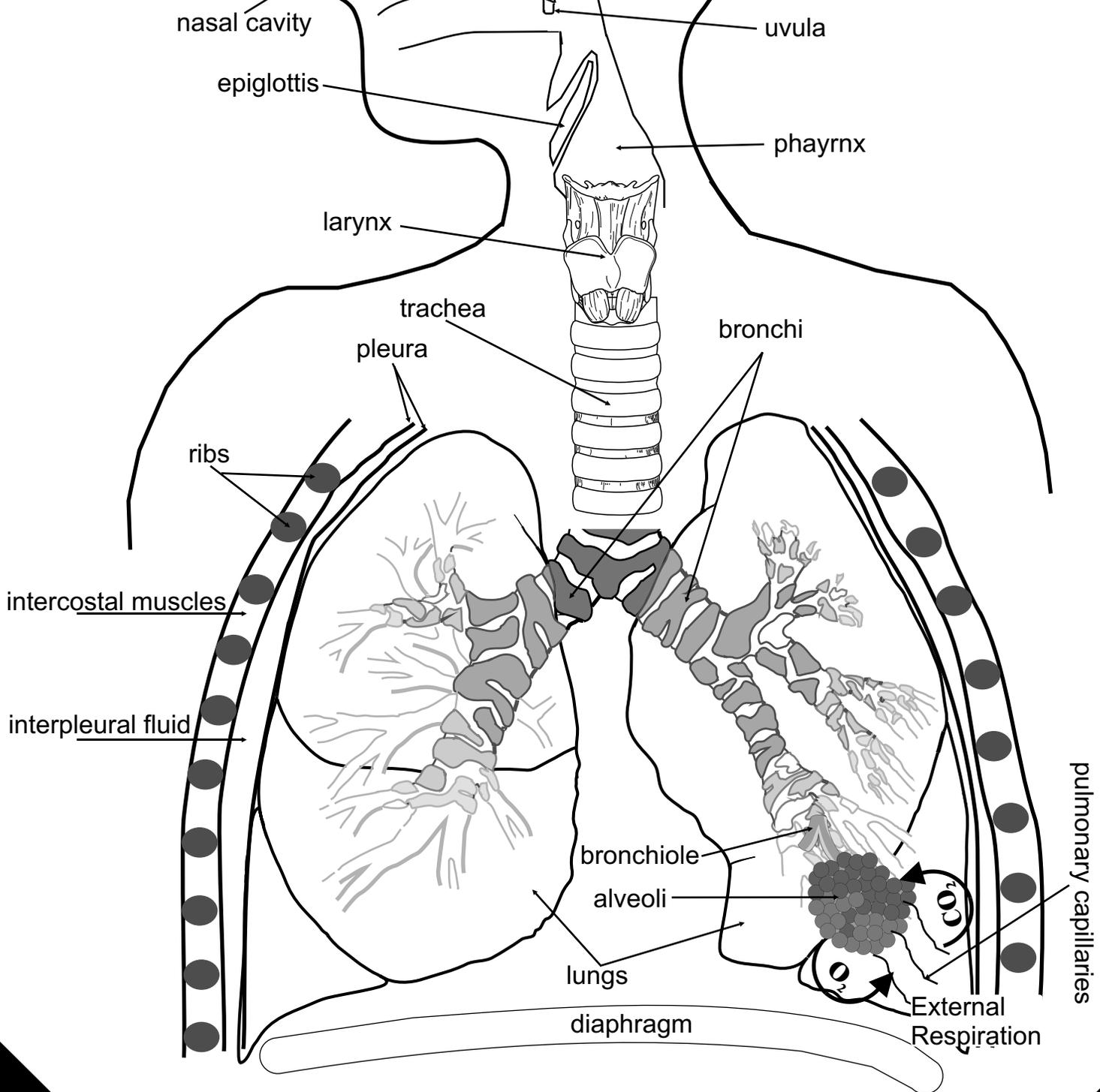
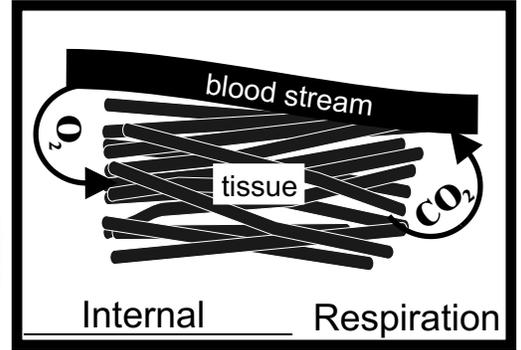
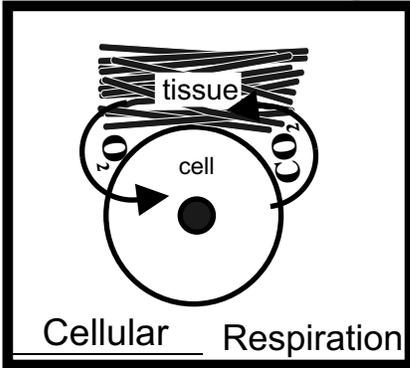


Internal Respiration



Cellular Respiration

Answer Key: Activity B



Fish vs. Human Respiration: External, Internal and Cellular

Answer Key: Assignment

Fill in the blank with one of the following phrases:

“external respiration”, “internal respiration” or “cellular respiration”.

- 1) External Respiration occurs when water passes over a fish's gills and oxygen enters the blood.
- 2) Cellular Respiration occurs when cells in the body take up oxygen and produce energy.
- 3) Internal Respiration occurs when carbon dioxide enters the bloodstream and oxygen enters tissue.
- 4) External Respiration occurs when oxygen leaves alveoli and enters capillaries as carbon dioxide enters the alveoli and leaves the bloodstream.
- 5) External Respiration occurs when hemoglobin releases carbon dioxide and takes up oxygen.
- 6) External Respiration occurs when gas exchange between the lungs and blood takes place.
- 7) Cellular Respiration releases energy from glucose molecules.
- 8) Internal Respiration is the process of gas exchange between cells and tissues.
- 9) Internal Respiration occurs when hemoglobin takes up carbon dioxide and releases oxygen.
- 10) Internal Respiration occurs when gas exchange between the blood and tissues takes place.

