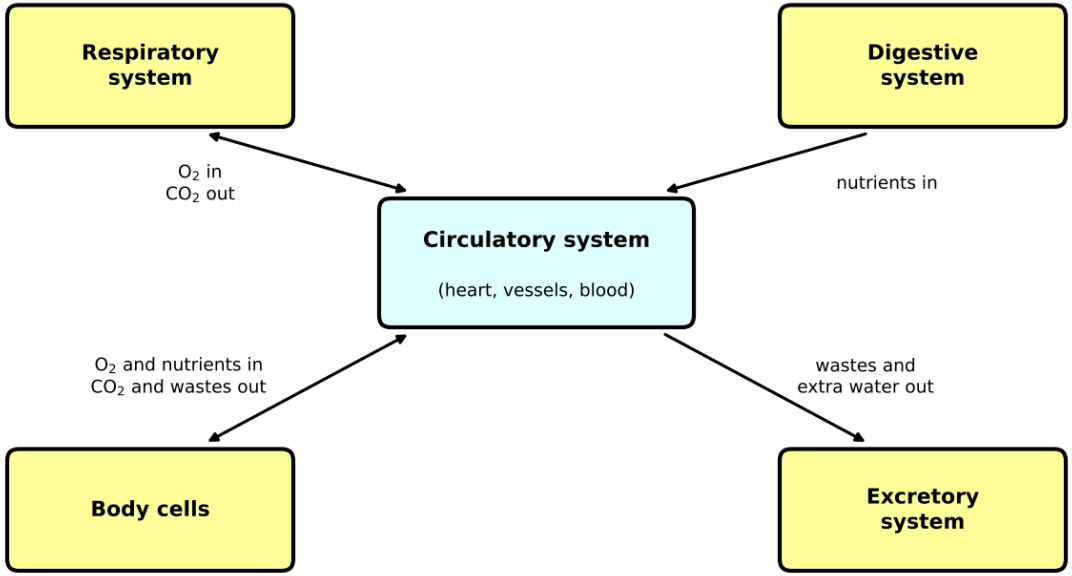
Essential Question

How do organ systems work together to keep an organism in balance?

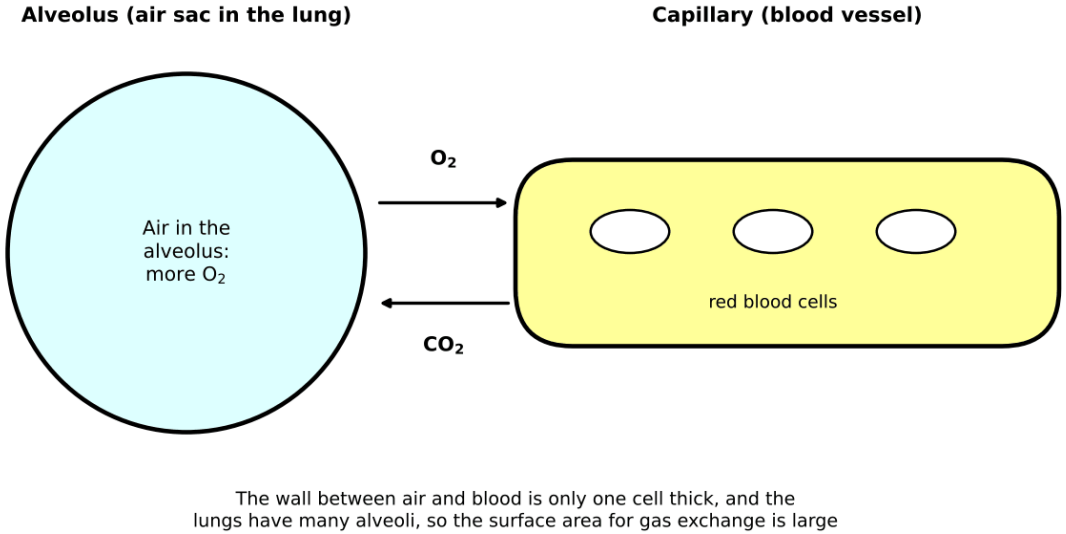
Systems Work Together

- Cells form tissues, tissues form organs, and organs form organ systems
- An organ system is a group of organs with a shared job
- The respiratory system brings in oxygen
- The digestive system brings in nutrients
- The circulatory system delivers to all cells



Gas Exchange

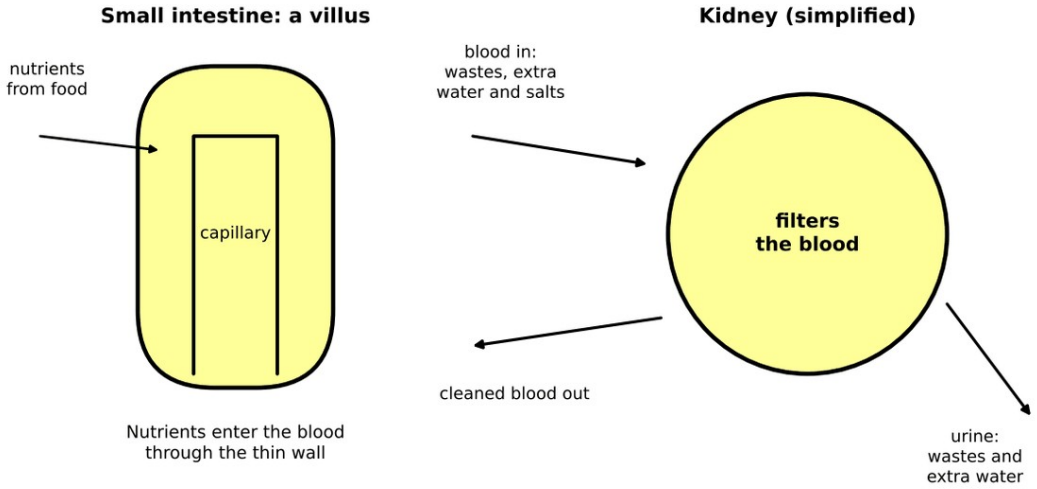
- Air reaches tiny air sacs called alveoli
- Each alveolus is next to a blood capillary
- O2 diffuses into the blood
- CO2 diffuses out of the blood



The wall between air and blood is only one cell thick, and the lungs have many alveoli, so the surface area for gas exchange is large

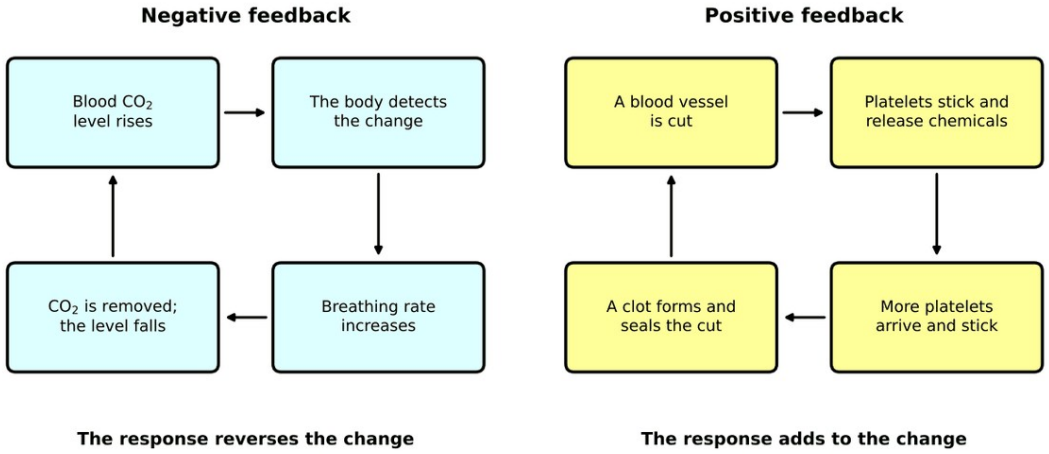
Nutrients In, Wastes Out

- The small intestine has villi, finger-like folds
- Nutrients pass through the thin wall into capillaries
- The kidneys filter wastes and extra water from the blood
- Useful substances stay in the blood



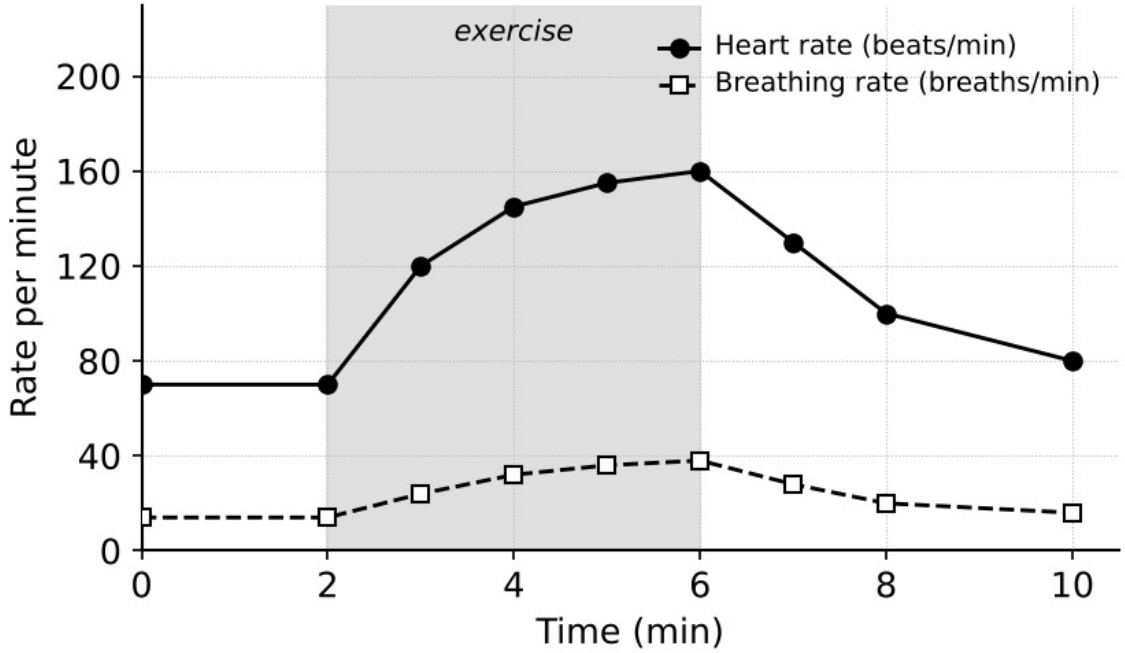
Feedback Loops

- Feedback loops keep conditions in a range
- Negative feedback reverses a change
- Positive feedback adds to a change
- Most homeostasis relies on negative feedback



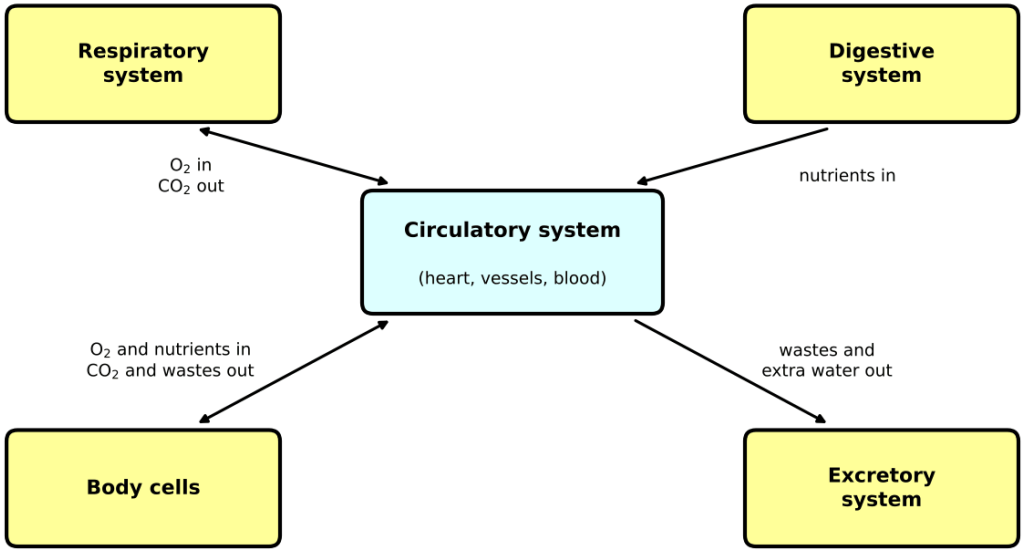
Systems Respond to Exercise

- Muscles need more oxygen during exercise
- Breathing rate and heart rate both rise
- Cardiac output = heart rate x stroke volume
- Both rates return toward resting values afterward



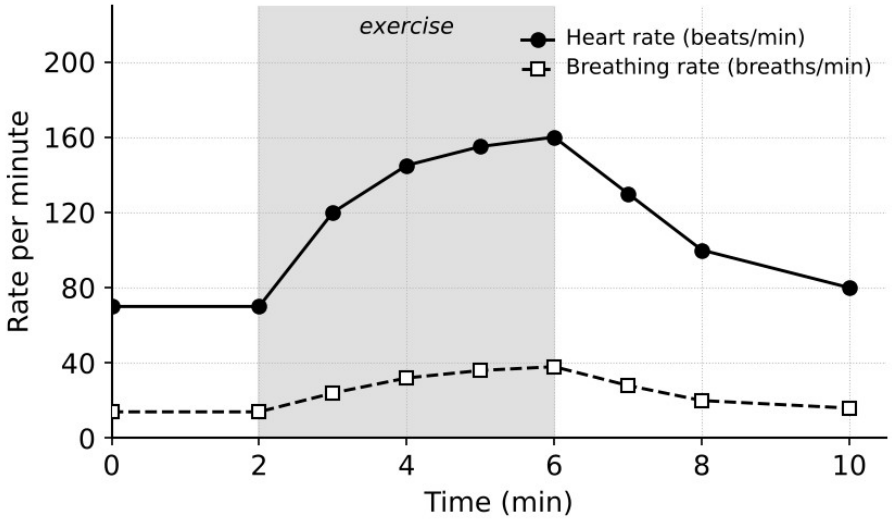
Example: Trace the Oxygen

Use the model to trace an oxygen molecule from the air you breathe in to a muscle cell, and name the organ system responsible for each step.



Example: Exercise Data

A student recorded heart rate and breathing rate before, during, and after exercise (sample data). Write a claim, evidence, and reasoning about how the two rates change.



Example: Cardiac Output

At rest, a person's heart beats 70 times per minute and pumps 70 mL of blood per beat. During exercise the heart rate is 150 beats per minute and the stroke volume is 100 mL. Find the cardiac output at rest and during exercise, in liters per minute, and how many times greater it is during exercise.

Condition	Heart rate (beats/min)	Stroke volume (mL/beat)
Rest	70	70
Exercise	150	100

Organ Systems

Big Ideas

- Organ systems work together to supply cells and remove wastes
- Alveoli and villi have large surface areas for exchange
- Negative feedback reverses a change and maintains homeostasis
- Positive feedback adds to a change
- Cardiac output = heart rate x stroke volume
- In plants, xylem carries water up, phloem carries sugars, and stomata exchange gases