Conceptual Story: STC/MS *HUMAN BODY SYSTEMS*

PART 1: DIGESTIVE SYSTEM

POM - 3 (apply)
SP

So that our bodies can act as an interconnected set of systems, energy must be distributed. *Peristalsis* is the process of *mechanical* digestion that breaks down food and moves food and waste through the digestive tract.

Lesson 1
Body Mapping

Focus Question: What do we know about the organs and systems that comprise the human body?

Students express what they know about organs and to which systems the organs belong.

Lesson 2
Movement of Food Through the Digestive Tract

Focus Questions: How is food moved through the digestive tract? What is the order of the parts of the digestive tract?

Students mechanically move a tennis ball by peristalsis through a full-scale model of the digestive tract.

1.1 **Properties of Systems:** Energy Sources and Kinds
1.2 **Structure of Systems:** Systems, Structure and Organization of Living Systems, Human Biology

AAAS Atlas:
Cells: Cells and Organs (p. 75)
Systems (p. 133)

Food continues to be broken down into different substances in the digestive tract by *chemical* digestion. Enzymes are special chemicals in our bodies that chemically break down food. We can infer the presence of enzymes by using indicators and making careful measurements.

Lesson 3
Exploring Carbohydrates

Focus Questions: How are indicators used to determine the presence of starches and sugars? How are carbohydrates used in the body?

Students investigate the use of indicators to test for the presence of starch and sugar in sample foods.

Lesson 4
Digestion in the Mouth

Focus Questions: How does the mouth physically and chemically change food? What is the purpose of mechanical digestion?

Students explore the mechanical and chemical digestion in the mouth, including the effect of amylase, an enzyme present in saliva.

Lesson 5
Digestion in the Stomach

Focus Questions: What is the role of gastric juice on proteins in the stomach? How effective are HCl and pepsin when they work alone to chemically digest and change proteins? How do our bodies use proteins?

Students explore the mechanical and chemical digestion that happens in the stomach. They see the synergistic effect of acid and an enzyme on the digestion of proteins.

1.1 **Properties of Systems:** Properties of Substances, Energy Sources and Kinds
1.2 **Structure of Systems:** Systems, Human Biology
1.3 **Changes in Systems**: Life Processes and the Flow of Matter and Energy, Physical and Chemical Changes

AAAS Atlas:
Cells: Cells and Organs (p. 75)
Structure of Matter: Chemical Reactions (p. 61)
Systems (p. 133)

When food has been broken down into less complex forms, it can pass through the lining of the small intestine through diffusion or active transport. The greater the surface area of the lining of the small intestine, the faster food can pass through. It then travels through the bloodstream or lymph to all the body's cells.

Lesson 6
Diffusion and Active Transport

Focus Questions: What is the role of diffusion and active transport in the small intestine? How are fats mechanically and chemically digested in the small intestine? How does the body use fats?

Students investigate diffusion of starch and/or sugar through dialysis tubing. Students investigate the diffusion of a gas through a membrane (balloon).

Lesson 7
Surface Area and Absorption

Focus Questions: How does changing the surface area affect the amount of contact points for nutrients to be absorbed in the small intestines? What happens to water and undigested food that cannot diffuse into the circulatory system?

Students learn an important role of the small intestine is to absorb the nutrients and this can happen through diffusion, active transport and special structures. Students model the outside wall of the intestine and inside wall of the small intestine. Students perform calculations in surface area.

1.2 **Structure of Systems:** Systems, Structure and Organization of Living Systems, Human Biology

AAAS Atlas:
Cells: Cells and Organs (p. 75)
Flow of Matter and Energy: Flow of Matter in Ecosystems (p. 77)

Lesson 8
The Digestive System: An Assessment

Focus Questions: How would you determine which unknown starch solution has an enzyme present?

Students perform tests to determine the presence of a digestive enzyme. Students independently respond to a variety of short answer questions. Students revise their human body posters.

1.1 **Properties of Systems:** Properties of Substances
2.1 **Investigating Systems:** Planning and Conducting Investigations, Explaining, Communicating

Lesson 9
Anchor Activity: Diseases and Health Careers

Focus Question: What can we learn about diseases that affect human body systems? What health careers are concerned about the treatment or cure of human disease?

One pair of students in each group researches a disease that affects one or more body systems. The other pair researches health care careers that deal with the treatment and/or cure of that disease.

1.2 **Structure of Systems:** Systems, Human Biology
1.3 **Changes in Systems:** Interdependence of Life

Conceptual Story: STC/MS *HUMAN BODY*

PART 2: RESPIRATORY AND CIRCULATORY SYSTEM

PE
POM - 3
EE - 1
DOL - 5

The body relies on the diaphragm, a muscle that separates the chest from the abdomen, to move air into and out of the lungs. The amount of air a pair of human lungs is capable of holding varies from person to person. Models of lungs and lung tissue are powerful tools for learning how human lungs do and don't work.

Lesson 10
Assessing Breathing Models

Focus Question: What are models and why are they used? How does air move into and out of the lungs? Why do humans breathe?

Students explore two different lung models that show the mechanical function of the lungs.

Lesson 11
How Much Air Can You Exhale

Focus Question: How much air can your lungs hold? What factors affect lung capacity?

Students exhale into graduated bags to determine their vital lung capacities.

1.2 Structure of Systems:
Systems, Structure and Organization of Living Systems, Human Biology

AAAS Atlas:
Systems (p. 133)

It is through cellular respiration, a process similar to combustion, that our cells get their energy from food. Different types of food have different amounts of chemical potential energy. Reactants and products for cellular respiration diffuse through our cell membranes.

Lesson 12
Recipe for Energy—Cellular Respiration

Focus Question: How are combustion and respiration alike and how are they different? What are the ingredients for cellular respiration and where do they come from? How does the body convert food into energy?

Students discover that that oxygen is required for combustion and that CO_2 and energy are released, just like in respiration but at a faster rate. Different forms of energy are released during combustion--heat and light.
Students then conduct three investigations that explore respiration: First they observe evidence that respiration produces heat by breathing into a test tube of water. Second they examine the chemical composition of inhaled air compared to that of exhaled air using bromothymol blue as an indicator for CO_2. Third they discover that carbon dioxide can pass through a membrane.

Lesson 13
Releasing Energy from Food

Focus Questions: How does the amount of energy released from one nutrient compare to the amount of energy released from a similar quantity of a different nutrient?

Students find that food is the source of energy in the body and different foods have different potential energies.

1.2 Structure of Systems:
Systems, Energy Transfer and Transformation, Structure and Organization of Living Systems, Human Biology
1.3 Changes in Matter and Energy:
Interdependence of Life, Energy Sources and Kinds, Physical and Chemical Changes

AAAS Atlas:
Flow of Matter and Energy: Flow of Matter in Ecosystems (p. 77)
Cells: Cell Functions (p. 73); Cells and Organs (p. 75)

While the circulatory system moves oxygen and digested food to the cells and carbon dioxide, water, and other waste from the cells, it is important that the system keeps matter moving in one direction. Different factors affect the body's heart rate and blood pressure.

Lesson 14
The Pumping Heart

Focus Question: Why does blood flow from the heart, to the lungs, back to the heart, and out to the body? What is the role of the heart in transporting the raw materials and waste products of cellular respiration?

Students use a double siphon model of the heart to investigate the double-pump action of the heart to move oxygen, food, carbon dioxide and other waste among systems in the body.

Lesson 15
Factors Affecting Heart Rate

Focus Question: What are some factors that affect heart rate? What are the jobs of the different types of blood?

Students investigate the effect of exercise and/or added weight on their heart rate.

Lesson 16
The Heart Meets Resistance

Focus Questions: What factors affect the flow of blood through the body?

Students use a siphon pump to investigate blood pressure. They discover how much force is necessary in order to move blood through openings of different diameters.

1.2 Structure of Systems:
Systems, Human Biology

AAAS Atlas:
Cells: Cells and Organs (p. 75)

Lesson 17
The Respiratory and Circulatory Systems—Assessment

Focus Questions: How is exercise and breathing related? How do the digestive, respiratory, and circulatory systems work together to keep humans alive and functioning efficiently?

Students work in pairs to design and conduct an inquiry that shows the relationship between breathing rate and exercise. Students respond independently to selected-response items. Students work in their groups of four to revise their human body system posters.

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EMM - 2

The musculoskeletal system is made of bones, muscles, tendons, and ligaments. Skeletal muscles work in opposing pairs to move our limbs. Our nervous system helps control this movement.

Different types of muscles have different functions. Our heart, for example, is composed of a special kind of muscle that rarely fatigues under normal conditions. We respire more when our muscles work hard and our bodies get hot. It is important that our bodies release this excess heat to maintain a constant temperature.

Lesson 18
The Musculoskeletal System—an Overview

Focus Questions: How do muscles and bones work together? How does the structure of a chicken wing compare with that of a human arm? Why is it important to build bone mass now? How do you do this?

Students stand on their toes to discover how the bones and muscles work together as a system and that muscles only pull. Students dissect chicken wings to observe five types of tissue: muscle, bone, connective, nerve, and epithelial.

1.2 Structure of Systems:
Systems, Structure and Organization of Living Systems, Human Biology

Lesson 19
Joints and Movement

Focus Questions: What types of movement do different joints allow? How do muscles work with bones to move the body?

Students design and assemble models of the human spine and arm. Student's arm model must correctly bend (flex) the forearm toward the upper arm and extend it by the pulling action of two different "muscles."

AAAS Atlas:
Systems (p. 133)
Cells: Cell Functions (p. 73); Cells and Organs (p. 75)
Motion: Laws of Motion (p. 63)

Lesson 20
Muscle Size and Strength

Focus Questions: How can you measure muscle strength? Is muscle size an indication of muscle strength?

Students use a bathroom scale to measure the strength of different muscles in the arm to determine the relationship between size of muscle and strength. They consolidate their data with those of other students in the room.

Lesson 21
Exploring Muscle Fatigue

Focus Question: How and why do muscles fatigue? How do muscles feel when they are fatigued? What controls the movement of muscles?

Students squeeze a test tube clamp repeatedly to determine the rate of fatigue of certain muscles and investigate the variability of muscle fatigue within the class.

Lesson 22
The Body in Balance

Focus Questions: How does the body maintain its homeostasis with regards to body temperature?

Students identify functions of the human body that are automatic. They attempt to maintain a constant temperature of a small amount of water in a test tube and gain an appreciation for the efficiency with which the body regulates itself.

1.2 Structure of Systems:
Systems, Energy Transfer and Transformation, Structure and Organization of Living Systems
1.3 Changes in Systems:
Nature of Forces

AAAS Atlas:
Systems (p.133)
Cells: Cell Functions (p. 73), Cells and Organs (p. 75)

Lesson 23
Module Assessment

Performance assessment selected response items.

Working in pairs, students demonstrate their investigative skills in a performance assessment that tests reaction time to a stimulus. Students independently respond to selected-response items that allow the student to demonstrate their understanding of the human body systems and their interactions.

Anchor Activity Presentation

Student presentations on diseases and health care careers.

Now that students have investigated the human body systems and their interactions, they present their research on diseases that affect human body systems and the health care careers concerned with the treatment and cure of those diseases.

AAAS Atlas:
Physical Health: Disease (p. 87)