Complex Systems

Grade Level: 9–12

Subject/Content: Science/Biology

Summary of Lesson
Students will compare and contrast the complexity of organisms' body systems within kingdom Animalia and then focus specifically on the human body through the creation of a life-size, interactive model that correctly displays complex body systems.

Focus Question
What are specific differences in the complexity of organisms' body systems within kingdom Animalia?

Databases(s): *Science in Context*

Procedures:

Steps/activities by teacher:

- Have each student copy down the following table.

	Circulatory System	**Respiratory System**	**Reproductive System**	**Digestive System**	**Sketch**
Annelids (worms)					
Porifera (sponges)					
Amphibians					
Reptiles					
Aves (Birds)					
Mammals					

- Have students fill in the missing information about the complexity of each organism's body systems by accessing the *Science in Context* database and entering the organism name as the search word. Articles such as "Physiology." *Animal Sciences*. Ed. Allan B. Cobb. New York: Macmillan Reference USA, 2010. *Gale Science in Context*, may also be helpful.
- During class, have the students create a master table on the board, filling in all of the information they have uncovered during their searches. Be sure to initiate discussion that highlights the differences in complexity between humans and each of the organism phyla in the table.

- Divide the students into groups of three and tell them to research the major systems of the human body. The groups should divide the systems evenly among their members.
- Allow students time to research the major body systems using the *Science in Context* database.
- Have students locate the following information as they research the body systems:
    - Define the purpose of each of your systems.
    - List critical organs/structures within each of your systems.
    - Sketch location and proportions of the structures within a body outline for each of your systems.
    - Document one interesting fact about each system.
- Obtain a large roll of paper that will allow students to trace the outline of a human body.
- Instruct the students to trace the full body outline of one of their group members onto the paper and cut it out.
- Provide each group with various colors of construction paper.
- Have the students create the organs/structures within each of their systems. Students will then glue just the *top* edge of each organ/structure in the appropriate position on the body outline they have cut out. The students should color code their systems. For example, all respiratory organs/structures should be one color.
- Students should lift up the bottom edge of each organ/structure and write its name under the construction paper. Under one of the organs in each system, encourage students to also include one interesting fact about that particular system.
- Provide the students with a 3 x 5 card to create a color coded key for their systems.
- Display the groups' completed body cutouts around the room.
- Allow students time to circulate around the room and use the cutouts as a study tool by identifying the organs or structures. Students can lift up the bottom edge of each organ/structure to check their answers and read about the interesting facts their classmates have discovered.
- As a class, discuss how all the systems of the human body are interrelated. Provide examples of how failure of one system can disrupt the homeostasis of the human body.
- Look over the Related Activities section below for information on how to tie this activity to Math, Global Studies, and English.

Steps/Activities by student(s):

- Copy the following table onto a piece of paper.
- Fill in the missing information about the complexity of each organism's body systems by accessing the *Science in Context* database.

	Circulatory System	Respiratory System	Reproductive System	Digestive System	Sketch
Annelids (worms)					
Porifera (sponges)					
Amphibians					
Reptiles					
Aves (Birds)					
Mammals					

- Share the information you have collected with your classmates, noting the differences in the complexity of body systems among various groups of animals.
- Now choose two other students to form a group of three.
- Your teacher will ask you to research the major systems of the human body. Divide the systems evenly among your group members.
- Begin researching information on the human body systems. Access the *Science in Context* database and enter the name of your body system in the keyword search area.
- Be sure to collect the following information for each of system:
    - Define the purpose of each system.
    - List critical organs/structures of each system.
    - Sketch location and proportions of the structures within a body outline for each of your systems.
    - Document one interesting fact about each system.
- Have one group member lie down and trace his or her outline onto the large sheet of paper provided by your teacher. When you're finished, cut out your outline.
- Use construction paper to create the organs/structures within each of your systems, gluing down just the *top* edge of the organ/structure to your body cutout. Be sure it is proportional and in the right position within the body. Your systems should be color coded. For example, all respiratory organs/structures should be one color.
- Carefully lift the bottom edge of each organ/structure you glued down and write its name under the construction paper. Under one organ in each system, write down one interesting fact about that particular system.
- On a 3 x 5 card provided by your teacher, your group should create a color coded key to your body systems.
- Display your body cutout with its completed body systems in the classroom.
- Circulate around the room and use the other bodies as study tools. Try to identify the organs or structures and then carefully lift the bottom edge of the organ/structure to check for accuracy.
- As a class, discuss the relationships between body systems. Think about how the failure of one system could affect the body's other systems.

Outcome
Students will be able to construct and effectively communicate general information about the complexity of the human body systems when compared to other species.

Related Activities: This activity can be easily integrated with the activities suggested.

Math

- Students can calculate the proportions of the organs within the body for increased accuracy on their displays.
- Students can examine the surface area of the lungs and small intestine and discuss and/or calculate the impact that decreasing or increasing the surface area would have on the body's functions.

Global Studies
Collect additional information on how societies, just like the human body, are complex operating systems. Explore the idea of how complex systems in society are interdependent on each other, just like the human body's systems depend on each other to maintain homeostasis.

English
Students can write an essay in which they imagine that they have been shrunken down to a microscopic size so they can travel through the human body. In their essays, students should address all the body systems, describing how each system functions and what structures they see in each system.

Learning Expectation
As a result of activities, students will understand the complexities of the human body and be able to compare the systems of the human body to the systems of other organisms.

National Science Education Content Standard(s):
As a result of their activities in grades 9–12, all students should develop an understanding of:
NS.9-12.7(C) biological evolution; interdependence of organisms; behavior of organisms.

Standard Source: National Academy of Sciences, 1996

ISTE NETS for Students

2. Communication and Collaboration
Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

- A. interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- D. contribute to project teams to produce original works or solve problems.

3. Research and Information Fluency
Students apply digital tools to gather, evaluate, and use information. Students:

- locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- process data and report results.

6. Technology Operations and Concepts
Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
A. understand and use technology systems.

Standard Source: ISTE NETS for Students, 2007

Information Power; Information Literacy Standards:

- **Standard 1:** The student who is information literate accesses information efficiently and effectively.
- **Standard 2:** The student who is information literate evaluates information critically and competently.
- **Standard 3:** The student who is information literate uses information accurately and creatively.
- **Standard Source:** American Library Association, 1998