Lesson Plan: Human Heart

Summary

In this episode, Blade discusses the human heart, comparing its function across species and exploring how its structure evolved from simple tubes to complex chambers. He describes how the heart manages two pressure systems, one gentle for lungs and one strong for the body, and how development mirrors evolution. The conversation connects natural design to modern challenges in medicine, such as artificial hearts and organ transplants.
https://www.youtube.com/live/nki7eBfa8Ds?si=ZTy9Ge7feaJL-_AG

Objective

Students will examine the structure and function of the human heart, compare it to other animal hearts, and explore how evolution and engineering intersect in the development of circulatory systems and artificial organs.

Standards

- NGSS MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems.
- CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments or analyzing processes.
- C3 D2.SCI.1.6-8: Gather, use, and interpret evidence to construct explanations of natural phenomena.

Materials

- 9 Fun Facts list
- Worksheet
- Whiteboard or projector (optional)
- Model or diagram of the human heart (optional)

Introduction

Begin by asking students to describe what they know about how the heart works. Discuss the difference between oxygenated and deoxygenated blood and why pressure differences are necessary. Introduce the idea that hearts evolved differently across species depending on oxygen needs and body complexity.

Activity

Students will read the 9 Fun Facts about the human heart, highlighting key ideas about evolution, structure, and medical technology. Divide students into pairs to create a labeled diagram showing how a two-chamber, three-chamber, and four-chamber heart differ. Follow with a group discussion on how artificial hearts mimic natural ones and where they fall short.

Assessment

Students complete the worksheet and participate in the group discussion. Evaluate their understanding of how evolution influenced heart structure and their ability to relate biological design to modern medical technology.

Rubric

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Content Understanding	Demonstrates strong understanding of heart structure and function	Shows clear understanding with minor errors	Basic understanding with some confusion	Limited or incorrect understanding
Discussion Participation	Actively contributes thoughtful ideas	Participates with relevant comments	Minimal contribution	No participation
Worksheet Completion	All sections complete and accurate	Minor errors or omissions	Partially complete	Incomplete
Technology Connections	Connects evolution to artificial heart design clearly	Makes basic connection	Limited or unclear connection	No connection made

9 Fun Facts

1. **Soft hearts almost never fossilize.** The heart is made of soft muscle that breaks down quickly after death, which means it rarely leaves a trace in the fossil record. Only rare conditions, such as rapid burial in fine sediment or mineral-rich mud, can preserve organs. Because of this, scientists usually study bones, teeth, or vessel imprints to learn about ancient anatomy. These rare preserved tissues help fill important gaps in the story of evolution.
https://www.nps.gov/subjects/fossils/body-fossils.htm

2. **Hearts evolved as animals grew larger and more active.** Early animals like sponges and flatworms had no heart at all, using simple diffusion to move oxygen and nutrients through their thin bodies. As animals became thicker and more complex, evolution created two main types of circulatory systems. Open systems, found in insects and many invertebrates, allow blood to mix freely with body fluids. Closed systems, found in vertebrates, keep blood within vessels that lead to and from the heart. This gradual change led from simple heart tubes to the complex four-chambered hearts seen in mammals and birds.
https://sunfox.in/blogs/evolution-of-the-heart-explained/?srsltid=AfmBOoppfe_TS-qValFyPlCSANYYClu6aM8u4FSMTUnTRTKS2jkjh_2w

3. **Hearts come in many different designs across species.** Earthworms use simple pumping tubes, and insects rely on several small hearts that push blood-like fluid through their open body cavities. Fish developed two-chambered hearts, amphibians and reptiles have three, and birds and mammals evolved four. From tiny insects to massive whales, each version matches the oxygen needs and lifestyles of its species. The variety of heart designs shows how evolution solves the same problem in many creative ways.
https://kids.britannica.com/kids/assembly/view/183797

4. **Your heart starts as a tube that folds into shape.** In early development, the human heart forms as a straight tube that soon loops and twists into a complex S shape. As it folds, internal walls and valves appear, dividing the heart into four chambers. This process mirrors millions of years of evolutionary change from simple pumps to efficient circulatory engines. Every heartbeat begins with this remarkable bit of biological origami.
https://www.labxchange.org/library/items/lb:LabXchange:8d4b9b1d-42ac-3023-927d-9cad85b6d0b9:html:1

5. **Four chambers make our hearts powerful and efficient.** Mammals and birds use a four-chambered heart that keeps oxygen-rich and oxygen-poor blood completely separate. This allows high pressure in the body's arteries without damaging the delicate lungs. The design supports warm-blooded metabolism, endurance, and intelligence by providing a steady and efficient oxygen supply. Without four chambers, flight, running, and complex thought would be much harder to sustain.
https://www.britannica.com/science/circulatory-system/The-vertebrate-circulatory-system

6. **Heart size and rhythm scale with the size of the animal.** A shrew's heart can beat more than a thousand times per minute, while a blue whale's heart beats only a few times in that same minute. Regardless of size, all hearts work in the same basic way by contracting to push blood and relaxing to refill. The blue whale's heart is the largest of any animal, weighing as much as a small car. This range of size and speed shows how the same design adapts perfectly to different creatures.
https://news.cvm.ncsu.edu/10-amazing-animal-heart-facts/

7. **Heart transplants are expanding beyond humans.** Xenotransplantation is the transfer of organs between species, such as implanting a pig heart into a human. After centuries of failed experiments, new genetic tools and better anti-rejection medicine are bringing this idea closer to reality. The first successful transplant of a genetically modified pig heart into a human patient occurred in 2022. These operations may one day ease organ shortages, though they still raise ethical and biological questions.
https://www.the-scientist.com/after-centuries-of-controversy-is-xenotransplantation-finally-here-to-stay-73468

8. **Artificial hearts show the limits of human engineering.** For decades, scientists have tried to build a fully mechanical heart that can replace a damaged human one. The challenge lies in copying the heart's adaptability, self-repair, and coordination with the body's natural rhythms. Engineers have built artificial hearts that can keep patients alive for months or years, but none can yet match the real organ's long-term reliability. The search continues to create a machine that can truly live inside the body for life.
https://thereader.mitpress.mit.edu/in-search-of-the-impossible-machine-the-artificial-heart/

9. **Scientists can now grow miniature beating hearts in the lab.** Using stem cells, researchers have created tiny heart-like structures called cardioids that form a hollow chamber and begin pulsing within days. These lab-grown mini-hearts help scientists study how the human heart develops and how diseases begin. The same methods could eventually lead to growing personalized heart tissue for repair or even full organs for transplant. This research marks a major step toward rebuilding the human heart from the ground up.
https://www.smithsonianmag.com/science-nature/scientists-use-stem-cells-invent-self-assembling-miniature-heart-chamber-180977778/

Worksheet

Name: ____ Date: __________

Review

1. Why do soft tissues like the heart rarely fossilize?

2. What is the difference between an open and a closed circulatory system?

3. How many chambers does a mammal's heart have?

Discussion

4. How does the process of embryonic heart folding relate to evolution?

5. Why are four chambers considered an efficiency upgrade?

Data Analysis

6. Compare the heartbeat speeds of a shrew and a blue whale. What does this tell you about energy use and metabolism?

7. What ethical concerns might arise from using animal organs for human transplants?

Reflection

8. What challenges do engineers face when trying to create artificial hearts?

9. How might lab-grown hearts change the future of medicine?