The Alchemist's Laboratory: Systems & Innovation

(Year 7 - Ages 12-13)

Lesson 3 of 9

Lesson Overview

Lesson Title:	The Alchemist's Laboratory: Systems & Innovation
Year Level:	Year 7 (Ages 12-13)
Lesson Duration:	60 minutes
Key Focus Areas:	Systems Thinking, Logistics, Scientific Innovation, Future Technology
Curriculum Links:	Australian Curriculum - Health and Physical Education (Foundation)

- AC9S7H02: Investigate how... scientific knowledge is used to solve problems and inform personal and community decisions. (Focus on how medical systems solve the problem of organ failure)
- AC9TDE7P01: ...Sequence and document steps in a design process... (Focus on systems thinking and process mapping)
- AC9HP7P01: Plan and implement strategies... to enhance their own and others' health... (Understanding health systems)

Learning Intentions

- Investigate the complex system of organ and tissue donation, identifying the key stages from donor to recipient.
- Distinguish between the logistical requirements of Organs (Time-Critical/Urgent) vs. Tissues (Bankable/Storable).
- Explore how scientific knowledge and innovation (e.g., machine perfusion, 3D printing) are solving problems and creating new possibilities for the future.
- Recognise that "Medical Alchemy" relies on a massive team of diverse professionals working in sync.

Success Criteria

- Create a flowchart or sequence diagram showing the basic steps of the Donation Pathway.
- Explain why a heart transplant must happen within hours, while a cornea transplant can happen weeks later.
- Identify one "Future Innovation" and explain how it could change the "Alchemy" of saving lives.
- Use systems thinking terms (e.g., logistics, preservation, recipient matching) to describe the process.

Teaching Sequence

Work through this lesson in the following sequence:

Duration	Part	Focus
10 minutes	Part A: The Sci-Fi Hook	Video (Heart in a Box/Bioprinting) & Introduction.
20 minutes	Part B: The Pipeline Challenge	Group Activity: Sequencing the "Organ Sprint" vs. "Tissue Marathon."
20 minutes	Part C: Future Alchemy	Class Discussion & Worksheet on Innovations.
10 minutes	Part D: The Human Key	Reflection: Why the system relies on the human "Yes."

Part A: The Sci-Fi Hook (10 minutes)

Step 1. The Video

- Play: A short clip of "Transmedics Organ Care System" (Heart beating in a box) OR a clip on "3D Bioprinting Ears/Skin."
  - Here are some useful links:
    - TransMedics Organ Care System – ex-vivo beating heart video: https://pubmed.ncbi.nlm.nih.gov/37408655/ pubmed.ncbi.nlm.nih.gov
    - 3D bioprinting of ears/skin (feature video): https://entcaresydney.com.au/3d-printing-hearts-ears-and-skin-by-think-digital-futures/
- Ask: "Is this Sci-Fi or Reality?" (Answer: It's Reality/Near Future).
- Say: "Welcome to the Alchemist's Laboratory. Today, we look at the machines and systems that make the magic possible."

Part B: The Pipeline Challenge (20 minutes)

Step 1. The Two Recipes

- Explain: "Not all 'Gold' is treated the same.
  - Organs (Heart, Lung): They are like Ice Cream—they melt fast. They need speed.
  - Tissues (Bone, Eye): They are like Gold Bars—they can be stored in a vault (Bank) for later."

Step 2. Sequencing Activity

- Activity: Students complete Part 1 of the Lab Report.
- Interactive Option: Give groups a set of mixed-up "Laboratory Cards." They must race to sort them into two timeline rows: "The Sprint" (Organ) and "The Marathon" (Tissue).

- Check: Did they put "Transport (Lights/Sirens)" with Organs? Did they put "Storage Bank" with Tissues?

Part C: Future Alchemy (20 minutes)

Step 1. The Problem

- Say: "The current system is amazing, but it has a problem: We don't have enough donors, and organs don't last long enough outside the body."

Step 2. The Innovation

- Discussion: detailed in the Teacher Content.
  - Machine Perfusion: Extends the time limit.
  - 3D Printing: Solves the supply limit.
- Worksheet: Students complete Part 2 of the Lab Report, choosing one technology to investigate/describe.

Part D: The Human Key (10 minutes)

Step 1. The System Failure

- Scenario: Read the scenario from Part 3 of the Worksheet (High-tech system ready, but family says 'No').
- Discuss: "All the science, all the jets, all the robots stop working if we miss one simple thing: The Conversation."

Step 2. Conclusion

- Discuss: "Why is 'Using the Lens' (Empathy) better than Arguing?"
- Conclusion: "Arguing tries to smash someone's lens. Empathy tries to look through it. As Alchemists, we always choose empathy.

Differentiated Learning

- Extension:
  - Challenge students to research Xenotransplantation (using animal organs). Ask them to list two potential scientific benefits and two ethical questions this new "Alchemy" raises.
  - Design Challenge: Ask them to sketch a concept for a "Future Transport Drone" specifically designed to carry organs through a busy city faster than an ambulance.
- Learning Support:
  - Visual Cues: Provide the "Laboratory Cards" with visual icons (e.g., a Clock icon for Organs and a Calendar icon for Tissues) to help students distinguish the timelines visually during the sorting activity.
  - Scaffolding: Provide the "Lab Report" worksheet with the first and last steps of the flowchart already filled in, so students only need to sequence the middle steps.

Teacher Reflection

- Did the "Laboratory" metaphor help ground the complex logistics in a way that felt organized rather than scary?
- Were students able to clearly distinguish between the "Sprint" (Organ) and the "Marathon" (Tissue) pathways?
- Did the discussion on "Future Alchemy" spark curiosity about STEM careers in health, or did it raise too many ethical questions that need addressing in a future lesson?

Assessment

- Worksheet (Part 1): Assess the accuracy of the Flowchart. Do they understand that Organs = Time Critical and Tissues = Storable?
- Class Discussion: Assess understanding of why innovation is needed (to solve the problem of scarcity/time).

Additional Notes:

This lesson is high-energy and focuses on "How things work." It appeals to students who might have found the "Empathy" lesson too "soft." By grounding the unit in hard science and logistics, we validate the complexity of the medical field. Ensure you emphasize that Tissues (like corneas) are stored in banks—this is often a new and fascinating concept for students (e.g., "There is a library of eyes?").