PRACTICAL *activities*

grade:
Key Stage 3 (11-14 yrs old) and early Key Stage 4 (15-16 yrs old)

subject: General Science (Biology)

lesson topic: Animal-Free Science

Overview

This pack provides teachers with simple, safe, and engaging activities to help students understand cells, tissues, organs, and modern animal-free science innovations. Activities are curriculum-aligned for KS3 (ages 11-14), activity 5 could be used with KS4 (15-16 year old).

Activity 1: Cells Need to Grow (Simulation)

Objective: To show what cells need to survive and grow in a lab environment.

Materials:

- Small cups or jars
- Gelatin (or agar)
- Lentils, beans, or cress seeds
- Water, sugar, fridge access

Instructions:

1. Prepare cups with gelatin/agar to represent growth medium.
2. Add seeds/beans to each cup under different conditions:
   - Sugar water (nutrients)
   - Plain water
   - In fridge (wrong temperature)
   - Left uncovered (risk of contamination)
3. Observe over a week which ones thrive or fail.

Discussion: Link to what real cells need in labs (nutrients, oxygen, warmth, sterile environment).

Activity 2: Organs-on-a-Chip Analogy

Objective: To demonstrate how fluid flow keeps cells alive in devices like organs-on-chips.

Materials:

- Clear straws or plastic tubing
- Small beads or paper discs
- Water (can add food colouring)

Instructions:

1. Place beads/discs inside a straw to represent cells.
2. Pour coloured water through to simulate nutrients flowing past.
3. Block the straw and observe what happens.

Discussion: Flow keeps cells alive – similar to how blood vessels keep organs alive.

Activity 3: Tissue Building Challenge
Objective: To understand how cells form tissues and organs.
Materials:
· Lego bricks, coloured sticky notes, or similar building blocks
Instructions:
1. Represent cells with single bricks/notes.
2. Build tissues (layers of the same type).
3. Combine tissues to create organs (multi-layered, different colours).

Discussion: Scientists can now do this with real human cells in labs (e.g., mini-organs known as organoids).

Activity 4: From Cheek Cells to Lab-Grown Skin
Objective: To link students' own biology with lab-grown tissues used in animal-free science.
Materials:
· Microscopes
· Prepared slides (optional: onion cells)
· Cotton swabs
· Microscope slides + cover slips
· Methylene blue stain
Instructions:
1. (Optional) Show onion cells to illustrate plant cell structure.
2. Students swab inside of cheek, smear onto slide, stain with methylene blue.
3. Observe under microscope and sketch cells.
Discussion: These cheek cells are the same type used to make lab-grown skin. Scientists layer them to create human skin models used instead of animals.

Activity 5: Human-Relevant Science – Choose & Build
Objective: Build familiarity with non-animal tools and why they're useful.
Note: This may be better for KS4 (15-16yr olds)

Station Carousel: "Meet the Methods" (40mins - 10mins per station)

- Stations:
  · A) Lab-grown skin models · B) Liver organoids · C) Heart-on-a-chip
  · D) Computer simulations
- At each station: 1 simple image, a 3-line explainer ("What it is / What it's good for / One limit"), and a stamp space.
- Student task: Collect stamps and complete a 1-line takeaway per station: "This helps because…"

Quick Assets (you can copy into worksheets/posters)

Station card A: Lab-grown skin models

What it is: Layers of human skin cells grown in the lab to mimic real skin structure and barrier function.
Good for: Checking skin irritation/sensitivity, corrosion, and how substances pass through skin.
One limit: Not a fully developed immune system, so it could be a potential problem if testing safety of hair dyes or fragrances.
Discuss: What products could be tested on lab-grown skin models?
Stamp: "Lab-grown skin models helps because ____________________."

Example "stamp" answers: it shows if the new cream/product irritates human skin / we can see whether a chemical passes through the skin layer / it uses human skin cells, so results are relevant for humans.

Station card B: Liver organoids

What it is: Tiny 3D clusters of human liver cells grown from stem cells that perform key liver functions.
Good for: Seeing how a substance is broken down (metabolism) and spotting early liver toxicity.
Limit: Not a whole body (no kidneys, gut, brain, hormones). If we need whole-body answers (kidneys, gut, immune responses), we add other human-relevant steps and computer models – we do not default to animals.
Discuss: If a lab result showed stress in liver organoids, what would your next step be?
Stamp: "Liver organoids helps because _____________________________."

Example "stamp" answers: it shows if a substance damages human liver cells / we can see how the liver breaks it down (metabolism)/ liver-toxicity warnings can stop unsafe products reaching paharmacies / it uses human liver tissue, so findings are relevant for humans.

Station card C: Heart-on-a-chip

What it is: A tiny, transparent device with living human heart cells inside. Nutrient fluid flows through small channels (like mini blood vessels) and the cells beat. Sensors let scientists watch the heartbeat and how it changes.
Good for: Checking if a substance affects heartbeat or rhythm (does it speed up, slow down, or become uneven?).
One limit: It's a piece of the heart, not a whole body. It won't show what happens after substance is broken down and processed by the liver.
Discuss: We want to test a new energy drink on heart-on-a-chip. If the chip shows an irregular heartbeat, what next step would you choose (e.g., computer model, liver organoid, different dose, another human-cell test)?
Stamp: "Heart-on-a-chip helps because _____________________________."

Example “stamp” answers: affects heartbeat in human heart cells/ we can see if the heartbeat becomes too fast, too slow, or uneven / we can test different doses safely and watch how the beat changes / it uses human heart cells, not animals

Station card D: · Computer simulations

What it is: Mathematical/computer models that predict how a substance behaves in humans using existing data.
Good for: Quick and accurate predictions about absorption or risk, comparing doses, and planning what to test in the lab next.
One limit: Only as good as the data provided - so we need lots of it!
Discuss: If we are testing the effects of a new energy drink, what data from our human-relevant tests could we feed into the computer simulation?
Stamp: “This helps because ____________________________.”

Example “Stamp” answers: it can predict how much gets into the blood at different doses / we can test ideas quickly before doing lab work / it combines results from human-cell tests to estimate risk / we can compare doses safely on a computer without using animals.