Teacher's Guide: Cells, Tissues, Organs & Human-Relevant Innovation (11-16 year olds)

This guide accompanies the slide deck "Cells, Tissues, Organs and Animal-Free Innovation for Schools." It provides **slide-by-slide notes, quick scripts, misconceptions, checks for understanding, and differentiation tips**

Overview & Lesson Goals

Students will:

Recall cell → tissue → organ relationships.

Explain at a simple level what cells need to grow in a lab (nutrients, oxygen, warmth ~37 °C, liquid, sterile conditions).

Describe three human-first methods: lab-grown skin, liver organoids, heart-on-a-chip.

Apply these to real questions: irritation, liver safety, heartbeat.

Time:

45–50 min core lesson (+ options for extensions/practicals).

How to Use This Guide

Each slide note includes: a 20–30s teacher script, a misconception to watch for, and a quick check.

Use the bolded "This helps because…" prompt to elicit one-sentence takeaways from students after method slides.

Keep the tone human-first. Treat animal testing as legacy context rather than a live option for this lesson.

Slides: BASICS OF HUMAN BIOLOGY – CELLS / WHAT ARE CELLS?

Teacher script (20–30s): A cell is the smallest building block of life. Different cells make up tissues; tissues build organs. Today we'll see how scientists can grow human cells in the lab to answer real questions safely and human-relevantly.

Common misconception to watch for: "Cells are only in humans." (Students may forget plants and other organisms also have cells; keep focus but acknowledge the broader truth.)

Quick check for understanding: Ask: "What's smaller, a tissue or a cell?" → Expect: a cell. Then: "Give one example of a tissue and its organ."

Differentiation: Provide a labeled diagram for EAL/SEND; use concrete examples like muscle tissue → heart.

Slides: Nucleus / Mitochondria / Cell Membrane (Cell Organelles)

Teacher script (20–30s): Think of the membrane as a smart gate (lets some things in/out), the nucleus as a control centre with instructions, and mitochondria as tiny power stations. Human cells may respond differently from animal cells—that's why human-first models matter.

Common misconception to watch for: "All cell membranes let everything through." (They are selective.)

Quick check for understanding: Ask students to match each organelle to its nickname: gatekeeper, control centre, powerhouse.

Differentiation: Use icon cues on the slide; allow students to mime 'gate', 'brain', 'battery' to anchor memory.

Slide: What do cells need to grow?

Teacher script (20–30s): In a lab, human cells need: nutrients (like food), oxygen, warmth at about 37 °C, clean/sterile conditions, and liquid to live in. This is why you'll see warm incubators and sterile media in videos of cell culture.

Common misconception to watch for: "Cells will grow anywhere if you add water." (They need the right nutrients, temperature, oxygen, and sterility.)

Quick check for understanding: Ask: "Name two things cells need to grow." → Expect: nutrients, oxygen, 37 °C, liquid, sterile conditions.

Differentiation: For low-literacy groups, show a 5-icon checklist and have students tick what labs provide.

Slides: TISSUES AND ORGANS (What is tissue? What are organs? How related?)

Teacher script (20–30s): Cells of the same type work together to form a tissue. Different tissues combine to form organs (like heart or skin). We'll use this idea to understand lab-grown skin, liver organoids, and heart-on-a-chip.

Common misconception to watch for: "An organ is just one tissue." (Most organs contain multiple tissues.)

Quick check for understanding: Ask: "Which tissues can you find in a heart?" → Expect: muscle tissue, connective tissue, nerve tissue.

Differentiation: Have students sort picture cards into 'cell', 'tissue', 'organ' quickly at their tables.

Slides: ORGANOIDS – What are organoids?

Teacher script (20–30s): Organoids are tiny 3D clusters of human cells that self-organise like mini-organs. Today we'll look at liver organoids to check early liver safety and metabolism.

Common misconception to watch for: "Organoids are full organs." (They are models of key parts/functions, not whole bodies.)

Quick check for understanding: Ask: "If a liver organoid shows stress with a chemical, what might that tell us?" → Expect: possible liver risk; check other steps next.

Differentiation: Provide the sentence starter: "An organoid helps because…". Repeat the 'This helps because…' routine.

Slides: ORGAN-ON-A-CHIP – What is it?

Teacher script (20–30s): An organ-on-a-chip is a tiny device lined with living human cells and channels for flowing nutrients—like mini blood vessels. A heart-on-a-chip can actually beat, letting us see rhythm and strength at different doses.

Common misconception to watch for: "It's a computer chip, not living." (Clarify it contains living human cells.)

Quick check for understanding: Ask: "What heart features could we measure on a chip?" → Expect: beat rate, rhythm, contraction strength.

Differentiation: Show a short clip or animation; for sensory needs, reduce sound and focus visually on the beating cells.

Slide: Lab-grown skin (human skin cell models)

Teacher script (20–30s): Layers of human skin cells grown in the lab mimic real skin structure and barrier. We use them to check irritation and whether substances pass through the skin.

Common misconception to watch for: "If it doesn't include blood, it's useless." (For local skin questions, it's ideal.)

Quick check for understanding: Ask: "What's one question a skin model can answer quickly?" → Expect: Does it irritate? Does it penetrate?

Differentiation: EAL scaffold: picture of skin layers; students point to where irritation would appear.

Slide: Liver organoids (mini-livers)

Teacher script (20–30s): Tiny 3D 'mini-livers' perform key liver functions. They help us see how a substance is broken down and if it harms human liver cells early on.

Common misconception to watch for: "If organoids can't show kidneys/gut, they're no use." (They're great for specific liver questions; add other human-first steps if needed.)

Quick check for understanding: Ask: "If organoids show stress, what would your next step be?" → Expect: modelling, dose check, another human cell system.

Differentiation: Provide a flow arrow card set: Liver organoid → PBPK model → (optional) next step.

Slide: Heart-on-a-chip (human heart cells)

Teacher script (20–30s): A tiny device with beating heart cells lets us test if a substance changes beat rate, rhythm, or strength at different doses.

Common misconception to watch for: "If it's not a full body, it won't show anything useful." (It answers the heart question directly and human-relevantly.)

Quick check for understanding: Ask: "Where would you put heart-on-a-chip in a plan for an energy drink?" → Expect: early step to screen heartbeat effects.

Differentiation: Give students three cards—First / Second / Later—and ask them to hold up their choice.

Slide: How these methods answer real questions

Teacher script (20–30s): We pick the tool that best answers the question for humans. Irritation? Start with skin. Liver safety? Start with liver organoids. Heartbeat? Start with heart-on-a-chip. Then add modelling or other human steps as needed.

Common misconception to watch for: "There's only one right pipeline." (Different human-first sequences can work; justify choices.)

Quick check for understanding: Ask: "Complete: We'd start with ___ then ___ because ___." (Pairs write one line, then share.)

Differentiation: Provide sentence frames and let students place method icons in order on mini whiteboards.

Extensions & Assessment

Extensions:

Station carousel with stamp cards (see activity worksheet : skin, liver organoid, heart-chip, computer model).

Build-a-pipeline card sort for one scenario (2-step human-first plan).

Cheek-cell microscope practical (link to lab-grown skin concept).

Assessment quick rubric (/10): uses human-relevant reasoning, chooses appropriate sequence, notes a limit, communicates clearly, collaborates respectfully.

Safety, Inclusion & Language

Follow school safety for stains, slides, and equipment; clean workspaces.

Use large fonts and high-contrast headers for readability; add image alt-notes in presenter notes.

Language: say “human-relevant methods” rather than “alternatives” (implies animals as default). Keep animal testing as legacy context, not a classroom option.