

Replacement parts comparison

Activity 4.4.1. Three ways to replace a part of a person, and how to choose

Grow it, build it, or take it from someone else. Every failing organ eventually meets those three options and none of them is free. This is the item in the pack the state exam does not measure, and it is here anyway.

NOT ON THE WEBXAM**45 TO 60 MINUTES****ONE SITTING****NOTHING NEEDED BEFOREHAND**

What this is

Compare three ways of replacing lost function, engineered tissue grown on a scaffold, a mechanical or bionic device, and a donor organ from another human being, then recommend one for a specific patient and defend the choice.

This comparison used to sit on 20 November. It came off the calendar so that **from a human gene to a protein medicine** could take a full block on 19 November, ahead of the cloning work rather than crammed against it.

DOES THIS HELP ON THE WEBXAM? NO. READ THIS BEFORE YOU CHOOSE IT

MI is assessed by WebXam **072130 Genetics of Disease**, and all four of its domains are laboratory practice: Bio-Molecular Technology, Culturing, Laboratory Standard Operational Procedures, and Biotechnology Research and Experiments. Comparing replacement strategies is not a laboratory technique, so it lands on none of them. Doing this item will not move your exam score, and pretending otherwise would be the easiest lie in this pack to get away with.

It is here because it is the item most likely to still be with you in ten years, and because a course that only taught what the exam counts would be a worse course. If you are choosing purely on exam value, do EC1 and EC3 first and come back to this one.

WHY IT IS WORTH YOUR TIME ANYWAY

More than 100,000 people are on the national transplant waiting list in the United States. The shortage is not a technical problem waiting for a better surgeon. It is arithmetic, and the only three ways out of it are the three options in this comparison. Whichever of them wins over the next thirty years will be decided partly by people who are in high school right now.

This item also does something the exam-heavy items do not: it makes you weigh things that are not measured in millimetres. Waiting time. Immunosuppression for life. Whether a device that works perfectly is the same as being well.

The three options, and what each one actually costs

Engineered tissue

Cells seeded onto a scaffold and grown into organized tissue. The scaffold shape guides how the tissue forms. Using the patient's own cells removes the rejection problem, which is the single largest advantage any option has.

Scaffold

The structure the cells grow on. It has to hold its shape, let nutrients through, and either break down safely or stay put without causing harm.

Mechanical or bionic device

A manufactured part that does the job. Available now, made to specification, and never rejected as foreign tissue. It also does not grow, does not repair itself, and needs power or maintenance.

Donor organ

A whole working organ from another person. The most complete restoration of function available today, and the one with the shortest supply and the longest list of conditions attached.

Immunosuppression

Drugs that stop the immune system attacking a transplanted organ. They work, and while you take them your body is less able to fight infection and cancer. That trade does not end.

Xenotransplantation

An organ from another species. It would solve the supply problem outright and it raises rejection and cross-species infection questions that are still open.

Build it in order

- 1 **Pick the function, not the organ.** Write one sentence naming what has to be restored: filtering blood, pumping it, moving a joint, sensing light. Everything downstream is judged against that sentence, so make it specific.

Done when: your sentence says what the replacement must DO, not what it must be

- 2 **Fill the three-column table.** For each option: how it restores the function, one real advantage, one real limitation, and its characteristic failure mode. Every option gets a failure mode. An option you cannot name a failure mode for is one you have not understood yet.

Done when: all three columns are full and no cell says 'none'

- 3 **Write the rejection row properly.** A donor organ is rejected by the immune system. Engineered tissue built from the patient's own cells largely avoids that. A mechanical device is not rejected as tissue but the body still responds to a foreign object, and it can fail mechanically or run out of power. Three different failure stories, not one.

Done when: your rejection row says something different in each column

- 4 **Read the patient scenario** in Activity 4.4.1 Replacement Parts in myPLTW and list the constraints it actually states: age, how urgent it is, whether they can take immunosuppression, how long they can wait, what they need to be able to do afterwards.

Done when: you have a written list of constraints taken from the scenario, not assumed

- 5 **Match constraints to columns.** Go through your list one constraint at a time and mark which options it rules out. Some constraints rule out nothing. Say so.

Done when: at least one constraint has visibly eliminated at least one option

- 6 **Write the recommendation.** Name one option, name the two constraints that drove it, and name what your patient gives up by taking it. Every choice here costs something. A recommendation that costs nothing has not been thought through.

Done when: your recommendation states what is being given up as well as what is gained

- 7 **Write the honest paragraph.** What would have to change, in the science or in the patient's situation, for you to recommend a different option? One specific change.

Done when: a reader can tell exactly what would flip your answer

- 8 **Name, period, submit.**

Done when: your table and both paragraphs are attached

Fill this in as you go

THE FUNCTION THAT HAS TO BE RESTORED

THREE WAYS TO REPLACE A PART OF A PERSON

	ENGINEERED TISSUE	MECHANICAL OR BIONIC DEVICE	DONOR ORGAN
How it restores the function			
One real advantage			
One real limitation			
How it fails, when it fails			
How soon could this patient have it			

YOUR RECOMMENDATION, AND WHAT THE PATIENT GIVES UP TO TAKE IT

WHAT WOULD HAVE TO CHANGE FOR YOU TO RECOMMEND A DIFFERENT OPTION

If you get stuck

Engineered tissue looks best in every row. Is that right?

It looks best on paper and it is the least available in practice. Add a row for how soon this patient could actually have it, and the picture changes. An option that is perfect in ten years is not an option for a patient who needs one in ten weeks. Availability belongs in the comparison.

The scenario does not say whether the patient can take immunosuppression.

Then say that in your report and state the assumption you are making. Naming an assumption is a professional move. Quietly assuming and hoping nobody notices is not.

I cannot find a limitation for the mechanical device.

Try these: it does not grow with a young patient, it does not repair itself, it usually needs a power source, and the body forms tissue around any foreign object over time. Pick the one that matters most for your specific patient.

My recommendation feels like a guess.

Then go back to your constraint list. If nothing on it eliminated an option, your list is too vague. Constraints that eliminate nothing are not constraints, they are description.

Does it matter which option I pick?

Much less than whether you can say what it costs. Two students can recommend opposite options and both earn full credit, if each one names the constraints that drove the choice and what the patient gives up. This item is not scored on the answer.

What to hand in

THE FINISHED COMPARISON

- **Where it goes.** The same place as everything else. Your class form on the portal, or handed to Mr. Mendoza in person. Nothing about extra credit needs a different route.
- **What to hand in.** Your written pages, plus photographs of anything the handout asks you to photograph. Photographs of handwritten pages are fine. A photograph you cannot read is not.
- **Put your name and period on every page and every photograph filename.** Unlabelled work cannot be credited and it is the single most common way points get lost.
- **When.** Any day after the pack opens, right up to the last week of the semester. There is no deadline inside that window and no penalty for going slowly.
- **Feedback.** You get it back with a note. If a piece is short of full credit you may fix the named thing and resubmit once.

HOW BIG THIS ITEM IS: THE SHORTEST ITEM IN THIS PACK

About 45 to 60 minutes in one sitting. No data to assemble and no laboratory time. It is short because the table does most of the work, and the two paragraphs at the end are where the thinking is.

The point value is printed on the portal the day this item opens, on the item's own card and in the gradebook entry. It is not printed here, because a number on paper and a number in the gradebook that disagree is worse than no number at all. Extra credit in this class is capped per semester, so check the cap on the portal before you start a fourth item.