

Engineered organism debate

Your goal: Argue whether genetically engineering bacteria to produce medicine is ethically justified despite biosafety risks.

One product: One sentence stating whether engineered-organism benefit justifies biosafety risk, with a specific reason grounded in containment or patient benefit.

Question: What patient benefit, safety evidence and safeguards would justify your position on contained production of insulin?

Start the work

A finished product connects each health claim to evidence, matches its privacy statement to its design and records only work actually completed.

1. Read the briefing on a recombinant bacterium engineered to make insulin.
2. Choose a side on whether the benefit justifies the risk.
3. List two reasons grounded in safety and patient benefit.
4. Debate in your group, tracking claims about containment and oversight.
5. Reflect on what safeguards would make you more comfortable.

If the assignment or access is missing, save the dated work and mark submission pending. Keep actual official reflection attachment and asynchronous post/reply separate.

Words you will use

ethical justification

Reasons for judging a choice acceptable while considering its effects on others.

position

The conclusion you defend, including any conditions.

stakeholder

A person or group affected by a choice.

patient benefit

A useful effect for people who need care.

access

Ability to obtain and use a needed resource or service.

biosafety

Practices and protections intended to prevent unintended exposure to biological hazards.

hazard

A possible source of harm.

risk

Likelihood and consequences of harm in stated conditions.

likelihood

How probable an event is in stated conditions.

severity

How serious an outcome would be.

containment

Measures intended to keep biological material from unintended exposure or release.

oversight

Responsible review and monitoring of work and decisions.

safeguard

A measure proposed or used to reduce harm.

exposure

Contact with a potentially harmful agent.

escape

Unintended movement of an organism outside its intended controlled setting.

release

Putting material into an environment; it may be deliberate or unintended.

risk assessment

A reasoned review of hazards, possible exposure and consequences for particular work.

burden

A cost, risk or disadvantage carried by a person or group.

fairness

How benefits, burdens and opportunities are distributed and justified.

uncertainty

What the available information does not establish.

evidence

Information that supports or challenges a claim.

claim

A statement that can be examined with evidence or reasoning.

value judgment

A decision about what matters or what tradeoff is acceptable.

tradeoff

A choice that gains something while accepting a cost or limit.

conditional support

Agreement only if stated conditions are met.

postponement

Waiting for a needed condition or evidence before proceeding.

steelman

The strongest fair version of an opposing argument.

reflection

A reasoned account of what you think and what could change it.

recombinant DNA

DNA formed by combining segments using laboratory methods.

genetic engineering

Changing an organism's DNA using laboratory methods.

genome editing

Changing DNA at particular locations in a genome.

CRISPR-Cas9

One genome-editing approach, not another name for all genetic engineering.

BMBL

Biosafety in Microbiological and Biomedical Laboratories, advisory guidance published by CDC and NIH.

genome

The complete set of genetic information in an organism.

DNA

The molecule that carries genetic information.

gene

A DNA region with information used to make a functional product.

protein

A molecule built from amino acids that carries out roles in cells and organisms.

insulin

A hormone used as a medicine in diabetes treatment.

bacterium

A single-celled organism whose cell lacks a nucleus.

Escherichia coli

A species of bacterium; different strains can have different properties.

strain

A particular genetic variant or lineage within a species.

mammalian cell

A cell from a mammal, a group of animals that includes humans.

somatropin

A form of human growth hormone made using recombinant technology.

epoetin alfa

A medicine made using recombinant technology to match human erythropoietin.

manufacture

Production of a material or product under planned conditions.

restriction enzyme

An enzyme that cuts DNA at recognized sequences.

plasmid

A DNA molecule separate from a cell's main chromosome.

vector

A carrier of genetic material in a research context.

selectable marker

A genetic feature used to help identify cells with a linked trait.

positive control

A comparison expected to give the response being tested.

negative control

A comparison expected not to give that response.

false positive

A positive test response when the target is absent.

validation

Evidence that a method or measure works for its intended use.

frequency

How often an event occurs in a stated set of opportunities.

asynchronous

Work completed outside a shared live class session.

milestone

A defined stage with actual requirements to complete.

tracker

A record of completed and pending work.

H1: prepare an ethical position without personal records

Today you evaluate an original paper proposal about engineered bacteria making a medicine. You do not build, handle or release an organism. No patient or student records are involved.

The final product is one sentence giving your position and a specific containment or patient-benefit reason. Keep your two reasons, debate notes and safeguards reflection as supporting work.

Warmup: use E1 to name a medicine made with living cells. Explain what losing that production option could mean for access to a treatment. Do not predict an individual outcome.

Then name one possible concern when scientists change bacterial genes. Treat it as a concern to assess, not a measured failure in D1.

For the three-medicine prerequisite, use all three E1 examples. Record the production cell type supplied for each. Do not list medicines you or relatives have taken.

A factory is a production setting; living cells can be part of its process. These are not opposite categories. E1 supplies examples, not the current global share of insulin production.

The earlier product lesson taught that a claim needs evidence and honest status. Apply that rule here even if your April 29 product remains unfinished.

E1: three real production examples and their limits

FDA records that Humulin became the first approved biosynthetic human insulin in 1982. Its history describes recombinant production using bacteria as an alternative to dependence on animal glands. [FDA-INSULIN]

Insulin is used in diabetes treatment. Losing a production option could limit treatment supply, but this history does not establish a current shortage or anyone's clinical outcome. [FDA-INSULIN]

Example two: the GENOTROPIN label describes somatropin, a human growth hormone protein, made by recombinant DNA technology in Escherichia coli bacteria. [LABEL-GH]

Example three: the EPOGEN label describes epoetin alfa made by mammalian cells carrying genetic instructions for human erythropoietin. These are mammalian production cells, not bacteria. [LABEL-EPO]

All three examples use living cells in medicine manufacture. They do not show that every medicine is made this way. A production cell is not the same thing as the finished medicine.

These sources establish examples of production. They supply no prices, clinic budgets, local availability or numerical escape rates. Do not promise that engineering alone makes medicine affordable.

Use medicine names and production facts only. This lesson gives no recommendation to take, stop or change a medicine.

E2: what genetic engineering means here

Genetic engineering changes an organism's DNA using laboratory methods. Recombinant DNA can combine DNA segments, and cells can copy the resulting DNA. NHGRI describes insulin and growth hormone applications. [NHGRI-GE] [NHGRI-RDNA]

DNA carries genetic information. A gene is a DNA region with information used to make a functional product. A protein is a molecule made from amino-acid building blocks.

MedlinePlus describes genome editing as changing DNA at particular locations. CRISPR-Cas9 is one approach. Do not assume every engineered organism was made by that approach. [MEDLINE-EDIT]

For this debate, the bacterium is a proposed production organism. The intended product is insulin medicine. The proposal does not call for giving people live bacteria or releasing them outdoors.

A selectable marker helps identify cells with a linked genetic feature. That identification role is different from preventing escape or harm. A marker alone does not demonstrate containment. [MARKER]

You need these meanings to assess the proposal. No genetic sequence, construction method, organism selection or operating conditions are supplied or requested.

D1: complete original paper proposal

Fictional proposal: a manufacturer seeks ethical support in principle for contained production of insulin using engineered *Escherichia coli* bacteria. This is an invented review case, not an actual facility or local clinic plan.

The stated aim is to provide another production option for an established medicine. No claim is made that the proposed facility has produced a safe medicine or lowered anyone's price.

The proposal promises a qualified safety review before work, trained personnel, restricted access and a documented response to failures. These are proposed safeguards, not verified performances.

No actual strain assessment, facility inspection, product-quality results, environmental monitoring, worker exposure data or patient access plan is supplied. No escape probability can be calculated from this case.

The reviewers must consider patients, workers and nearby communities. Patients could value reliable supply. Workers could carry exposure burdens. Communities could reasonably ask who monitors failures and reports them.

These stakeholder concerns are original prompts, not interviews or claims that every person agrees. No actual illness, accident or escape has occurred in the case.

Your choice may be conditional support, postponement pending evidence or a reasoned objection. State what your position allows and what it does not. No classroom vote authorizes real production.

E3: risk assessment and accountable safeguards

CDC and NIH describe the BMBL as advisory biosafety guidance, not a regulation. Its core is risk assessment matched to the work; one document cannot cover every risk combination. [BMBL]

Distinguish a hazard, a possible source of harm, from risk, which concerns likelihood and consequences in stated conditions. Severity asks how serious a harm could be.

An escape is not itself a complete health outcome. Survival, exposure and the organism's properties matter. D1 provides none of the measurements needed to infer those outcomes.

For D1, ask for evidence that proposed safeguards fit the actual work and are checked. Name who reviews concerns, who may stop work and how affected people can raise questions.

You can request a documented independent safety review and a clear stop-and-review rule after a reported failure. These are high-level governance proposals, not a laboratory protocol or legal finding.

An assigned containment level must follow qualified assessment, not a classroom guess. A promise, a selection marker or a checked box does not establish zero risk.

Keep patient benefit, likelihood, severity and fairness separate in your reasoning. Missing evidence may justify waiting without claiming harm is certain. A known benefit does not remove the need for review.

C1: complete opposing positions and solo rounds

Position A, conditional support: The insulin history supports the value of a production option. I support the idea only if qualified review verifies suitable safeguards and product quality before work proceeds.

A also asks for a patient access plan and clear responsibility for reporting failures. Its strongest point is preserving potential benefit while imposing conditions. Those conditions are not yet met in D1.

Position B, postpone approval: Patients matter, but D1 lacks the evidence needed to judge exposure burdens and safeguard performance. I would wait for the safety review and access plan.

B would reconsider if those records address its concerns. Its strongest point is refusing to shift unknown burdens onto others. Its cost is delay in a possible production option.

Both positions use the same D1 facts. Neither asserts an actual shortage, price saving, accident or measured risk. You may defend either with clear conditions and evidence limits.

Group round one: state one patient-benefit reason and one safety reason. Track the speaker's claim, cited card, uncertainty and proposed oversight. Record actual words or a fair paraphrase.

Group round two: reply to the strongest opposing concern and name the safeguard or missing evidence that matters. Record what changed in your view, or explain why it did not.

If no group is available, complete both rounds using A and B. Label the speakers supplied positions and your replies solo practice. Do not invent a classmate, discussion or class vote.

For the debrief, name the concern hardest to dismiss and explain its remaining limit. For the extension, steelman the opposition and state one piece of evidence that would change your vote.

Q1: self-check and conceptual preparation

Self-check: a speaker says that making life-saving insulin makes the proposal obviously ethical, with nothing else to weigh. Explain the flaw using a benefit and a separate safety question.

Return to E1 for the benefit and E3 for what risk assessment must establish. Do not replace the unsupported claim with the opposite claim that every engineered cell causes harm.

If stuck, use M1's everyday comparison first. Then return to D1, choose a position and list both required reasons. A bakery number cannot supply a bacterial escape rate.

Before the next class, review these conceptual roles. A restriction enzyme cuts DNA at a recognized sequence. A plasmid is a DNA molecule separate from a cell's main chromosome. [NHGRI-RE] [NHGRI-PLASMID]

A vector carries genetic material in a research context. A selectable marker helps identify a linked feature. [NHGRI-VECTOR] [MARKER] Selection is not itself proof of the intended product or of safe containment.

A positive control is a comparison expected to give the target response. A negative control is expected not to give that response. They help interpret a test; they do not grant safety approval.

Paper example: Card A is described as containing a square; Card B is described as blank. The checker should answer square for A and no square for B. These are stipulated text cases, not a performed test. Decide which card is the positive comparison and which is the negative comparison.

If the blank is called a square, the checker gives a false positive in this model. If the known square is missed, it fails the positive check. Neither result describes bacteria.

Write one question about these roles or comparisons to bring to Monday, May 3. This is concept review only, not permission to run a virtual or physical experiment.

P1: dated work, posting and honest status

For Friday, April 30, save Engineered organism debate in Exit Tickets. Keep the exact one-sentence position with a specific containment or patient-benefit reason, plus the supporting debate and reflection work.

For asynchronous work, draft a 150-word stance, post it on the actual teacher-provided board, then reply to a classmate who took the opposing view.

If the board or opposing post is unavailable, save your draft and complete both C1 solo rounds. Mark the real post and classmate reply pending. Do not count supplied positions as actual classmates.

Nothing new in myPLTW today; catch up on unfinished Problem 5 work. Your teacher may also assign a Problem 6 ethics milestone with a reflection paragraph attachment.

Activity 6.1.1 Restriction Enzyme Challenge may also be assigned. Ask your teacher which work and stopping point apply.

Keep the Problem 5 catch-up duty visible. If a Problem 6 reflection or tracker milestone is assigned, complete its actual requirements before attaching evidence or marking it done.

The original debate is not proof of official activity completion. Keep the reflection paragraph ready, but label any required actual attachment pending until the route is confirmed.

The next scheduled BI lesson is Monday, May 3, Workflow notes and controls. Bring the Q1 question then.

No homework is due before this class. May 6 has its own preparation: Transformation notes, 25 minutes in Class Records. Do not treat this debate as completion of that preparation or a later lab.

If the teacher assigns a molecular workflow plan or virtual cloning task, obtain its actual materials and confirm the required evidence. This debate does not complete either.

The weekly communication product and any actual April 29 submission remain separate. Do not replace today's task with a different one unless your teacher assigns it.

Use Schoology in your enrolled BI section and match Engineered organism debate by the assignment description. Submit one PDF through the confirmed route and check that the intended file is attached.

Follow teacher name and filename directions locally. If access or the assignment is missing, save the dated work, mark submission pending and ask the teacher for the route.

Actual equipment, course simulations and laboratory materials require their own supplied instructions and approval. Today's paper discussion authorizes no biological work, medicine production, public release or personal-data collection.

M1: a different worked bakery decision

Original toy case: a bakery considers a machine that could lower bread costs but might cause a fire. For this model only, assume one fire per thousand operating days.

This is an invented frequency assumption, not measured appliance evidence. One divided by one thousand is 0.001, or 0.1 percent. It does not predict when a fire would occur.

The toy case gives no injury count, price reduction or proof of safety features. My benefit reason is a possible lower production cost. My concern is potential harm to workers.

I would postpone operation until qualified review checked the safeguards and responsibility for responding to a failure. I would reconsider after evidence addressed those gaps, not after a promise alone.

The strongest opposing argument is conditional support for the cost-saving idea, with actual operation still held until review. We differ on what approval in principle means, not on whether checks are needed.

My final sentence: I would postpone using the machine because its potential benefit does not establish that workers are protected from the stated fire hazard.

Map benefit, possible harm, missing evidence and review to D1. Do not transfer the fire frequency to bacteria, equate lower production cost with affordable insulin, or treat the model as your final answer.

Try the decision

Which reasoning approach is supported by E1/E2/E3 and D1?

- Weigh patient benefit and safety separately, name the missing evidence, and state conditions or reasons for waiting without authorizing real work.
- Approve production automatically because a medicine benefit means there is nothing else to weigh.
- Conclude an escape must cause disaster and a selection marker removes every risk.

Explain your choice using the reading. Discuss it or say it to yourself. This practice does not add another submission.

Your 80-minute flow

0–5 minutes	Name the three production examples and a bounded concern.
5–20 minutes	Read the briefing and source limits, choose a side and prepare both reasons.
20–40 minutes	Complete both C1 rounds in a real group or labeled solo route.
40–55 minutes	Debrief the hardest concern, use Q1's self-check and review M1 if needed.
55–70 minutes	Write safeguards reflection and review Q1's concepts for the next-class question.
70–80 minutes	Write the one-sentence exit and save work; record the P1 actual-work and submission status.

Your response record

Use these labels on paper or in your document. The space below also works when this page is printed.

Three examples and one concern

Use all three E1 medicine examples to name the production cell types. Choose one medicine, explain a bounded loss-of-production concern, and name one possible engineering concern.

Use supplied public examples only. A factory can use living cells. No family medication history or global market-share guess is needed.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

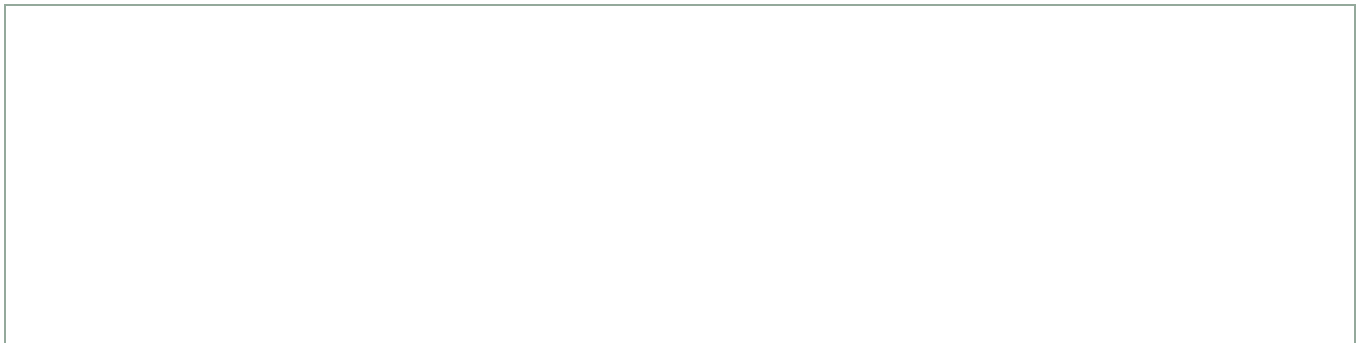


Position and two reasons

Choose your position on D1. Write one patient-benefit reason and one biosafety reason, each tied to a supplied card and its limit.

Conditional support, waiting or a reasoned objection can be defended. Separate missing information from evidence that harm occurred.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Two debate rounds

Complete both C1 rounds. Track each claim, supporting card, uncertainty and oversight proposal. Reply to the strongest opposing concern.

Use actual group discussion or label the supplied A/B positions and your own responses solo practice. Do not invent participation.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Hardest concern and safeguards reflection

Name the concern hardest to dismiss. Write a reflection paragraph explaining a safeguard, what it addresses, what it cannot prove and what evidence could change your position.

Use E3 and C1. Your paragraph supports today's work; an actual official reflection attachment remains pending until confirmed.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Benefit is not the whole decision

Answer Q1's self-check using a patient benefit and a distinct safety question. Explain why a selection marker does not itself establish containment.

Use E1/E2/E3. Do not replace automatic approval with a claim of inevitable harm.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

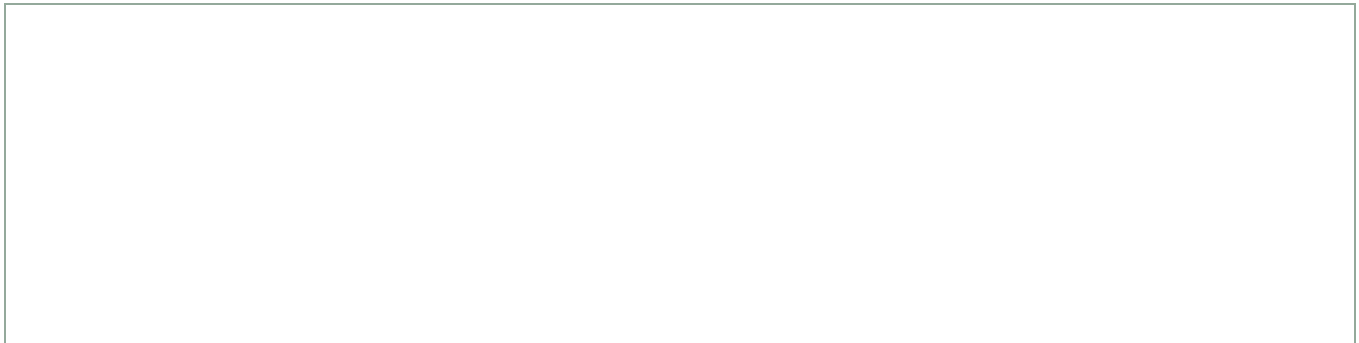


One question for Monday, May 3

Review Q1's enzyme, plasmid/vector, marker and control roles. Identify the positive and negative comparisons in the paper example, then write one question for next class.

This is conceptual preparation only. No organism, sample, experimental conditions or procedure is needed.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



150-word stance and actual opposing-peer reply

For the asynchronous route, write a 150-word stance with both reasons, evidence limits and safeguards. Post and reply to an actual opposing classmate only on the teacher-provided board.

Without the board or post, save the draft, use both C1 solo rounds and mark genuine posting/reply pending. Do not fabricate a classmate response.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Optional strongest opposing argument

Steelman the position you disagree with. Name one piece of evidence that would change your vote and explain why.

Use the matched C1 arguments and D1 limits. No experimental design or real test is requested.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

One sentence and actual status

Write exactly one sentence stating whether engineered-organism benefit justifies biosafety risk, with a specific containment or patient-benefit reason. Record actual work and submission status separately.

Keep both preparation reasons and reflection with the sentence. Use P1 for official-work, post/reply, preparation and submission holds.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Check your product

- The one-sentence exit states a position with a specific containment or patient-benefit reason.
- Two preparation reasons, debate tracking and safeguards reflection distinguish benefit, risk and uncertainty.
- Concept preparation and actual course, peer and submission status are truthful; no real operation is approved.

Keep the limit: This original paper debate supports ethical reasoning under stated uncertainty. It cannot establish a real escape rate, product safety, price, patient outcome, legal approval, completed coursework or permission for biological work.

Turn in your work

Save the one-sentence Engineered organism debate exit with both reasons, debate notes and reflection. Submit one PDF through the confirmed enrolled BI assignment; the dated folder is Exit Tickets.

If the assignment or access is missing, save the dated work and mark submission pending. Keep actual official reflection attachment and asynchronous post/reply separate.

[Open this assignment in Schoology.](#)

Carry forward

A medical benefit informs an ethical choice, but the choice also needs a bounded account of harm, safeguards and who carries the burden.

Bring one conceptual question about the workflow or controls to Monday, May 3. No actual organism work is authorized by this debate. Which control could help distinguish the intended process from another explanation?

Sources and resources

[Open today's page](#)

FDA-INSULIN · 100 Years of Insulin

FDA History Office

<https://www.fda.gov/about-fda/fda-history-exhibits/100-years-insulin>

LABEL-GH · GENOTROPIN label, section 11 Description

DailyMed, National Library of Medicine

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ffebf88b-d257-4542-9808-74d9b7167765>

LABEL-EPO · EPOGEN label, section 11 Description

DailyMed, National Library of Medicine

<https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=1f2d0b28-9cc5-4523-80b8-637daf3f7a5>

NHGRI-GE · Genetic Engineering

National Human Genome Research Institute

<https://www.genome.gov/genetics-glossary/Genetic-Engineering>

NHGRI-RDNA · Recombinant DNA Technology

National Human Genome Research Institute

<https://www.genome.gov/genetics-glossary/Recombinant-DNA-Technology>

MEDLINE-EDIT · What are genome editing and CRISPR-Cas9?

MedlinePlus Genetics

<https://medlineplus.gov/genetics/understanding/genomicresearch/genomeediting/>

BMBL · Biosafety in Microbiological and Biomedical Laboratories, sixth edition overview

CDC and NIH

<https://www.cdc.gov/labs/bmbi/index.html>

NHGRI-RE · Restriction Enzyme

National Human Genome Research Institute

<https://www.genome.gov/genetics-glossary/Restriction-Enzyme>

NHGRI-PLASMID · Plasmid

National Human Genome Research Institute

<https://www.genome.gov/genetics-glossary/Plasmid>

NHGRI-VECTOR · Vector

National Human Genome Research Institute

<https://www.genome.gov/genetics-glossary/Vector>

MARKER · Selectable marker definition

Northwestern University molecular biosciences glossary

https://groups.molbiosci.northwestern.edu/holmgren/Glossary/Definitions/Def-S/selectable_marker.html