# Biology Lab of Horrors Free Teaching Kit

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Turn your biology classroom into a student-created museum. Students research real biology, build a small handmade display, explain four features, and separate science from Halloween fiction. The kit includes real classroom examples and supports individual or partner work in grades 9–10, with optional advanced extensions.

## Start with these files

| File | Use |
|---|---|
| 01 Teacher Guide | Supplies, prep, pacing, safety, and teacher answers |
| 02 Student Guide and Research | Directions, choices, research, planning, and museum card |
| 03 Reference Cards | Nine self-contained science starting points |
| 04 Gallery Walk and Evaluations | Three-display investigation, private self/peer checklists, voting |
| 05 Teacher Grading Checklist | 50-point project and separate 10-point individual grade |
| 06 Daily Checklists and Supports | Chunked steps and the 35-minute label lesson |
| 07 Absent Student Alternative | Six-format choice board for absent students; choose one format and one biology topic |
| 08 Worked Example | Completed example and illustrative scoring |
| 09 Student Display Examples | Four photographs with science captions and discussion prompts |
| 10 Launch and Daily Slides | Editable classroom presentation with teacher notes |
| 12 Station Cards | Nine student-facing station directions, one per page |
| 13 Nature’s Monsters Card | Standalone copy of Reference Card 9 |

## Schedule and grading

Days 1, 2, 4, and 5 are 50 minutes. Day 3 is 35 minutes and focuses on labels. All graded display components are ready by the end of Day 4. The project earns 50 points. Individual work earns 10 separate points. The gallery walk informs learning and reflection; award votes do not change grades.

# Using and sharing the free kit

## Printing

PDFs provide fixed layouts. Student worksheets use blank, unruled response spaces. Print one research/planning packet per team, one gallery and self-evaluation set per student, and one peer-review page per teammate. Print only the reference cards needed. Additional paper may be attached for longer responses.

## Google Docs and Slides

Upload DOCX or PPTX files to Google Drive, open with Google Docs or Google Slides, and save a native copy if desired. Check tables, wrapping, and page breaks after conversion. Replace response prompts as students type. Native Google links are not included.

## Materials and access

Basic craft supplies and clean recycled containers are sufficient. No live cultures or real tissues are required. Provide two accessible sources per team; a reference card may count as one. Internet access is optional when a textbook or printed reading is supplied. Physical supplies are not included.

## Free classroom use

Teachers may download, print, and adapt these materials for their own teaching and share student-facing copies in a private classroom platform. Credit Wages Biology when adapting. Please direct other educators to wagesbiology.com for their own free copy. Do not sell the kit or repost the full package publicly. Student photographs and work remain the property of their respective rights holders; classroom-use permission is not permission to reuse the photos in another commercial product.

## Credits

Lesson materials and classroom photographs: Jeanne Wages, Wages Biology. Scientific readings are credited on reference cards and example pages. External readings retain their own use terms. The kit was developed with AI assistance and reviewed for classroom use; teachers should make any changes needed for their students. Optional student examples are illustrative, not required designs.

# Biology Lab of Horrors Teacher Guide

Five-day project for General Biology grades 9–10 with optional dual-enrollment extensions

Students create a small handmade museum exhibit that uses a Halloween theme to explain real biology. Students work individually or in pairs. Days 1, 2, 4, and 5 are 50 minutes; Day 3 is 35 minutes. Finish every graded display component by the end of Day 4.

### Files to use

Start Here explains the kit. Share the Student Guide, matching Science Reference Card, and the Gallery Walk and Evaluations. Use the worked example and real Student Display Examples to introduce expectations. The Teacher Grading Checklist provides separate project and individual scores.

### Printing and digital distribution

For 30 students in 15 pairs, provide 15 student packets and 30 gallery and self-evaluation sheets. Copy one peer-evaluation page per teammate per student. Print only the reference cards selected. Documents contain unruled response spaces. PDFs are for printing; DOCX files allow typing.

### Research expectations with this kit

Each team uses two sources. The assigned reference card may count as Source A. For Source B, use one of its linked readings or a teacher-provided textbook section. Teacher and students should verify the specific facts used. The cards are self-contained introductions; internet access is optional when a textbook or printed reading is supplied.

### Quick preparation checklist

- Review the nine reference cards and worked example. Choose the sources your students can access.
- Gather the quantities below, assign storage spaces, and copy or share student files.
- Review the teacher answers and identify misconceptions likely to arise.
- Update dates, classroom-use procedures, and any accommodations before assigning.

## Teacher guide

### Learning goals

- Use reliable sources to explain a biological structure or process.
- Connect at least four model features to accurate biology.
- Distinguish real science from fictional Halloween exaggeration.
- Communicate biological cause and effect to a museum visitor.

### Before the project

- Choose solo or partner work and assign a labeled storage space for every exhibit. For 30 solo exhibits, double per-exhibit bases and containers.
- Gather clean recycled materials and sort shared supplies into nine category bins. Keep glue, scissors, markers, and tape at a common supply station.
- Prepare a small teacher sample with four labels. A paper mitochondrion with folded inner membrane is enough; elaborate decoration is unnecessary.
- Provide school-approved textbooks or bookmarked biology sources. Offer diagrams and short reference notes for students who need support.
- Copy the student pages and rubric. Explain that students must use two sources and record source titles, organizations, and URLs or textbook pages.
- Set up a drying shelf, a photo location, and separate storage for each class period. Check school rules before planning food or photos.

### Science and materials safety

- Use only simulated microbes. Do not culture environmental samples or bring in bodily fluids, animal tissue, or real biological specimens.
- Use clean plastic containers with secure lids. Do not use glass jars, blades, open flames, or exposed sharp wire. Teacher handles any cutting tools beyond classroom scissors.
- Default to paper and clay. If a gel is used, prepare it yourself, check ingredient sensitivities, seal the container, and discard promptly after the showcase. No student mixing of borax slime is needed.
- Keep all craft materials out of mouths and away from food. Use non-toxic school-approved adhesives and paints; wash hands after construction.
- Use age-appropriate fictional horror. Avoid graphic injury, stigmatizing disease, or descriptions that identify a classmate or real patient.

### Approval checkpoint

Before construction, check the four facts, the four planned labels, the science explanation, the size, and the materials. Ask: Which parts are real? Which parts are invented? What will visitors learn? Redirect inaccurate or oversized plans before supplies are issued.

## Supply list and preparation

Inventory before purchasing. Quantities are planning amounts, not store price quotes. Students can complete every category with paper, cardboard, and clay; specialty materials are optional.

| Supply | For 15 exhibits | Preparation |
|---|---|---|
| Cardboard bases or shoebox lids | 15 plus 3 spares | Cut to about 12 by 12 inches; cover sharp edges |
| Cardstock and construction paper | 60 cardstock and 100 mixed sheets | Include white for readable labels |
| Modeling clay or dough | 2–3 pounds total | Portion about 2–3 ounces per exhibit as needed |

| Supply | For 15 exhibits | Preparation |
|---|---|---|
| Pipe cleaners | 100 | Fold sharp ends inward |
| Cotton swabs and cotton balls | 100 swabs and 1 bag balls | Portion into small trays |
| Tissue paper or scrap yarn | 1 mixed pack each | Cut small starter pieces |
| Clean plastic containers with lids | 8–10 | For microbes and ooze; paper circles can substitute |
| White glue and glue sticks | 6 bottles and 15 sticks | Check caps and place on trays |
| Tape | 4 rolls | Set at shared supply station |
| Scissors and markers | 15 scissors and 6 marker sets | Count before and after each period |
| Labels and student copies | 15 sets plus 30 gallery sheets | See Start Here |
| Storage trays or bags | 15 per class period | Label with names and period |
| Cleanup supplies | Paper towels and scrap bin | Keep wipes and handwashing available |

### Optional additions

Googly eyes, beads, craft sticks, LED tea lights, and recycled packaging can add character. None are required or graded by cost. Skip real pumpkins, food-based models, and wet paint when storage or drying time is limited.

### Daily preparation

Day 1: Put out choices, sources, and planning sheets. Day 2: Set out labeled trays and portioned supplies. Day 3: Put out reference cards, precut label tabs, and models before class. Day 4: Provide museum-card templates and peer-review prompts. Day 5: Number exhibits and provide gallery sheets, private evaluations, and voting slips.

## Teacher pacing guide

| Day | Minutes and actions | Checkpoint |
|---|---|---|
| 1 | 5 introduce; 10 review choices; 10 focused research; 20 complete facts and sketch; 5 approval | Two sources started, four facts and four planned labels |
| 2 | 5 safety; 35 build; 5 partner accuracy check; 5 photograph and clean | Main model about 75 percent complete |
| 3 | 4 retrieve and select features; 3 label example; 12 draft labels; 6 accuracy check; 6 revise and attach; 4 teacher checkpoint and cleanup | Four accurate labels placed on model or approved sketch; museum card finished Day 4 |
| 4 | 5 model details; 15 museum card; 10 peer review; 10 revise; 5 set up and rehearse; 5 clean | Every graded display component finished |

| Day | Minutes and actions | Checkpoint |
|---|---|---|
| 5 | 5 open; 20 gallery walk; 10 private self/peer evaluations and voting; 10 celebration; 5 cleanup | Collect individual gallery work and score exhibits |

### Research support

Keep research to the biology needed for the model. Use a textbook, university, museum, public health agency, or established science education source. A search snippet, image caption, or AI-generated answer is a starting point to verify, not a source by itself. Students should paraphrase and trace each fact to a source.

### Differentiation

- Provide a short teacher-selected reading and a labeled diagram for each category. Let students use paper cutouts instead of sculpting.
- Offer sentence starters: This structure helps the cell by…; In a real organism…; Our fictional feature exaggerates…
- Allow typed, dictated, or teacher-scribed explanations. Keep the same science goals and accept accessible model formats.
- For dual enrollment enrichment, request one molecular mechanism, a documented example, and a stated model limitation. Use the same 50-point rubric; do not add hidden requirements.

### Museum logistics

During the 20-minute gallery walk, partner A hosts for 10 minutes while B tours, then switch. Solo creators may post an explanation or arrange a host break. Students visit three exhibits and ask a host a question when available. If a host is absent, they identify the museum card as their source. Voting awards do not affect grades.

### Assessment

Score the group project out of 50: accuracy 15, model 10, labels 5, research 10, museum card 5, and creative science connection 5. Record the individual work evaluation separately out of 10. Gallery work and peer reports provide evidence; they are not a hidden deduction from the project score.

## Teacher science checks

| Category | Check for accurate biology | Common correction |
|---|---|---|
| Organelle Asylum | Real organelle function and structure; abilities clearly fictional | Mitochondria convert energy in fuels into ATP; they do not create energy |
| Microbial Graveyard | Shape, margin, elevation, pigmentation; bacterial binary fission | Colony appearance alone cannot identify a species or prove danger |

| Category | Check for accurate biology | Common correction |
|---|---|---|
| Anatomy Crypt | Four correctly positioned structures and how they work together | A model must show function as well as name parts |
| Mutation Station | Specific DNA change and plausible protein or trait effect | Mutations can be neutral, harmful, or beneficial; not every mutation changes a protein |
| Diseased Tissue Gallery | Comparable healthy and altered tissue with functional consequence | Cancer is abnormal cell regulation; sickled red cells are not an example of cancer |
| Cell Death Cemetery | Apoptosis versus necrosis and causes or contexts | Apoptosis is regulated fragmentation; necrosis often involves swelling and rupture |
| Carnivorous Greenhouse | Photosynthesis plus nutrient acquisition and two adaptations | Carnivorous plants obtain mineral nutrients from prey and still photosynthesize |
| Biological Ooze Collection | Composition, producer, and function of mucus, biofilm, or matrix | Mucus is not a microbe; a biofilm includes microbes within an extracellular matrix |

## Quick teacher prompts

- Show me the model feature that supports this fact.
- What happens first, and what happens because of it?
- What is exaggerated in your horror story?
- What can this model show well, and what can it not show?

## No internet alternative

Provide textbook pages or printed references about the selected topic. Students list the book title and page numbers for two relevant sections or use a second teacher-provided reference. If only one source is available, announce an adjusted source expectation before work begins.

## End of project

Photograph exhibits only under school policy. Return reusable materials, remove names before any public sharing, and discard sealed gels without opening them in class. Students keep dry models or recycle paper and cardboard. Save a few anonymous examples for next year.

# Reference card teacher answers

## 1 The Organelle Asylum

Check question: Why do folds matter in a mitochondrion?

Expected answer: They increase inner membrane area for proteins involved in ATP production.

## 2 The Microbial Graveyard

Check question: Can a scary-looking colony prove that a bacterium causes disease?

Expected answer: No. Appearance alone does not establish species identity or disease-causing ability.

## 3 The Anatomy Crypt

Check question: Why does a heart model need arrows as well as chamber names?

Expected answer: Arrows communicate the direction of blood flow and show how the chambers work together.

## 4 The Mutation Station

Check question: Does every mutation change an amino acid?

Expected answer: No. Some coding substitutions are synonymous, and many mutations occur outside coding regions.

## 5 The Diseased Tissue Gallery

Check question: Does every tumor invade nearby tissue?

Expected answer: No. Benign tumors do not invade or metastasize. They may still cause serious problems.

## 6 The Cell Death Cemetery

Check question: Why can membrane rupture affect neighboring tissue?

Expected answer: Released cell contents can activate inflammation and affect surrounding cells.

## 7 The Carnivorous Greenhouse

Check question: Why does capturing insects not replace photosynthesis?

Expected answer: Prey primarily supplements mineral nutrition. Photosynthesis supplies the plant's organic carbon compounds.

## 8 The Biological Ooze Collection

Check question: Are mucus, biofilm, and animal extracellular matrix the same thing?

Expected answer: No. They differ in composition, producers, and functions, although each involves extracellular material.

# Assessment and classroom adaptation

## Scoring consistency

Use the same 50-point project checklist for each category, plus a separate 10-point individual evaluation. Optional extensions do not add hidden requirements. The worked example demonstrates one possible response. Peer ratings support teacher judgment; do not automatically average them into a grade.

## Support options

- Supply a diagram, read the reference card aloud, and allow speech-to-text.
- Let students describe labels through recorded audio when writing is a barrier.
- Use a smaller paper model while keeping four accurate features.
- For advanced students, add a molecular mechanism and one model limitation.

## Before sharing student work outside class

Use only examples you have permission to share. Follow district requirements for public sharing of student-created work and photographs. Remove identifying information. Teacher-made illustrations in this kit are examples, not photographs of student work.

# Final schedule and support notes

## The 35 minute label lesson

Day 3 focuses on four biological labels rather than new decoration. Each label names a feature and explains its function or meaning. If a model is unfinished, place labels on the approved sketch or beside the unfinished portion; complete essential construction on Day 4. See the Daily Checklists and Supports for chunked tasks.

## Research submission

The completed research sheet is sufficient for the core project. If assigning a separate research paper, explain length and format before Day 1. Grade either submission using the same 10-point research category; do not require an unannounced additional paper.

## Photographs as examples

The four supplied photos document student-made displays. Bicephaly and Tissue Culture Gone Wrong are examples of teacher-approved alternatives. They do not add new mandatory exhibit categories. Discuss model limitations, and use the edited captions rather than assuming every student-written label in a photo is fully accurate.

## Private evaluations

Collect self- and peer-evaluations privately. Use reported contributions, teacher observations, and each student's biological explanation together. Consider absences and accommodations. A peer's low score alone should not determine a student's grade.

## Station 9  Nature’s Monsters

Students choose a real organism and explain how an unusual adaptation supports survival or reproduction. The reference card models a tongue-replacing isopod and links to anglerfish and parasitoid-wasp readings. Use paper, cardboard, clay, and yarn; no live organisms or preserved specimens are needed. Plan one additional category tray if offering all nine stations.

Check question: Why is the isopod–fish relationship parasitism rather than mutualism? Expected answer: The isopod gains food and a place to live and reproduce, while feeding damages the fish. Keep the science separate from any fictional warning.

## Choice board for absent students

Assign file 07 Absent Student Alternative. Students choose one of six formats and one of the nine biology topics, including Nature’s Monsters. Provide the matching reference card and a second accessible source. Allow about 60–90 minutes across two sessions, with a due date based on available work time. No physical display, group ratings, or gallery visits are required.

Use the alternative’s own common requirements and 50-point scoring checklist, plus its separate 10-point individual evaluation. A self-check replaces collaboration. Do not also require the physical exhibit or the former two-page case-file assignment. Offer one work chunk at a time, outlines, word banks, speech-to-text, or scribing as needed.

# Biology Lab of Horrors Student Guide

Create a creepy exhibit that teaches real biology

Work alone or with a partner to build a handmade museum display. Use inexpensive craft supplies, accurate science, and a clearly marked fictional backstory. Keep the base about 12 by 12 inches or smaller. No homework is required.

## Your exhibit needs

- A creative title and small handmade model.
- Four accurate facts linked to two sources.
- Four biological labels or annotated process features.
- A 3–5-sentence scientific explanation.
- A 1–2-sentence fictional backstory or warning marked as fiction.
- A completed research and planning sheet and museum card.

## Daily goals

| Day | Length | Finish |
|---|---|---|
| 1 | 50 min | Choose, research, sketch, and get approval |
| 2 | 50 min | Build most of the model |
| 3 | 35 min | Write, check, and place four biological labels |
| 4 | 50 min | Complete every display component and peer review |
| 5 | 50 min | Tour, reflect, celebrate, and clean |

## Safety and teamwork

Use craft materials only. No real microbes, tissues, bodily fluids, glass, or open flames. Keep containers sealed. Both partners contribute and can explain the biology. Expensive materials and artistic skill do not determine your score.

# Exhibit choices

### 1 The Organelle Asylum

How does an organelle help a cell function? Make a paper mitochondrion on cardboard. Use a folded paper strip for the inner membrane. Add a fictional face separately from the biological labels.

### 2 The Microbial Graveyard

What can colony appearance tell us about bacteria? Place paper or clay colonies in a clean plastic container. Include a side-view drawing for elevation and a small binary-fission sequence beside the container.

### 3 The Anatomy Crypt

How do heart structures work together to move blood? Make a four-chamber paper heart. Add flow arrows, simple valve flaps, and a septum. Label the four chambers and explain the extra features in your card.

### 4 The Mutation Station

How can a DNA change affect a protein or trait? Make a before-and-after sequence strip and a chain model. Connect the DNA change to the protein and cell effect. You may use the documented HBB example or a clearly marked hypothetical example.

### 5 The Diseased Tissue Gallery

How can changes in cells disrupt a tissue? Use paper circles or clay to make side-by-side tissue models. Keep scale and viewpoint similar. Show a boundary and label where the cancer model crosses it.

### 6 The Cell Death Cemetery

How do apoptosis and necrosis differ? Make two short sequences of paper cells on a cemetery base. Use arrows to show the changes. Keep ghost decorations separate from cell labels.

### 7 The Carnivorous Greenhouse

Why do some photosynthetic plants capture prey? Build a paper pitcher plant with a smooth inner surface and a digestive region near the bottom. Add a photosynthesis annotation and explain two trap-related adaptations.

### 8 The Biological Ooze Collection

How do materials outside cells support living systems? Choose ONE material. Use yarn for matrix fibers, paper cells, and a clear sealed plastic container. Colorless tissue paper can represent water without making real slime.

### 9 Nature’s Monsters

How does an unusual adaptation help a real organism survive or reproduce? Model a tongue-replacing isopod, deep-sea anglerfish, parasitoid wasp, or another approved organism. Explain four features and how they affect survival, prey, or a host. Use Reference Card 9.

# Research sheet

Names and class

[Type your response here]

Exhibit category, title, and biology question

[Type your response here]

Use the assigned card as one source if your teacher allows. Use a linked reading or textbook as the second source. Paraphrase facts and record where you found them.

Source A title, organization, URL or textbook pages

[Type your response here]

Source B title, organization, URL or textbook pages

[Type your response here]

Why are these sources trustworthy?

[Type your response here]

Fact 1 in your own words and supporting source A or B

[Type your response here]

Fact 2 in your own words and supporting source A or B

[Type your response here]

Fact 3 in your own words and supporting source A or B

[Type your response here]

Fact 4 in your own words and supporting source A or B

[Type your response here]

# Model planning sheet

Names and exhibit title

[Type your response here]

Insert a sketch or photo of your drawing here. Show where the four biological labels will go. On paper, draw in the open area below.

[Insert sketch here]

Feature 1 and what it does or represents

[Type your response here]

Feature 2 and what it does or represents

[Type your response here]

Feature 3 and what it does or represents

[Type your response here]

Feature 4 and what it does or represents

[Type your response here]

Materials, construction steps, and partner task plan

[Type your response here]

What is real biology and what will be fictional?

[Type your response here]

Teacher approval: [Teacher response]

# Museum card and peer review

Exhibit number, specimen name, and creators

[Type your response here]

Biology topic

[Type your response here]

Real science explanation in 3–5 sentences

[Type your response here]

Four verified facts in numbered bullets

[Type your response here]

Fictional backstory or warning in 1–2 sentences

[Type your response here]

Short source titles and organizations

[Type your response here]

## Peer review

Check for four accurate facts, four labels, a model that matches the explanation, clearly marked fiction, and readable text.

Reviewer name and one science question or correction

[Type your response here]

Revision made after review

[Type your response here]

# Project scoring and submission

Submit your physical model, museum card, and research sheet or assigned paper. Complete the separate Gallery Walk and Evaluations individually. Your project earns up to 50 points; your individual work evaluation earns up to 10 additional points as a separate grade.

| **Project category** | Pts | **Evidence** |
|---|---|---|
| Scientific accuracy | 15 | Four accurate facts, a correct explanation, and real science separated from fiction. |
| Biological model | 10 | Handmade model clearly represents the biology and matches the explanation. |
| Biological labels | 5 | Four correct labels or annotations, each with a function or meaning. |
| Research submission | 10 | Completed research sheet or assigned paper; two traceable sources; paraphrased facts linked to sources. |
| Museum card and communication | 5 | Creative title, readable explanation, four facts, and clearly marked fiction or warning. |
| Creative science connection | 5 | Halloween features meaningfully connect to the biology. |

## Individual work evaluation

Your teacher scores specific contribution, task completion, use of available time, collaboration, and biological understanding. Each criterion earns 0, 1, or 2 points, for a separate total of 10. Your self-evaluation and peer reports are supporting evidence.

## Final submission checklist

☐ Model and four explained biological labels are complete.

☐ Museum card includes the scientific explanation, four facts, and marked fiction.

☐ Research submission includes two sources and fact-to-source links.

☐ I completed my gallery sheet and private contribution checklist.

Artistic skill, purchased supplies, and winning a student-voted award do not determine your grade. Partial credit reflects the quality and completeness of the scientific work. Optional advanced extensions are not required for full credit.

# Science Reference Cards

Nine exhibit starting points for Biology Lab of Horrors

## 1 The Organelle Asylum

How does an organelle help a cell function?

### Biology background

- Organelles organize specialized jobs within eukaryotic cells.
- Mitochondria have an outer membrane and a folded inner membrane called cristae.
- Lysosomes contain enzymes that break down material for recycling.
- Ribosomes assemble proteins using information carried by messenger RNA.

Organelle: a specialized cell structure. Enzyme: a biological catalyst. ATP: a molecule used in cellular energy transfer.

### Four features to show

Outer mitochondrial membrane; Inner membrane and cristae; Matrix; ATP production annotation.

### Model idea

Make a paper mitochondrion on cardboard. Use a folded paper strip for the inner membrane. Add a fictional face separately from the biological labels.

### Accuracy check

ATP is an energy-transfer molecule. Mitochondria transform energy rather than creating it.

Think about it: Why do folds matter in a mitochondrion?

Optional advanced extension: Explain how the electron transport chain and ATP synthase use the inner membrane.

### Reading sources

OpenStax Biology 2e 4.3 Eukaryotic Cells
https://openstax.org/books/biology-2e/pages/4-3-eukaryotic-cells

OpenStax Biology 2e 4.4 The Endomembrane System and Proteins
https://openstax.org/books/biology-2e/pages/4-4-the-endomembrane-system-and-proteins

# 2 The Microbial Graveyard

What can colony appearance tell us about bacteria?

## Biology background

- A colony is a visible population that develops from a cell or a small cluster of cells.
- Form describes the overall shape and margin describes the colony edge.
- Elevation describes the side profile. Pigmentation describes color.
- Most bacteria reproduce by binary fission after copying their DNA.

Colony: visible microbial growth. Morphology: form and appearance. Binary fission: division into two daughter cells.

## Four features to show

Form such as circular; Margin such as smooth; Elevation such as raised; Pigmentation such as yellow.

## Model idea

Place paper or clay colonies in a clean plastic container. Include a side-view drawing for elevation and a small binary-fission sequence beside the container.

## Accuracy check

This is a craft simulation. Do not collect, grow, or open real environmental cultures.

Think about it: Can a scary-looking colony prove that a bacterium causes disease?

Optional advanced extension: Explain why one colony-forming unit does not always equal one original bacterial cell.

## Reading sources

American Society for Microbiology Colony Morphology Protocol
https://asm.org/protocols/colony-morphology-protocol

OpenStax Microbiology 9.1 How Microbes Grow
https://openstax.org/books/microbiology/pages/9-1-how-microbes-grow

# 3 The Anatomy Crypt

How do heart structures work together to move blood?

## Biology background

- The heart has two atria that receive blood and two ventricles that pump blood out.
- The right side sends blood toward the lungs. The left side sends blood toward the body.
- Valves help prevent backward flow when pressure changes.
- The septum separates the right and left sides of the heart.

Atrium: receiving chamber. Ventricle: pumping chamber. Septum: dividing wall. Valve: structure that limits backflow.

## Four features to show

Right atrium; Right ventricle; Left atrium; Left ventricle.

## Model idea

Make a four-chamber paper heart. Add flow arrows, simple valve flaps, and a septum. Label the four chambers and explain the extra features in your card.

## Accuracy check

Right and left refer to the person's body. In a front view, anatomical right appears on the viewer's left. Red and blue are diagram conventions, not actual blood colors.

Think about it: Why does a heart model need arrows as well as chamber names?

Optional advanced extension: Compare the thickness of the left and right ventricular walls using their pumping jobs.

## Reading sources

OpenStax Anatomy and Physiology 2e 19.1 Heart Anatomy
https://openstax.org/books/anatomy-and-physiology-2e/pages/19-1-heart-anatomy

# 4 The Mutation Station

How can a DNA change affect a protein or trait?

## Biology background

- A mutation is a change in a DNA sequence.
- Substitutions replace bases. Insertions and deletions add or remove bases.
- A coding change can alter an amino acid, introduce a stop signal, or leave the amino acid unchanged.
- One HBB variant replaces glutamic acid with valine in beta-globin. Hemoglobin S can form fibers under low-oxygen conditions, distorting red cells.

Codon: three RNA bases read during translation. Variant: a DNA sequence difference. Protein: an amino-acid chain with biological functions.

## Four features to show

Original DNA sequence; Changed DNA sequence; Protein consequence; Cell or trait consequence.

## Model idea

Make a before-and-after sequence strip and a chain model. Connect the DNA change to the protein and cell effect. You may use the documented HBB example or a clearly marked hypothetical example.

## Accuracy check

Do not imply that one variant always causes the same disease severity or that mutations are always harmful.

Think about it: Does every mutation change an amino acid?

Optional advanced extension: Use a codon chart to verify a specific DNA-to-RNA-to-amino-acid change and identify the strand shown.

## Reading sources

OpenStax Biology 2e 14.6 DNA Repair
https://openstax.org/books/biology-2e/pages/14-6-dna-repair

MedlinePlus Genetics HBB Gene
https://medlineplus.gov/genetics/gene/hbb/

# 5 The Diseased Tissue Gallery

How can changes in cells disrupt a tissue?

## Biology background

- Tissues contain organized cells that work together.
- Normal cells respond to signals that regulate division and survival.
- Cancer cells can escape some controls on division or death.
- Malignant tumors can invade nearby tissues. Some cancers spread to distant sites.

Tissue: cells working together. Tumor: abnormal mass of tissue. Malignant: cancerous and capable of invasion. Metastasis: spread to distant sites.

## Four features to show

Normal organized cell layer; Controlled division annotation; Abnormal crowded growth; Invasion into adjacent tissue.

## Model idea

Use paper circles or clay to make side-by-side tissue models. Keep scale and viewpoint similar. Show a boundary and label where the cancer model crosses it.

## Accuracy check

This model simplifies one solid-tumor example. Not all cancers form solid tumors, and a craft model cannot diagnose disease.

Think about it: Does every tumor invade nearby tissue?

Optional advanced extension: Connect one disrupted cell-cycle checkpoint or signaling pathway to abnormal growth.

## Reading sources

National Cancer Institute What Is Cancer
https://www.cancer.gov/about-cancer/understanding/what-is-cancer

# 6 The Cell Death Cemetery

How do apoptosis and necrosis differ?

## Biology background

- Apoptosis is a regulated process that removes cells, including unneeded or damaged cells.
- During typical apoptosis, a cell shrinks and breaks into membrane-enclosed fragments.
- Necrotic cell injury commonly involves swelling and loss of membrane integrity.
- Leaking cell contents can provoke inflammation, whereas prompt clearance of apoptotic fragments usually limits it.

Apoptosis: regulated cell dismantling. Necrosis: cell or tissue death with destructive changes. Inflammation: a tissue response to injury.

## Four features to show

Apoptotic cell shrinkage; Membrane-enclosed fragments; Necrotic cell swelling; Rupture and leaking contents.

## Model idea

Make two short sequences of paper cells on a cemetery base. Use arrows to show the changes. Keep ghost decorations separate from cell labels.

## Accuracy check

This is a basic contrast. Some necrotic cell-death pathways are regulated, so avoid claiming all necrosis is unregulated.

Think about it: Why can membrane rupture affect neighboring tissue?

Optional advanced extension: Explain how caspases help execute apoptosis and why avoiding apoptosis can benefit a cancer cell.

## Reading sources

OpenStax Anatomy and Physiology 2e 4.6 Tissue Injury and Aging
https://openstax.org/books/anatomy-and-physiology-2e/pages/4-6-tissue-injury-and-aging

Alberts and colleagues Molecular Biology of the Cell Programmed Cell Death
https://www.ncbi.nlm.nih.gov/books/NBK26873/

# 7 The Carnivorous Greenhouse

Why do some photosynthetic plants capture prey?

## Biology background

- Photosynthesis uses light energy to build carbohydrates from carbon dioxide and water.
- Carnivorous plants still photosynthesize.
- Prey supplies mineral nutrients, including nitrogen, that may be scarce in their habitats.
- Modified leaves can trap prey using mechanisms such as pitchers, sticky surfaces, or snap traps.

Adaptation: an inherited feature shaped by evolution. Photosynthesis: light-driven sugar production. Mineral nutrient: an inorganic element needed for growth.

## Four features to show

Photosynthetic leaf surface; Prey trap; Digestive region; Nutrient uptake annotation.

## Model idea

Build a paper pitcher plant with a smooth inner surface and a digestive region near the bottom. Add a photosynthesis annotation and explain two trap-related adaptations.

## Accuracy check

A plant does not develop a new trap because it decides it needs one. Label imaginary teeth or movement as fictional.

Think about it: Why does capturing insects not replace photosynthesis?

Optional advanced extension: Discuss the costs of constructing traps and why carnivory can be advantageous in nutrient-poor habitats.

## Reading sources

OpenStax Biology 2e 31.3 Nutritional Adaptations of Plants
https://openstax.org/books/biology-2e/pages/31-3-nutritional-adaptations-of-plants

OpenStax Biology 2e 8.1 Overview of Photosynthesis
https://openstax.org/books/biology-2e/pages/8-1-overview-of-photosynthesis

# 8 The Biological Ooze Collection

How do materials outside cells support living systems?

## Biology background

- Mucus is a hydrated material containing mucin proteins with attached sugars. It helps protect and lubricate surfaces.
- Biofilms contain microorganisms associated with a surface and an extracellular matrix.
- Biofilm matrix can help cells remain attached and alter their local environment.
- Animal extracellular matrix includes molecules such as collagen and proteoglycans that support tissue organization and cell interactions.

Extracellular: outside cells. Mucin: a major mucus-forming glycoprotein. Matrix: a surrounding network of material.

## Four features to show

Cells that produce or occupy the material; Structural molecules; Water or hydrated space; Function such as support or attachment.

## Model idea

Choose ONE material. Use yarn for matrix fibers, paper cells, and a clear sealed plastic container. Colorless tissue paper can represent water without making real slime.

## Accuracy check

A container of decorative slime alone does not demonstrate biology. Explain what each material represents. No bodily fluids or live cultures.

Think about it: Are mucus, biofilm, and animal extracellular matrix the same thing?

Optional advanced extension: Relate matrix composition to diffusion, mechanical support, or cell signaling in your chosen example.

## Reading sources

OpenStax Biology 2e 4.6 Connections between Cells and Cellular Activities
https://openstax.org/books/biology-2e/pages/4-6-connections-between-cells-and-cellular-activities

OpenStax Microbiology 9.1 How Microbes Grow
https://openstax.org/books/microbiology/pages/9-1-how-microbes-grow

Mucus Current Biology Primer
https://pmc.ncbi.nlm.nih.gov/articles/PMC8759706/

# 9 Nature’s Monsters

How does an unusual adaptation help a real organism survive or reproduce?

## Biology background

- Cymothoa exigua, the tongue-replacing isopod, is a crustacean that parasitizes fish.
- Young isopods enter a fish through its gills. A female attaches to the tongue with her legs.
- Feeding damages the tongue, which withers. The attached isopod can occupy its place and serve as a replacement.
- This is parasitism: the isopod benefits while the fish is harmed. A living host provides a place for the parasite to feed and reproduce.

Adaptation: an inherited feature shaped by evolution. Host: an organism used by a parasite. Parasite: an organism that benefits at a host’s expense.

## Four features to show

Fish host and mouth; Attached isopod; Attachment legs; Feeding site and effect on host.

## Model idea

Make a paper fish with a hinged mouth and a clay or paper isopod inside. Use arrows to connect attachment and feeding to the effect on the fish. Add four explained labels.

## Other real monsters to investigate

Deep-sea anglerfish: a female’s bacteria-lit lure attracts prey. Parasitoid wasp: larvae develop on or in a host insect and eventually kill it. Choose one organism; research four facts and adapt the labels to its biology.

## Accuracy check

“Monster” is a theme, not a scientific group. These organisms are not evil. Do not imply that all parasites replace tongues or that organisms choose to evolve traits. Mark invented behavior as fiction.

Think about it: Why is this relationship parasitism rather than mutualism?

Optional advanced extension: Explain a benefit and a cost of the adaptation, or compare parasitism with predation and parasitoid development.

## Reading sources

University of Texas Marine Science Institute  Tongue Snatcher
https://utmsi.utexas.edu/science-and-the-sea/radio-program/tongue-snatcher/

Woods Hole Oceanographic Institution  Creature feature Anglerfish
https://www.whoi.edu/ocean-learning-hub/ocean-facts/anglerfish/

University of California IPM  Parasites of Insect Pests
https://ipm.ucanr.edu/home-and-landscape/parasites-of-insect-pests/

# Gallery Walk and Evaluations

Visit three displays and complete your own private contribution review

Name: Class: Your exhibit:

Read the card, examine the model, and ask the host a question. Record biology rather than only decorations. If a host is unavailable, use the museum card and check that source.

**Display 1**

Exhibit name and host name

☐ Model examined ☐ Card read ☐ Host questioned ☐ Host unavailable; card used

One biological feature and what it does or represents

One question I asked and the information I learned

**Display 2**

Exhibit name and host name

☐ Model examined ☐ Card read ☐ Host questioned ☐ Host unavailable; card used

One biological feature and what it does or represents

One question I asked and the information I learned

# Gallery walk continued

### Display 3

Exhibit name and host name

☐ Model examined ☐ Card read ☐ Host questioned ☐ Host unavailable; card used

One biological feature and what it does or represents

One question I asked and the information I learned

### Museum reflection

Which display helped you understand a biological idea best? Explain the specific feature that helped.

☐ I visited three other exhibits.

☐ I recorded accurate biological information.

☐ I treated hosts and displays respectfully.

Useful questions: Why did you include that feature? What would happen if it stopped working? What is real and what is fictional?

# My contribution and self evaluation

Complete independently and submit privately. Name: Exhibit:

### What did I personally do

Check only work you actually completed or helped complete.

☐ Researched facts or checked sources.

☐ Drew or revised the plan and organized supplies.

☐ Built biological structures or assembled the model.

☐ Wrote labels and explained their biological functions.

☐ Wrote or corrected the scientific museum card.

☐ Created the title, backstory, or science-related decorations.

☐ Explained the science to visitors.

☐ Helped with setup, storage, or cleanup.

Two specific things I personally made, wrote, researched, or explained

Ratings: 4 = consistently; 3 = usually; 2 = sometimes; 1 = rarely. Rate work during the time you were present.

| I... | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| Completed agreed tasks | ☐ | ☐ | ☐ | ☐ |
| Used available work time | ☐ | ☐ | ☐ | ☐ |
| Contributed accurate biology | ☐ | ☐ | ☐ | ☐ |
| Worked respectfully and shared tasks | ☐ | ☐ | ☐ | ☐ |
| Helped solve problems | ☐ | ☐ | ☐ | ☐ |

Understanding: ☐ Can explain all four features ☐ Can explain some ☐ Need notes/help

Absences, accommodations, or other information my teacher should consider

# Teammate contribution review

Your name: Teammate:

Complete one copy per teammate. Rate observed work, not friendship, artistic skill, or how much someone talked. Use Not observed when you lack evidence. Ratings: 4 = consistently; 3 = usually; 2 = sometimes; 1 = rarely.

☐ I saw this person research or plan.

☐ I saw this person construct biological features.

☐ I saw this person write labels or explanations.

☐ I saw this person present, set up, or clean up.

☐ I did not observe enough to identify their contribution.

One specific contribution I observed

| This person... | 4 | 3 | 2 | 1 | Not observed |
|---|---|---|---|---|---|
| Completed agreed tasks | ☐ | ☐ | ☐ | ☐ | ☐ |
| Used work time productively | ☐ | ☐ | ☐ | ☐ | ☐ |
| Contributed to biology or model | ☐ | ☐ | ☐ | ☐ | ☐ |
| Shared tasks respectfully | ☐ | ☐ | ☐ | ☐ | ☐ |

## Group reflection

Responsibilities were: ☐ Fairly shared ☐ Mostly fair ☐ Uneven ☐ Unsure

Explain any rating that needs context using a concrete example

These reports help the teacher understand contributions. They do not automatically determine a teammate's grade.

# Student choice award ballot

Vote once per category. Choose displays other than your own. Awards celebrate the museum and do not affect project grades.

### Mad Scientist Masterpiece

The most creative display, with a memorable Halloween theme connected to real biology.

Exhibit name or number

### Science That Sticks With You

The display that best helped you understand a biological concept through its model, labels, and explanation.

Exhibit name or number

Optional reason for your choice:

# Teacher Grading Checklist

50 point group project and separate 10 point individual work evaluation

Exhibit: Class/date:
Group members:

## Group project

| Component | Checklist | Score |
|---|---|---|
| Scientific accuracy | ☐ Four accurate facts, a correct explanation, and real science separated from fiction. | /15 |
| Biological model | ☐ Handmade model clearly represents the biology and matches the explanation. | /10 |
| Biological labels | ☐ Four correct labels or annotations, each with a function or meaning. | /5 |
| Research submission | ☐ Completed research sheet or assigned paper; two traceable sources; paraphrased facts linked to sources. | /10 |
| Museum card and communication | ☐ Creative title, readable explanation, four facts, and clearly marked fiction or warning. | /5 |
| Creative science connection | ☐ Halloween features meaningfully connect to the biology. | /5 |

GROUP PROJECT TOTAL: /50

Research paper or research sheet grade and feedback

Project strengths and scientific corrections

Award partial credit for partly complete or partly accurate work. Grade biological communication rather than artistic skill or the cost of materials.

# Individual work evaluation

Student: Exhibit:

Evidence reviewed: ☐ Self-evaluation ☐ Peer reports ☐ Teacher observations
☐ Student work/progress photos ☐ Individual biology explanation

## Group evaluation record

Self-rating and peer ratings received

Specific contributions reported and confirmed

☐ Reports consistent ☐ Check-in needed ☐ Insufficient peer evidence
☐ Absences and accommodations considered

Use 2 = demonstrated, 1 = partly demonstrated, 0 = not demonstrated.

| Criterion | Evidence | Score |
|---|---|---|
| Specific contribution | Identifies concrete work personally completed. | /2 |
| Task completion | Completes agreed responsibilities or an approved alternative. | /2 |
| Use of available time | Works productively with assigned supports as needed. | /2 |
| Collaboration | Shares responsibilities and contributes respectfully. | /2 |
| Biological understanding | Explains the exhibit and the student's own contribution. | /2 |

INDIVIDUAL WORK TOTAL: /10
Keep this separate from the project score of /50.

Individual feedback

Do not automatically average peer ratings into a grade. Use multiple sources of evidence and provide required accommodations.

# Daily Checklists and Supports

Small steps for independent work and students needing additional support

### Day 1  Plan

☐ Choose a category and read the matching reference card.

☐ Write the biology question and four facts.

☐ Record two sources.

☐ Sketch four biological features and get approval.

### Day 2  Build

☐ Gather the approved sketch, base, and first materials.

☐ Build the main shape and attach it to the base.

☐ Build and explain one biological feature.

☐ Build and explain a second feature.

☐ Mark where four labels will go.

☐ Show or photograph progress and identify the next step.

Suggested chunks for 50 minutes: 5 setup; 10 base; 10 first feature; 10 second feature; 10 check and plan; 5 cleanup. Aim for most main construction complete, not a polished display.

### Support choices

☐ Show one task at a time with a visual timer.

☐ Offer two material choices and precut pieces.

☐ Provide a picture outline, word bank, and numbered label tabs.

☐ Allow pointing, dictation, speech-to-text, or typed responses.

☐ Assign specific partner responsibilities and switch roles.

☐ Offer a brief movement break or check-in as needed.

Keep the same biological goals while reducing model size or construction demands. Apply each student's accommodations.

# Day 3 labels and final checks

## Day 3  Label the horror in 35 minutes

| Minutes | Task |
|---|---|
| 0–4 | Retrieve model and choose four features |
| 4–7 | Review a name-plus-function label example |
| 7–19 | Draft four labels using sources |
| 19–25 | Check labels against model and reference card |
| 25–31 | Revise and attach or position labels |
| 31–35 | Teacher checkpoint and cleanup |

### One label at a time

☐ Point to one feature.

☐ Write its biological name.

☐ Explain its function or meaning.

☐ Check the explanation against a source.

☐ Place the label beside the matching feature. Repeat four times.

Sentence frame: This is the ____. It helps by ____.
For a process: This change shows ____. It happens because ____.

If construction is behind, label the approved sketch or unfinished section. Show four accurate labels today; finish the museum card on Day 4.

## Day 4  Ready for visitors

☐ Model complete ☐ Four explained labels ☐ Four facts
☐ Sources recorded ☐ Real science and fiction separated
☐ Peer corrections made ☐ Museum card readable

## Day 5  Share and reflect

☐ Host or provide a written explanation ☐ Visit three displays
☐ Complete private evaluations ☐ Vote ☐ Clean up

# Lab of Horrors Choice Board

Absent student alternative  Choose one format and one biology topic

Choose ONE format below and ONE biology topic. Complete the common requirements on page 2. You do not need to complete a row, build a craft model, work with a group, or attend the gallery walk.

Name: [type here]  Class: [type here]  Due date: [teacher sets]

| | |
|---|---|
| ☐ **1  Specimen Case File**<br>Create a two-page investigation. Page 1 shows your specimen diagram and evidence. Page 2 explains the biology, fictional warning, and what happens if a feature fails. | ☐ **2  Biology Horror Comic**<br>Create a six-panel comic that explains a biological process. Show cause and effect, not only a monster story. Add an annotated diagram and source notes on a second page. |
| ☐ **3  Digital Museum Exhibit**<br>Create four slides: specimen introduction; labeled model; scientific explanation and facts; fiction, What if response, and sources. Use speaker notes or an extra page for your reflection. | ☐ **4  Field Guide to a Creepy Specimen**<br>Create a two-page field guide. Include a labeled illustration, real structures or adaptations, and how they function. Clearly separate your invented specimen name or backstory from scientific facts. |
| ☐ **5  Science News Report**<br>Write a 250–350-word news script explaining the science behind your specimen. Include an original annotated diagram and sources. Recording the report is optional; a written script is sufficient. | ☐ **6  Before and After Investigation**<br>Create two annotated drawings showing a change, such as healthy versus altered tissue or apoptosis versus necrosis. Explain what changes, why it matters, and what your model leaves out. |

## Choose a biology topic

Organelles; microbes; anatomy; mutations; healthy and diseased tissue; cell death; carnivorous plants; mucus, biofilm, or extracellular matrix; or Nature’s Monsters and unusual adaptations. Another topic needs teacher approval.

My format: [type here]  My topic: [type here]

# Common requirements for every choice

Suggested work time: 60–90 minutes across two sessions. Use paper and pencils or a document/presentation editor. All options have the same science expectations and point values.

### Research and evidence

☐ Use two sources. Your assigned science reference card may count as one; use a linked reading or textbook as the second.

☐ Record each source title, author or organization, and URL or textbook pages.

☐ Include four accurate facts in your own words and show which source supports each fact.

### Scientific representation

☐ Create your own scientific drawing, process model, or annotated comparison. Digital shapes and teacher-provided outlines are allowed; add your own scientific annotations.

☐ Include at least four biological labels or annotated features. Explain the function or meaning of each.

☐ Use arrows to show movement, sequence, or cause and effect.

☐ State one limitation of your model.

### Explanation and application

☐ Explain how the biology works in 5–7 sentences or an equivalent set of captions or script sections. Connect the explanation to your model.

☐ Add a creative title and 1–2 sentences of backstory or warning, clearly marked as fiction.

☐ Answer: What would happen if one important structure or process stopped working? Explain why.

☐ Add a short reflection naming what you personally created, one thing you checked or revised, and one thing you learned.

Fit these elements into your chosen format. You may attach one evidence or reflection page. A comic still needs scientific explanations; a written report still needs an annotated model.

### Four small work chunks

1. Choose a topic and collect facts.
2. Create the model and four explained labels.
3. Add the science explanation, fiction, and What if response.
4. Check accuracy, record sources, and complete your reflection.

Sentence starters: This feature helps by… If it stopped working… because… The real biology is… The fictional part is…

# Scoring and teacher guidance

## Project grade 50 points

| Category | Pts | Full credit evidence |
|---|---|---|
| Scientific accuracy | 15 | Four correct facts and a sound biological explanation |
| Scientific model | 10 | Clear original representation, meaningful arrows, and a stated limitation |
| Biological labels | 5 | Four correct labels or annotations, each with function or meaning |
| Research | 10 | Two traceable sources, paraphrased facts, and source links for claims |
| Communication and application | 5 | Clear organization and a biologically reasonable What if explanation |
| Creative science connection | 5 | Creative title and clearly marked fiction connected to the biology |

PROJECT TOTAL: /50. Partial credit reflects accuracy and completeness. Missing evidence earns zero for that component. Artistic skill, recording quality, and purchased supplies do not determine the grade.

## Individual work grade 10 separate points

| Criterion | Pts |
|---|---|
| Specific work personally completed is documented | 2 |
| Agreed tasks are completed | 2 |
| Available work time is used productively, with supports as needed | 2 |
| Student checks work or responds to feedback | 2 |
| Student explains the biological meaning of the work | 2 |

Score each criterion 2 = demonstrated, 1 = partly demonstrated, 0 = not demonstrated.
INDIVIDUAL TOTAL: /10. No peer ratings are required for this independent assignment.

## Teacher implementation

Have each student choose one format. Provide a reference card and a second accessible source. Offer outlines, word banks, speech-to-text, or scribing as needed. Give one work chunk at a time. Accept a written news script. Check understanding through a brief explanation in an accessible format.

# Worked Example

The Midnight ATP Factory | Teacher-made exemplar

Category: The Organelle Asylum. This example shows one acceptable approach using paper and cardboard. It is an illustration and completed sample response, not actual student work.

## Completed research question

How do mitochondrial structures support energy transfer in a cell?

## Completed source record

Source A: Science Reference Card 1, Wages Biology. Source B: OpenStax Biology 2e, section 4.3 Eukaryotic Cells, https://openstax.org/books/biology-2e/pages/4-3-eukaryotic-cells. The OpenStax reading is a reviewed college biology textbook; the card organizes the project background.

## Four researched facts

- Mitochondria contain outer and inner membranes. [B]
- The inner membrane has folds called cristae. [B]
- The matrix is the compartment inside the inner membrane. [B]
- Proteins in the inner membrane participate in ATP production. [B]

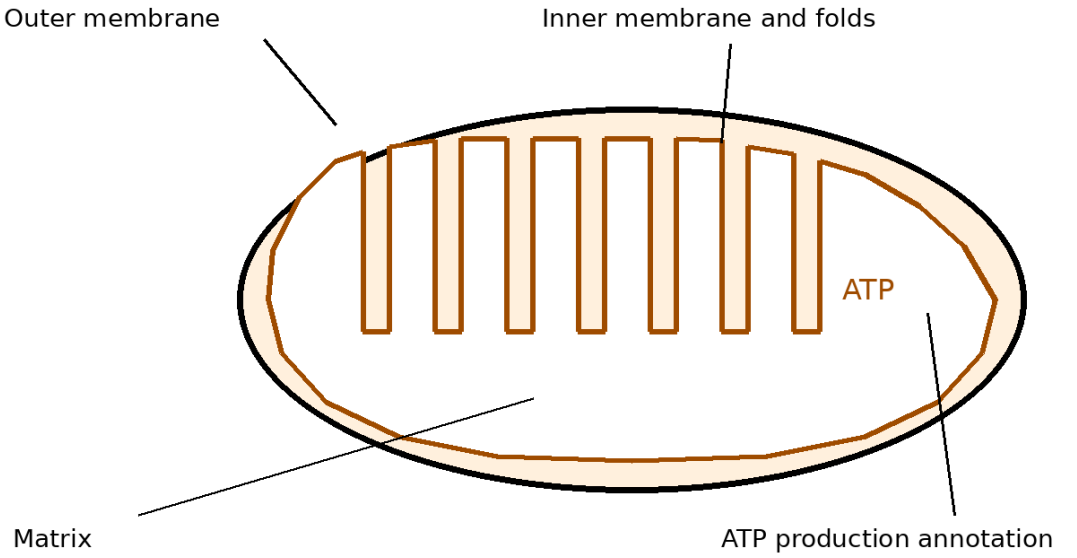
## Materials and construction

Use one cardboard lid, white and orange paper, a folded paper strip, four label tabs, a marker, tape, and glue. Outline two membranes, place the folded strip inside, and label the space within. Add the fictional title and face last.

## Real and fictional

Real: membranes, cristae, matrix, and ATP production. Fictional: the factory becoming active only at midnight and making ghostly noises.

# Model plan and labels




Simplified model plan, not a micrograph or student photograph

## Label text

| Label | Meaning |
|---|---|
| Outer membrane | Outer boundary of this organelle |
| Inner membrane and cristae | Folded membrane with proteins involved in ATP production |
| Matrix | Compartment inside the inner membrane |
| ATP production | Annotation linking the model to cellular energy transfer |

## Model limitation

The model enlarges structures and omits most molecules and reactions. The orange folds represent the inner membrane schematically; the paper does not perform cellular respiration. ATP symbols represent molecules, not visible packets inside a cell.

# Completed museum card

## The Midnight ATP Factory

Exhibit 01 | Biology topic: mitochondrial structure and energy transfer

## Real science explanation

Mitochondria help cells transfer energy from fuels into ATP through cellular respiration. Their folded inner membrane provides surface for proteins involved in ATP production. The matrix lies inside that membrane. Our paper folds represent cristae, while the ATP label connects the structure to its function.

## Four facts

1. Mitochondria have two membranes.
2. Cristae are folds of the inner membrane.
3. The matrix lies inside the inner membrane.
4. Inner-membrane proteins participate in ATP production.

## Fictional backstory and warning

At midnight, this factory hums loudly enough to wake the ghost cells. Fictional warning: Keep your laboratory ghosts away from the imaginary night shift!

Sources: Wages Biology Science Reference Card 1; OpenStax Biology 2e section 4.3.

## Completed peer review

Reviewer comment: Your first draft says mitochondria create energy. Revise it to explain energy transfer. Revision: Changed the phrase to transfer energy from fuels into ATP.

## Example 30 second explanation

The creepy factory is fictional, but the folds are real. These paper folds stand for cristae. They provide inner-membrane surface for proteins involved in ATP production. Our model helps explain how structure supports function.

# Example project and individual scoring

Illustrative scoring assumes the submitted physical model matches the plan and labels. A plan alone does not earn physical-model points. Use the two scores separately.

| Project criterion | Example score | Reason |
|---|---|---|
| Accuracy | 15/15 | Four accurate facts and explanation |
| Biological model | 10/10 | Assumed model clearly shows organelle structures |
| Labels | 5/5 | Four explained labels or annotations |
| Research | 10/10 | Two sources, fact links, and complete planning |
| Museum card | 5/5 | All card elements complete and readable |
| Creative science connection | 5/5 | Factory theme links to ATP production |
| PROJECT TOTAL | 50/50 | Shared exhibit grade |

## Example individual contribution

I researched the matrix, folded the inner membrane, wrote two labels, and corrected the phrase create energy to transfer energy after peer review. I can explain how cristae relate to ATP production.

Assuming the teacher confirms task completion, productive work time, and respectful collaboration, this student could earn 2 points in each individual category: 10/10, separate from the 50-point project.

## What students should notice

The example separates real biology from a fictional backstory. A different exhibit can earn full credit. Drawing skill and materials cost do not determine scores.

# Student Display Examples

Actual classroom photographs supplied by Jeanne Wages

## The Cell Organelle Asylum



Everyday materials become cellular monsters. Egg-carton ribosomes represent protein builders, a brain-topped nucleus houses genetic instructions, a mitochondrial energy vampire represents ATP production, and a hungry lysosome breaks down and recycles cellular materials.

Discuss: Which visible features communicate function? The brain and monster personalities are fictional analogies, not literal organelle anatomy.

# Bicephaly Two Heads One Body

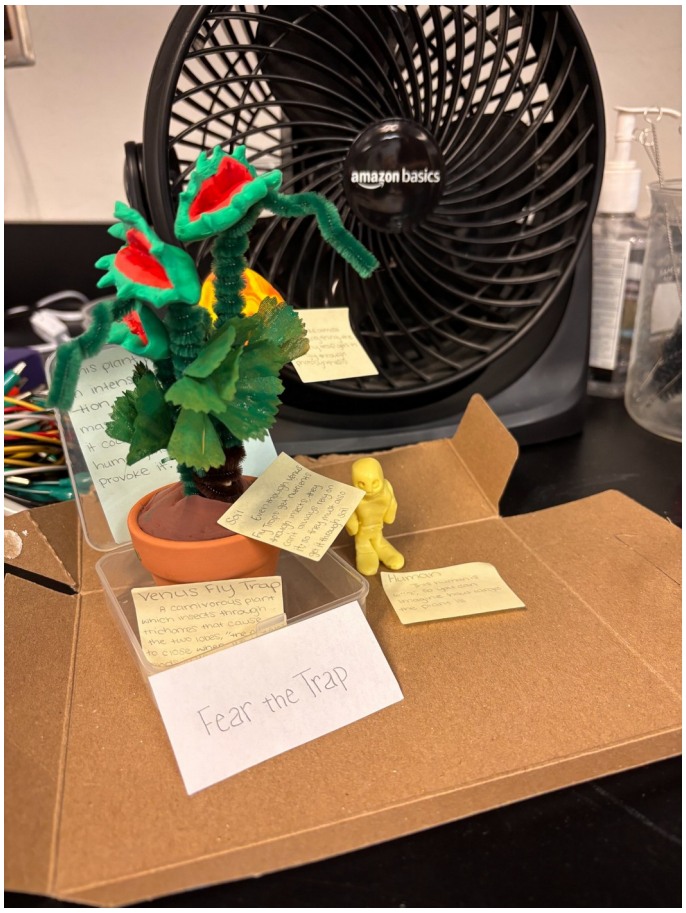


This snake models a rare developmental condition in which two heads share one body. Each head has its own brain and can respond independently. Tongue flicks collect chemical cues that help locate prey. The heads may respond differently, compete for food, or attempt to move in opposite directions, complicating feeding and escape.

Discuss: The challenge is coordinating responses, not necessarily impaired chemical sensing. A developmental anomaly is not automatically evidence of a specific genetic mutation.

Background sources: FWC Fish and Wildlife Research Institute, https://www.flickr.com/photos/myfwc/50540505582/ ; California Academy of Sciences, Snake Sense Scents, https://www.calacademy.org/sites/default/files/assets/docs/sah_snakes_snake_sense_scents_210722.pdf

# The Carnivorous Greenhouse




Clay, pipe cleaners, and artificial leaves transform a Venus flytrap into a botanical monster. Real flytraps use modified leaves with sensitive trigger hairs to capture prey, obtaining nutrients such as nitrogen while making sugars through photosynthesis. The oversized traps and tiny human add fiction; real Venus flytraps cannot eat people.

Discuss: Which features show prey capture, and which show photosynthesis? Prey supplies mineral nutrients rather than replacing photosynthesis.

Background: OpenStax Biology 2e, Nutritional Adaptations of Plants, https://openstax.org/books/biology-2e/pages/31-3-nutritional-adaptations-of-plants

# Tissue Culture Gone Wrong




These simulated petri dishes tell the fictional story of an attempt to grow human tissues, including bone, with unsettling results. Miniature bones, eyes, and spooky details create the horror scene. Growing living cells requires carefully controlled conditions, and producing organized tissues is more complex than placing cells in a dish. These are craft models, not actual tissue cultures.

Discuss: Which details represent actual tissue biology, and which are fictional? Do not interpret the decorations as a realistic image of a living culture.

# Lab of Horrors Station Cards

Nine project options  Choose one station and use its matching Science Reference Card

## Station 1  The Organelle Asylum

### Your biology question

How does an organelle help a cell function?

### Build an exhibit

Make a paper mitochondrion on cardboard. Use a folded paper strip for the inner membrane. Add a fictional face separately from the biological labels.

### Four biological features to explain

- Outer mitochondrial membrane
- Inner membrane and cristae
- Matrix
- ATP production annotation

### Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

### Check your science

ATP is an energy-transfer molecule. Mitochondria transform energy rather than creating it.

Discuss or write: Why do folds matter in a mitochondrion?

### Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 2  The Microbial Graveyard

## Your biology question

What can colony appearance tell us about bacteria?

## Build an exhibit

Place paper or clay colonies in a clean plastic container. Include a side-view drawing for elevation and a small binary-fission sequence beside the container.

## Four biological features to explain

- Form such as circular
- Margin such as smooth
- Elevation such as raised
- Pigmentation such as yellow

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

This is a craft simulation. Do not collect, grow, or open real environmental cultures.

Discuss or write: Can a scary-looking colony prove that a bacterium causes disease?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 3  The Anatomy Crypt

## Your biology question

How do heart structures work together to move blood?

## Build an exhibit

Make a four-chamber paper heart. Add flow arrows, simple valve flaps, and a septum. Label the four chambers and explain the extra features in your card.

## Four biological features to explain

- Right atrium
- Right ventricle
- Left atrium
- Left ventricle

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

Right and left refer to the person's body. In a front view, anatomical right appears on the viewer's left. Red and blue are diagram conventions, not actual blood colors.

Discuss or write: Why does a heart model need arrows as well as chamber names?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 4  The Mutation Station

## Your biology question

How can a DNA change affect a protein or trait?

## Build an exhibit

Make a before-and-after sequence strip and a chain model. Connect the DNA change to the protein and cell effect. You may use the documented HBB example or a clearly marked hypothetical example.

## Four biological features to explain

- Original DNA sequence
- Changed DNA sequence
- Protein consequence
- Cell or trait consequence

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

Do not imply that one variant always causes the same disease severity or that mutations are always harmful.

Discuss or write: Does every mutation change an amino acid?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 5  The Diseased Tissue Gallery

## Your biology question

How can changes in cells disrupt a tissue?

## Build an exhibit

Use paper circles or clay to make side-by-side tissue models. Keep scale and viewpoint similar. Show a boundary and label where the cancer model crosses it.

## Four biological features to explain

- Normal organized cell layer
- Controlled division annotation
- Abnormal crowded growth
- Invasion into adjacent tissue

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

This model simplifies one solid-tumor example. Not all cancers form solid tumors, and a craft model cannot diagnose disease.

Discuss or write: Does every tumor invade nearby tissue?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 6  The Cell Death Cemetery

## Your biology question

How do apoptosis and necrosis differ?

## Build an exhibit

Make two short sequences of paper cells on a cemetery base. Use arrows to show the changes. Keep ghost decorations separate from cell labels.

## Four biological features to explain

- Apoptotic cell shrinkage
- Membrane-enclosed fragments
- Necrotic cell swelling
- Rupture and leaking contents

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

This is a basic contrast. Some necrotic cell-death pathways are regulated, so avoid claiming all necrosis is unregulated.

Discuss or write: Why can membrane rupture affect neighboring tissue?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 7  The Carnivorous Greenhouse

## Your biology question

Why do some photosynthetic plants capture prey?

## Build an exhibit

Build a paper pitcher plant with a smooth inner surface and a digestive region near the bottom. Add a photosynthesis annotation and explain two trap-related adaptations.

## Four biological features to explain

- Photosynthetic leaf surface
- Prey trap
- Digestive region
- Nutrient uptake annotation

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

A plant does not develop a new trap because it decides it needs one. Label imaginary teeth or movement as fictional.

Discuss or write: Why does capturing insects not replace photosynthesis?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 8  The Biological Ooze Collection

## Your biology question

How do materials outside cells support living systems?

## Build an exhibit

Choose ONE material. Use yarn for matrix fibers, paper cells, and a clear sealed plastic container. Colorless tissue paper can represent water without making real slime.

## Four biological features to explain

- Cells that produce or occupy the material
- Structural molecules
- Water or hydrated space
- Function such as support or attachment

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

A container of decorative slime alone does not demonstrate biology. Explain what each material represents. No bodily fluids or live cultures.

Discuss or write: Are mucus, biofilm, and animal extracellular matrix the same thing?

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.

# Station 9  Nature's Monsters

## Your biology question

How does an unusual adaptation help a real organism survive or reproduce?

## Build an exhibit

Make a paper fish with a hinged mouth and a clay or paper isopod inside. Use arrows to connect attachment and feeding to the effect on the fish. Add four explained labels.

## Four biological features to explain

- Fish host and mouth
- Attached isopod
- Attachment legs
- Feeding site and effect on host

## Every exhibit needs

- Four accurate facts in your own words, linked to two traceable sources. The reference card may count as one source.
- A handmade model with four labels that explain functions or meanings. Use arrows when showing movement or change.
- A readable museum card with a creative title, four facts, a 3–5 sentence scientific explanation, and a clearly marked 1–2 sentence fictional backstory or warning.
- A completed research sheet or assigned paper. Both partners can explain the science.

## Check your science

"Monster" is a theme, not a scientific group. These organisms are not evil. Do not imply that all parasites replace tongues or that organisms choose to evolve traits. Mark invented behavior as fiction.

Discuss or write: Why is this relationship parasitism rather than mutualism?

## Other organism choices

Investigate a deep-sea anglerfish or parasitoid wasp, or propose another real organism for teacher approval. Choose one organism and adapt all four labels to it. Use the reference card's linked readings to begin.

## Materials and scoring

Use paper, cardboard, clay, yarn, markers, tape, or clean recycled containers. Use craft models only. Project grade: 50 points. Individual work evaluation: 10 separate points. Artistic skill and purchased supplies do not determine your grade.