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]

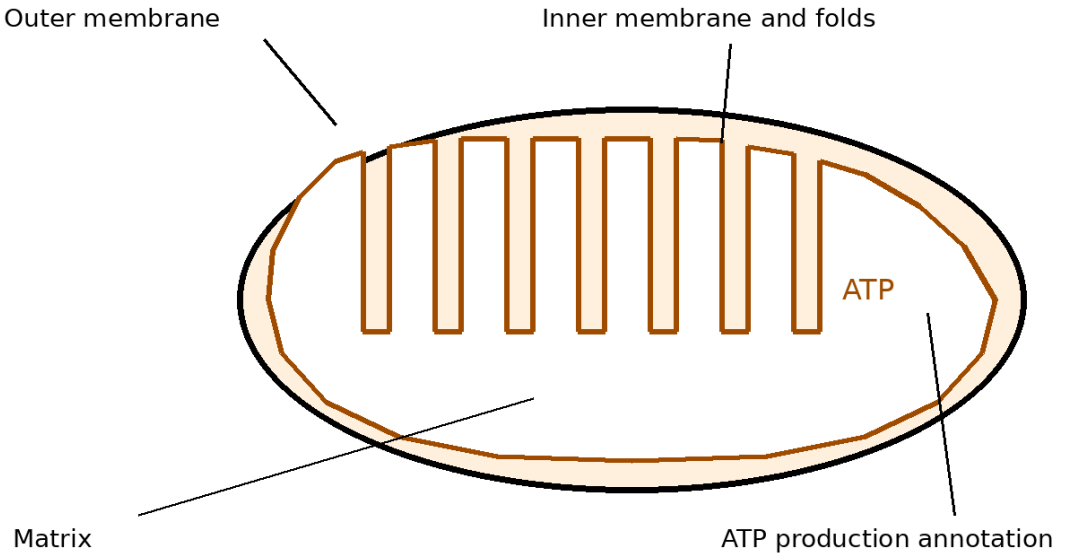
Materials and construction

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.