



**Literacy Design  
Collaborative**

# How are Mitochondria Connected to the Aging Process?

★ TASK ★ LADDER

by Christina Roberts

An understanding of organism organization, cell structure, mitochondria, and cellular respiration is a prerequisite for this module!

The role of the mitochondria in providing the energy that organisms require for basic life functions is something that most students have a basic grasp of, but that they often fail to connect to the bigger picture of human health.

Using an idea that is almost universally engaging-the idea of slowing down the aging process-students will be supported in making the connection between healthy mitochondria at a cellular level and an organism's ability to repair tissue damage and produce energy necessary for health.

The articles are presented in chronological fashion, with an early article taking a negative view on our ability to slow down the aging process, followed by a more recent article that takes a much more optimistic approach. The articles do a good job of connecting anti-aging research (which is often considered to be 'quackery') with legitimate scientific processes and scientific method.

In this assignment, students will synthesize information from two articles on mitochondria and the aging process with information about cellular respiration and mitochondria learned in class. They will be asked to explain the role of mitochondria in the aging process, as well as to discuss the advances in research scientists are making.

For a shorter assignment, the second text could be used by itself or the texts could easily be edited. Alternatively, the articles could also be used for argumentative writing, where the student is asked to take a position on whether or not scientists will be able to slow down the aging process.

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GRADES

**8 - 11**

DISCIPLINE

 **Science**

COURSE

**Any**

PACING

 **N/A**

# *Section 1: What Task?*

## ***Teaching Task***

### ***Task Template IE99 - Informational or Explanatory***

How are mitochondria connected to the aging process? After reading "What if you didn't have to grow old?" and "Power Failure", write a report that addresses the question and analyzes the advances scientists are making in slowing down the aging process, providing examples to clarify your analysis. What conclusion or implications can you draw? A bibliography is not required.

## ***Standards***

### ***Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects***

#### **RST.9-10.1**

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

#### **RST.9-10.2**

Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

#### **RST.9-10.6**

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

#### **WHST.9-10.2.a**

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

#### **WHST.9-10.2.b**

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

#### **WHST.9-10.2.d**

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

#### **WHST.9-10.2.e**

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

#### **WHST.9-10.2.f**

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Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

### WHST.9-10.4

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

### WHST.9-10.9

Draw evidence from informational texts to support analysis, reflection, and research.

### **Custom Standards**

#### HS.C1

As a result of their activities in grades 9-12, all students should develop understanding of the cell. (NSES - Life Science)

#### HS.C5

As a result of their activities in grades 9-12, all students should develop understanding of matter, energy, and organization in living systems. (NSES - Life Science)

### CUSTOM

SCIENCE CONTENT: FUNCTION OF THE MITOCHONDRIA: Student shows understanding of the function of the Mitochondria and it's connection to the health of the organism as a whole.

### **Texts**

#### Biology (Miller & Levine)

This is the biology text used.

#### WHAT IF YOU DIDN'T HAVE TO GROW OLD?

Lexile: 1070L Publication: Men's Health (10544836)(Jan/Feb2009) Author: McGrath, Tom WHAT IF YOU DIDN'T HAVE TO GROW OLD? Men's Health (10544836) (Jan/Feb2009)—McGrath, Tom The article focuses on various factors responsible for expanding one's life and longevity. It states that strong, healthy mitochondria can make one strong and healthy now, and maybe for a very long time. Over the past couple of decades, researchers have gained an increasing understanding of just how crucial mitochondria are to every aspect of human health and fitness. Two factors stand in the way of properly functioning mitochondria, that are, genetic mutation and time.

#### Power Failure

Power failure. Science News (09/27/97)—Fackelmann, Kathleen Describes research which investigated the introduction of mitochondrial energy defects in mice to study their relation to cardiomyopathy. Diseases' ties to mitochondrial gene flaws; Role of adenine nucleotide translocator (ANT) protein; Methods of studying energy deficiency in mice; Mitochondrial disease in people; Flaw in research; Research presented in July, 1997 edition of 'Nature Genetics'; Use of research relating to controversial hypothesis about aging.

**Student Work Rubric - Informational or Explanatory Task - Grades 9-12**

	Emerging	Approaches Expectations	Meets Expectations	Advanced
	1	2	3	4
<b>Controlling Idea</b>	Presents a general or unclear controlling idea.	Presents a <b>clear</b> controlling idea <b>that addresses the prompt</b> , with an <b>uneven focus</b> .	Presents <b>and maintains a clear, specific</b> controlling idea that addresses <b>all aspects</b> of the prompt and <b>takes into account the complexity of the topic</b> .	Presents and maintains a <b>precise, substantive</b> controlling idea that addresses all aspects of the prompt, <b>takes into account the complexity of the topic</b> and, where appropriate, <b>acknowledges gaps in evidence or information</b> .
<b>Selection &amp; Citation of Evidence</b>	Includes minimal details from sources. Sources are used without citation.	Includes <b>details, examples, and/or quotations</b> from sources that are <b>relevant to the controlling idea</b> . <b>Inconsistently</b> cites sources.	Includes details, examples, and/or quotations from sources that <b>support the controlling and supporting ideas</b> . <b>Consistently</b> cites sources <b>with minor formatting errors</b> .	Includes <b>well-chosen</b> details, examples, and/or quotations from sources that <b>fully support</b> the controlling and supporting ideas. <b>Consistently</b> cites sources <b>using appropriate format</b> .
<b>Development / Explanation of Sources</b>	Explanation of ideas and source material is irrelevant, incomplete, or inaccurate.	Explains ideas and source material <b>to support the controlling idea</b> , with <b>some incomplete reasoning or explanations</b> .	<b>Accurately</b> explains ideas and source material and <b>how they support</b> the controlling idea.	<b>Thoroughly</b> and accurately explains ideas and source material <b>to support and develop</b> the controlling idea.
<b>Organization</b>	Lacks an evident structure. Makes unclear connections among ideas, concepts, and information.	<b>Groups ideas and uses transitions</b> to develop the controlling idea, with <b>some lapses in coherence or organization</b> .	<b>Groups and sequences</b> ideas to <b>develop a cohesive explanation</b> . Uses transitions to <b>clarify the relationships among complex ideas, concepts, and information</b> .	Groups and sequences ideas <b>in a logical progression in which ideas build to create a unified whole</b> . Uses <b>varied</b> transitions to clarify the <b>precise</b> relationships among complex ideas, concepts, and information.
<b>Conventions</b>	Major errors in standard English conventions interfere with the clarity of the writing. Language or tone is inappropriate.	Errors in standard English conventions <b>sometimes interfere</b> with the clarity of the writing. Uses language and tone that are <b>sometimes inappropriate</b> for the audience and purpose.	<b>Consistently applies</b> standard English conventions; <b>minor errors</b> , while noticeable, <b>do not interfere</b> with the clarity of the writing. Uses language and tone <b>appropriate to the audience and purpose</b> .	Consistently applies standard English conventions, <b>with few errors</b> . Demonstrates <b>varied syntax and precise word choice</b> . <b>Consistently</b> uses language and tone appropriate to the audience and purpose.
<b>Content Understanding (Generic)</b>	Attempts to include disciplinary content in explanation or argument but understanding of content is weak; content is irrelevant, inappropriate, or inaccurate.	Briefly notes disciplinary content relevant to the prompt; shows basic or uneven understanding of content; minor errors in explanation.	Accurately presents disciplinary content relevant to the prompt with sufficient explanations that demonstrate understanding.	Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding.

## ***Background for Students***

You have begun studying the structure and function of the parts of the cell, and have been introduced to the mitochondria as the "powerhouse" of the cell. This assignment will help you formulate a deeper understanding of how the well-being of the mitochondria inside the cell are connected to the health of the organism as a whole.

## ***Extension***

There are a number of experiments and scientific studies described in the articles. Students who have been learning about experimental design can analyze the experiments and studies, determining independent and dependent variables, state the hypothesis that was tested, or even do additional internet research about the studies. Higher level students can read the original studies and analyze the interpretation in the article.

## *Section 2: What Skills?*

### ***Preparing for the Task***

**TASK ENGAGEMENT:** Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns.

### ***Reading Process***

**ACTIVE READING:** Ability to identify the central point and main supporting elements of a text.

**ESSENTIAL VOCABULARY:** Ability to apply strategies for developing an understanding of text(s) by locating words and phrases that identify key concepts and facts, or information.

### ***Transition to Writing***

**PREPARING FOR WRITING:** Ability to begin linking reading results to writing task.

**ACADEMIC INTEGRITY:** Ability to use and credit sources appropriately.

### ***Writing Process***

**CONTROLLING IDEA:** Ability to establish a controlling idea and consolidate information relevant to task.

**PLANNING:** Ability to develop a line of thought and text structure appropriate to an information/explanation task.

**DEVELOPMENT:** Ability to construct an initial draft with an emerging line of thought and structure.

**COMPLETION:** Ability to submit final piece that meets expectations.

## Section 3: What Instruction?

PACING	SKILL AND DEFINITION	PRODUCT AND PROMPT	SCORING GUIDE	INSTRUCTIONAL STRATEGIES
<b>Preparing for the Task</b>				
10 mins	<b>TASK ENGAGEMENT:</b> Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns.	<b>SHORT-CONSTRUCTED RESPONSE</b> In a quick write, describe how this article is connected to the content we are studying this unit.	None	<ul style="list-style-type: none"> <li>Link this task to earlier class content.</li> <li>Discuss student responses.</li> </ul> <p>PACING: 10 minutes at the end of Day 1.</p>
10 mins	<b>TASK ENGAGEMENT:</b> Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns.	<b>SHORT-CONSTRUCTED RESPONSE</b> How are the ideas in "Power Failure" similar or different to "What if you didn't have to grow old?"	None	<ul style="list-style-type: none"> <li>Link this task to earlier class content.</li> <li>Discuss student responses.</li> </ul> <p>PACING: 10 minutes at the end of Day 5</p>
<b>Reading Process</b>				
50 mins	<b>ACTIVE READING:</b> Ability to identify the central point and main supporting elements of a text.	<b>NOTES</b> What is the "gist" of the article "Power Failure?"  Write a newspaper headline designed to capture your reader's attention and engage them in the text.	<ul style="list-style-type: none"> <li>Answers questions with credible response.</li> </ul>	<ul style="list-style-type: none"> <li>Focusing Question (Do-Now): What is the function of the mitochondria? Check your notes if necessary!</li> <li>Instruct students to 'skim' the text.</li> <li>Discuss strategies such as reading the first sentence of each paragraph, reading the introduction and conclusion, etc.</li> <li>Instruct students to take notes in the right-hand column of the article as they skim. They should use metacognitive markers to indicate questions they have, connections they can make to other things they know, and thoughts or ideas that they have as they read.</li> <li>Invite students to share and discuss their answers for the text.</li> <li>After the discussion, allow them to add to their entries.</li> </ul> <p>* Notes: Have sample newspaper headings available to share with students.</p> <p>* Close with the Task Engagement prompt for Day 1</p> <p>PACING: DAY 1</p>
1 hr and 40 mins	<b>ACTIVE READING:</b> Ability to identify the central point and main supporting elements of a text.	<b>NOTES</b> How can we break down a long text into manageable pieces?	<ul style="list-style-type: none"> <li>The explanation given by students for each 'chunk' is reasonable.</li> </ul>	<ul style="list-style-type: none"> <li>Student readings should have numbered paragraphs with horizontal lines between each 'chunk' of the text.</li> <li>Ask students why they think you drew lines between different sections.</li> <li>Explain to students that you have divided the text into sections based on where the author transitions between ideas.</li> </ul>

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				<p>Accommodations and Interventions: Advanced students: Allow them to chunk the text on their own and explain their reasoning for each chunk.</p> <p>PACING: Days 2 &amp; 3</p>
50 mins	<p><b>ACTIVE READING:</b> Ability to identify the central point and main supporting elements of a text.</p>	<p><b>NOTES</b> Create a group summary of the article</p>	None	<ul style="list-style-type: none"> <li>● Read/think aloud as you model summarizing a chunk of text.</li> <li>● Break students into groups.</li> <li>● Assign each group multiple chunks of text to summarize.</li> <li>● Student groups will write each 10 word summary on a different sentence strip or small poster.</li> <li>● The summaries will be posted on the wall in order so that there is a class summary of the entire article.</li> </ul> <p>PACING: Day 4</p> <p><i>* This lesson can be switched with day 2 if desired.</i></p> <p><i>* Use heterogeneous groups so higher level students can assist lower level students.</i></p>
50 mins	<p><b>ACTIVE READING:</b> Ability to identify the central point and main supporting elements of a text.</p>	<p><b>NOTES</b> What is the "gist" of the article "What if you didn't Have to Grow Old?"</p>	Summary of the text and newspaper heading are reasonable	<ul style="list-style-type: none"> <li>● Focusing Question (Do-Now): What is the function of the mitochondria? Check your notes if necessary!</li> <li>● Instruct students to 'skim' the text.</li> <li>● Discuss strategies such as reading the first sentence of each paragraph, reading the introduction and conclusion, etc.</li> <li>● Instruct students to take notes in the right-hand column of the article as they skim. They should use metacognitive markers to indicate questions they have, connections they can make to other things they know, and thoughts or ideas that they have as they read.</li> <li>● Invite students to share and discuss their answers for each text.</li> <li>● After the discussion, allow them to add to their entries.</li> </ul> <p><i>* Close with task engagement prompt for day 5</i></p> <p>PACING: Day 5</p>
50 mins	<p><b>ACTIVE READING:</b> Ability to identify the central point and main supporting elements of a text.</p>	<p><b>NOTES</b> How can we break down a long text into manageable pieces?</p>	<ul style="list-style-type: none"> <li>● The explanation given by students for each 'chunk' is reasonable</li> </ul>	<ul style="list-style-type: none"> <li>● Student readings should have numbered paragraphs with horizontal lines between each 'chunk' of the text.</li> <li>● Ask students why they think you drew lines between different sections.</li> <li>● Explain to students that you have divided the text into sections based on where the author transitions between ideas.</li> </ul> <p><i>For low performing students, the text can be chunked as on day 2. An alternative is pairing them with higher level students, or creating a homogeneous group and working with them closely while they chunk the text.</i></p> <p>PACING: Day 6</p>



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40 mins	<b>ESSENTIAL VOCABULARY:</b> Ability to apply strategies for developing an understanding of text(s) by locating words and phrases that identify key concepts and facts, or information.	<b>LIST</b> In your notebook, list words and phrases essential to the texts. Add definitions, and (if appropriate) notes on connotation in this context.	<ul style="list-style-type: none"> <li>Lists appropriate phrases.</li> <li>Provides accurate definitions.</li> <li>Differentiates between three types of words: Content vocabulary, vocabulary defined in the text, and tier 2 vocabulary</li> </ul>	<ul style="list-style-type: none"> <li>After scoring, ask some students to share definitions of terms that others overlooked or misunderstood.</li> <li>After scoring, be willing to provide direct instruction or guide a close reading if needed to work through a key phrase most students missed.</li> </ul> <p>PACING: ONGOING</p>
<b>Transition to Writing</b>				
15 mins	<b>PREPARING FOR WRITING:</b> Ability to begin linking reading results to writing task.	<b>LIST</b> Read the writing prompt again. In a quick write, write about what you know now that you've read both articles.	None	<ul style="list-style-type: none"> <li>Small group brainstorm and share out.</li> </ul> <p>PACING: Day 7</p>
20 mins	<b>ACADEMIC INTEGRITY:</b> Ability to use and credit sources appropriately.	<b>SHORT CONSTRUCTED RESPONSE</b> Define "plagiarism" and list ways to avoid it.	<ul style="list-style-type: none"> <li>Provides accurate definition</li> <li>Lists several appropriate strategies</li> </ul>	<ul style="list-style-type: none"> <li>Provide students with work samples and scenarios.</li> <li>Have them locate examples of plagiarism and explain what should have been done differently.</li> </ul> <p>PACING: Day 7</p>
<b>Writing Process</b>				
50 mins	<b>CONTROLLING IDEA:</b> Ability to establish a controlling idea and consolidate information relevant to task.	<b>SHORT CONSTRUCTED RESPONSE</b> Write an opening paragraph that includes a controlling idea and sequences the key points you plan to make in your composition	<ul style="list-style-type: none"> <li>Writes a concise summary statement or draft opening.</li> <li>Provides direct answer to main prompt requirements.</li> <li>Establishes a controlling idea.</li> <li>Identifies key points that support development of argument.</li> </ul>	<ul style="list-style-type: none"> <li>Offer several examples of opening paragraphs.</li> <li>Ask class to discuss what makes them strong or weak.</li> </ul> <p><i>Provide with a handout on how to write an engaging introduction.</i></p> <p>PACING: Day 8</p>
50 mins	<b>PLANNING:</b> Ability to develop a line of thought and text structure appropriate to an information/explanation task.	<b>OUTLINE</b> Create an outline based on your notes and reading in which you state your claim, sequence your points, and note your supporting evidence.	<ul style="list-style-type: none"> <li>Creates an outline or organizer.</li> <li>Supports controlling idea. Uses evidence from texts read earlier.</li> </ul>	<ul style="list-style-type: none"> <li>Provide and teach one or more examples of outlines or organizers.</li> <li>Invite students to generate questions in pairs about how the format works, and then take and answer questions.</li> </ul> <p>PACING: Day 9</p>

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50 mins	<b>DEVELOPMENT:</b> Ability to construct an initial draft with an emerging line of thought and structure.	<b>LONG CONSTRUCTED RESPONSE</b> Write an initial draft complete with opening, development, and closing; insert and cite textual evidence.	<ul style="list-style-type: none"><li>Provides complete draft with all parts.</li><li>Supports the opening in the later sections with evidence and citations.</li></ul>	<ul style="list-style-type: none"><li>Encourage students to re-read prompt partway through writing, to check that they are on track.</li></ul> <p>PACING: Day 10</p>
50 mins	<b>COMPLETION:</b> Ability to submit final piece that meets expectations.	<b>LONG CONSTRUCTED RESPONSE</b> Turn in your complete set of drafts, plus the final version of your piece	<ul style="list-style-type: none"><li>Fits the “Meets Expectations” category in the rubric for the teaching task.</li></ul>	Not Provided

### Instructional Resources

#### Teacher Resource

 **Close Reading Template**

#### Student Handout

 **Close Reading: "Power Failure"**

 **Close Reading: "What if you didn't have to grow up?"**

 **Scaffolding for Essay Writing**

 **Mitochondria Prompt**

## *Section 4: What Results?*

### ***Student Work Samples***

No resources specified

### ***Teacher Reflection***

Not provided

## ***All Attachments***

- 📎 Close Reading Template : <https://s ldc.org/u/4oxa4qm50ca24usio1uvzdx yv>
- 📎 Close Reading: "Power Failure" : <https://s ldc.org/u/8jmsjvi0r572snxgy9294fknv>
- 📎 Close Reading: "What if you didn't have to grow up?" :  
<https://s ldc.org/u/3bo9ozb07e2199ckwmnu76czr>
- 📎 Scaffolding for Essay Writing : <https://s ldc.org/u/oe6ibj76etdgwhc3e8lmy2nh>
- 📎 Mitochondria Prompt : <https://s ldc.org/u/bzon3y0ia1j6tviq5uaxukasm>