# RUBRIC
## EVALUATE LESSON 24

Food and Agriculture Center for Science Education

| Part 2 Task Rubric | | | |
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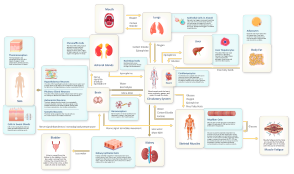
| **INFO-H5: Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).**<br><br>**LS1.A-H1: Systems of specialized cells within organisms help them perform the essential functions of life.**<br><br>**LS2.B-H1: Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.**<br><br>**SC-H1: Much of science deals with constructing explanations of how things change and how they remain stable.** | | | |
| | Emerging | Developing | Proficient |
| **Sample Student Response** |  <br><br>You can see in the exercise effects model that when we exercise, our body uses glucose to make energy.<br><br>To make energy, the cells use oxygen and | Now, let's talk about why you get fatigued during exercise and how milk can help you recover.<br><br>Intense exercise requires a lot of energy to keep your muscles moving. Our muscles make energy using cellular respiration to make ATP. At the beginning of intense exercise, our muscle cells are able to break down their glycogen stores into glucose molecules that can be used for anaerobic respiration.<br><br>Most of the energy generated in the beginning of an intense workout is anaerobic because that doesn't require waiting for extra oxygen to be delivered in the bloodstream. | Now let's talk about why you get fatigued during exercise and what you can do to help recover from that fatigue and keep going. One thing to know going into this is that when scientists study how the body responds to exercise, they typically do so by describing the changes that happen to a lot of different molecules in the body. So we'll be discussing a lot of molecular details in this part of the presentation.<br><br>Exercise requires a lot of energy! Your body transforms stored molecules or molecules in the food you eat into cellular energy. Let me show you how this works on this model. |

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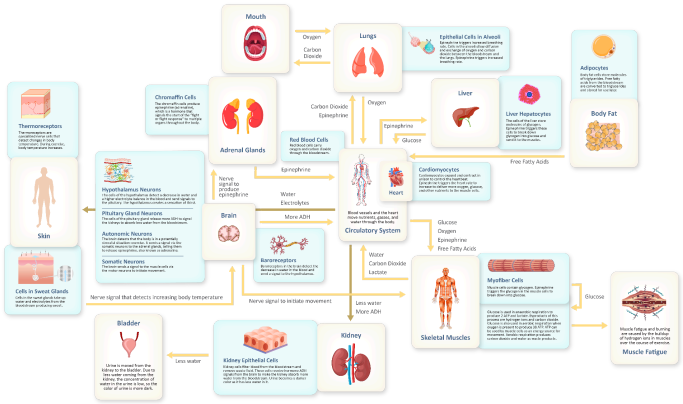
| | glucose. The oxygen comes from the lungs.<br><br>After exercise, the glucose from milk replaces the glucose our body used so that we have energy to work out again. | While anaerobic respiration is happening, we are also breathing faster and our heart is beating faster. Oxygen is breathed into the lungs and enters the bloodstream through the alveoli sacs. Carbon dioxide from the muscle cells making ATP is moving in the opposite direction to exit the bloodstream, enter the lungs and be breathed out of the body.<br><br>As enough oxygen gets to the muscle cells, they can use oxygen to generate energy using aerobic cellular respiration. To keep blood glucose levels steady, the liver breaks down its glycogen stores and releases the glucose molecules into the bloodstream.<br><br>After intense exercise, our bodies need to replace the glucose molecules that were used. As milk is digested, lactose is broken down into glucose and galactose molecules. The glucose molecules can be absorbed into the bloodstream, where they can refill the glycogen stores inside the liver and the skeletal muscles. |  <br><br>To make energy to power your muscles to move rapidly during exercise, muscle cells need glucose. Glucose is used in the process of anaerobic respiration early in intense exercise. This process occurs without oxygen present and produces 2 ATP, which is the cellular energy your muscles use for movement. When exercise continues, oxygen moves in from your lungs, through the epithelial cells, into your bloodstream, and finally to the muscles, where the myocytes take it in to use in aerobic respiration. This process uses glucose to produce 38 ATP to power the muscle cells for rapid movement during exercise.<br><br>Muscle cells get this glucose from a couple of different places. First, they can get it from the bloodstream, but that glucose runs out very quickly.<br><br>Next, they can get it from glycogen or a form of stored glucose. As you can see in the model, when the body needs to make energy quickly to power your exercise, the brain sends a signal along the |

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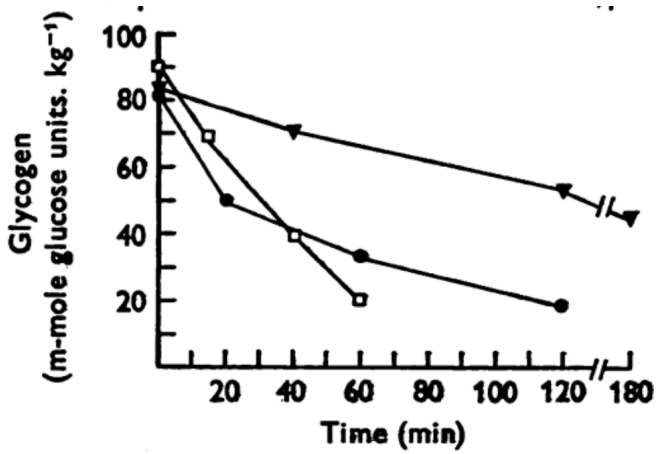
| | | | autonomic neurons to the chromaffin cells in the adrenal glands to produce epinephrine and pass it to the bloodstream. There, it moves to the hepatocytes in the liver and to the myocytes in the muscles to tell these organs to start breaking down their glycogen into glucose, which can be used by the muscles in anaerobic and aerobic respiration to generate more energy. The figure below from Gollnick, Piehl, and Saltin demonstrates that muscle glycogen stores in the myocytes decrease rapidly with intense exercise (open square line), meaning that glycogen is being broken down into glucose, which is used in the myocytes to produce ATP.<br>  <br><br>Now, as you keep exercising, you start to get fatigued, and your muscles start to feel like they are burning. This burning and fatigue comes from the change in pH of the muscles during exercise. |

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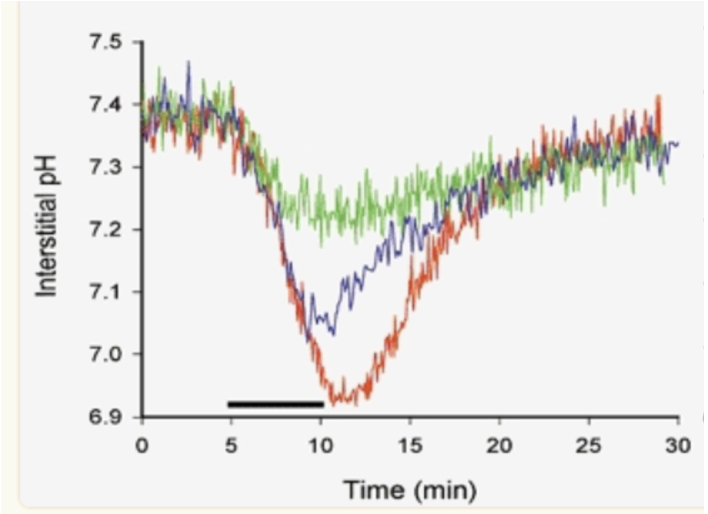
| | | | Below is a graph of the Interstitial pH in human skeletal muscle during and after dynamic-graded exercise by Street, Bangsbo, and Juel. Each color was a different intensity of workout. Red was the most intense. You can see pH in the interstitial space of the muscle dropped, especially during high intensity exercise.<br>  <br><br><br>When the pH of the muscles drops, the brain receives an alert of pain/burning from the skeletal muscle as a way of telling you to slow down! When you stop and rest, the pH of the muscle returns to its normal level so you can keep going.<br><br>Now, let's say an athlete was doing very long endurance workouts. They would not be able to maintain the high intensity, but their bodies could keep exercising for a very long time because the body can modify fatty acids to use as a fuel source for a process called beta oxidation in the myocytes. This |

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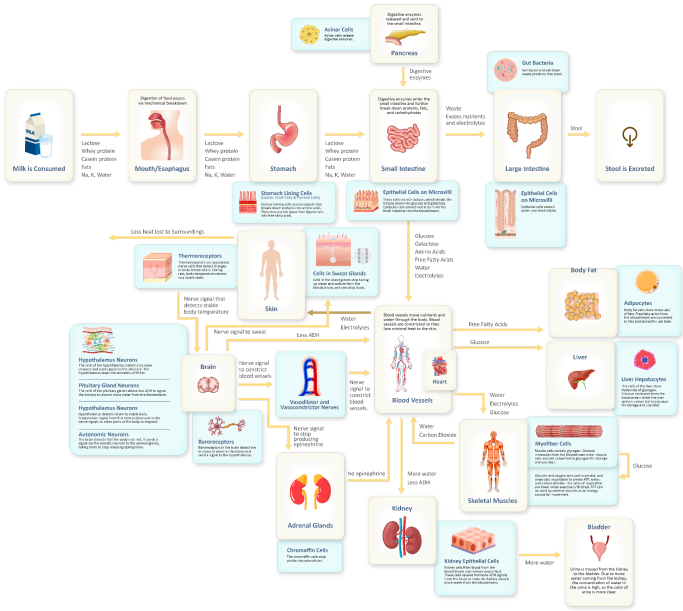
| | | | is a process the body uses to create ATP from fats.<br><br>What can you do to help your body have enough energy to keep going? Well, let me show you in this model.<br><br>  <br><br><br>Drinking milk after an intense workout helps the body restore its fuel sources. After the nutrients in milk are digested and absorbed, glucose arrives in the bloodstream. There it can enter the liver hepatocytes and the muscle myocytes, which allows the liver and muscle glycogen stores to be replenished. This way, an athlete has a supply of |

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| | | | glycogen that is available for their next intense workout to be made into ATP. |
| **How to Achieve This Level** | Student completes 0-1 out of 5 Look Fors | Student completes 2-3 out of 5 Look Fors | Student completes 5 out of 5 Look Fors |

| **Part 2 Look Fors** | **Prompts to Support Students in Improving on Look Fors** |
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| Include multiple methods of communication, including models and evidence from the module (video plus graphics/diagrams, written report plus graphics/diagrams, or video with narration of a slideshow) (INFO-H5).<br>● You can use the class consensus model, data sets, and/or models from any other resources from the module. | What specific evidence from the module did you choose to include in your presentation? |
| Clearly communicate scientific information in a way that is appropriate for your chosen audience (INFO-H5). | Ask students to compare their presentation language to the scientific explanations they wrote in the module and reflect on how they modified the language to be appropriate to their chosen audience. What terms and ideas did they simplify? Which did they make more complex? What would their chosen audience prefer? |
| Describe how the energy for exercise comes from aerobic and anaerobic respiration and how this energy is expended during exercise and recovered with milk (LS2.B-H1). | How did you describe where people get the cellular energy that is used in exercise? How is that cellular energy replenished with milk? |
| Describe how the function of multiple kinds of specialized cells contributes to the processes of cellular respiration and anaerobic respiration (LS1.A-H1). | Identify at least three different kinds of specialized cells from the module resources and incorporate those into your presentation. |
| Describe how much of the study of exercise and recovery involves tracking how various molecular factors in the body change or remain stable (SC-H1). | In what ways did you include a reflection on stability and change in your response? |

**To Support Students in Revising Their Tasks Based on Peer or Teacher Feedback**

- Prior to submitting their work, hold a peer-feedback session using a protocol such as Tell-Ask-Give or with norms such as SPARK. Alternatively, students can utilize the peer feedback form. Students can use this feedback to revise their presentations in this lesson, in the next module, and/or in the final unit performance task.
- After submitting their work and receiving feedback and a grade, hold a session for students to norm on the features of high-quality work. Choose three samples of student work (one Emerging, one Developing, and one Proficient), anonymize them, and distribute them to students. Ask students to analyze the three samples of work and annotate what features of the work are high-quality examples of the Look Fors and what features are not. Share out the features of high-quality work that students identified and ask them to point to specific examples in the work samples. Build a class list of features of high-quality work. Then, allow students time to revise their work based on the list they generated and resubmit it for a revised grade.