**Unit Essential Question:** *How does energy and matter flow within natural and designed ecosystems?*

You will be creating a sustainable aquaponics system that mimics the properties of a river environment. After each task, you will return to the table below to organize what you learn as you go through the unit. By the end of the five tasks, you will have all this information to use for your culminating project. For each activity, be sure to include answers to **ALL** the questions provided.

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| **Lift-Off Task:**  Changing Rivers | What did you see in the pictures that you might also want to include in your aquaponics system (garden and tank)? |
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| **Task 1:**  Types of Changes | Now that you understand physical and chemical changes on the molecular level, identify one physical change and one chemical change that you anticipate may occur in your aquaponics system.   * Draw a before and after picture of your aquaponics system for each change and write a caption explaining each.   + Use data from this task, or research the properties of your own environmental change, to explain how you know what type of change it is. * For each change, decide if it represents a threat to your aquaponics system. If it is a threat, describe a potential solution to prevent it. |
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| **Task 2:**  Matter Moves You | Identify or add an organism to your aquaponics system that does cellular respiration.   * Identify what molecules the organism requires for cellular respiration. How will your system provide these molecules? * Identify what molecules the organism will create through this process. How will your system use up the products that it creates? * Draw a picture of your organism and the molecules identified. Use arrows to show which molecules enter or leave the organism. |
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| **Task 3:** Cycling Matter Through Living Things | Identify or add an organism to your aquaponics system that does photosynthesis.   * Identify what molecules it will need to have in order to do photosynthesis. How will your system provide what the organism needs? * Identify what molecules it will create through this process. How will the system use up the products that it creates? * Draw a picture of your organism and the molecules identified, using arrows to show whether the molecules enter or leave the organism. * Make connections to the organism you chose after Task 2: How do the plant and animal work together to cycle matter and keep energy flowing through the system? |
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| **Task 4:**  Cycling Matter Through Rocks | Look back at the design sketch for your aquaponics system from Task 1:   * How might cycling of matter come into play in your aquaponics system? * Describe which process(es) of the rock cycle might occur in your aquaponics system over time. * What will the effects be on your system? |
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| **Task 5:**  Design a Thermal Device | Now that you have designed a heat-regulation device to help maintain river water temperature, you can use this knowledge to design your own heat-regulation devices that will work to maintain the temperature of your aquaponics fish tank.   * Draw the final heat-regulation device.   + Label the materials used and explain how it works. * Describe how you combined best characteristics of different designs to create a device that best meets the criteria and constraints.   + Cite the data that supported your decisions. |
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