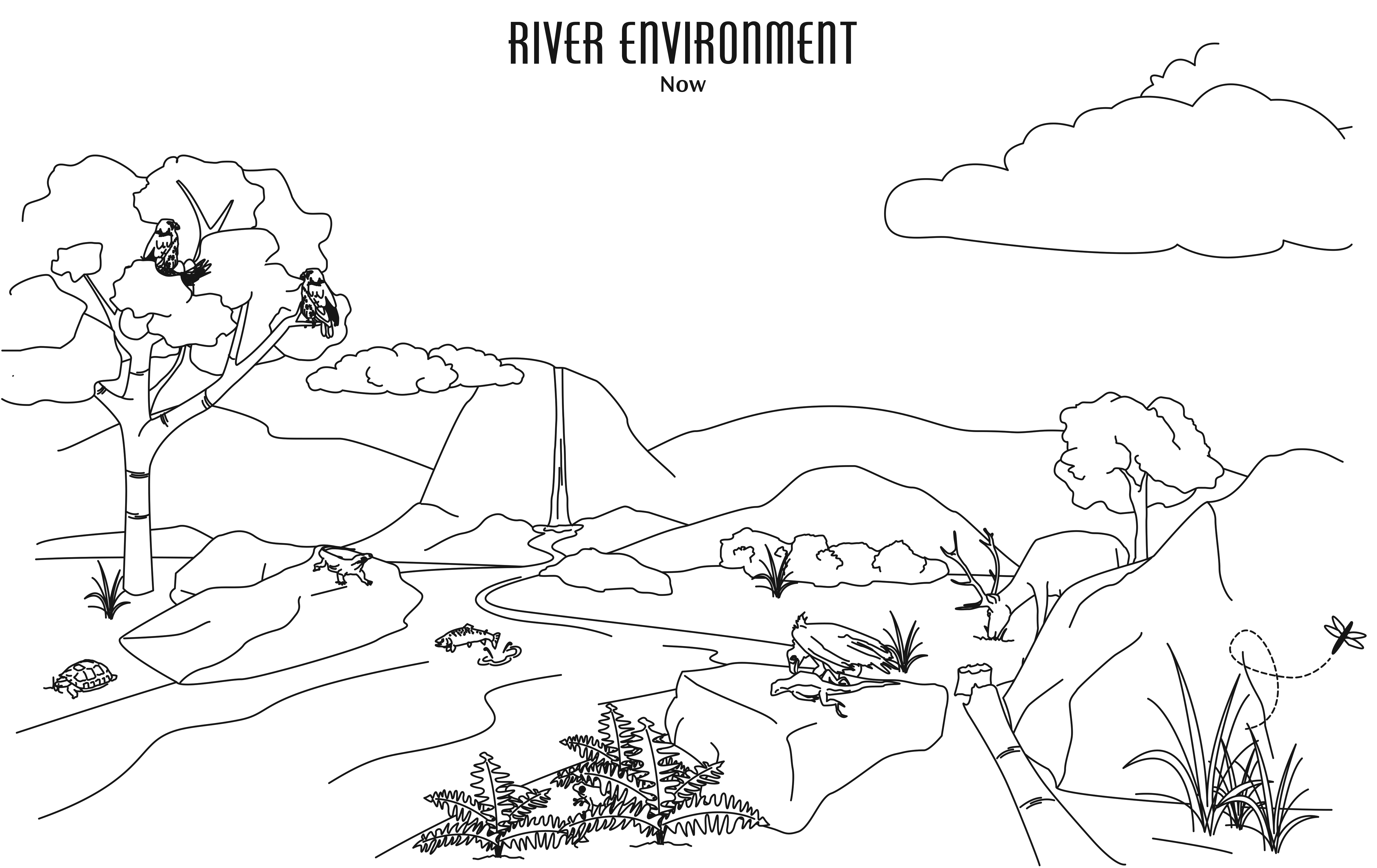
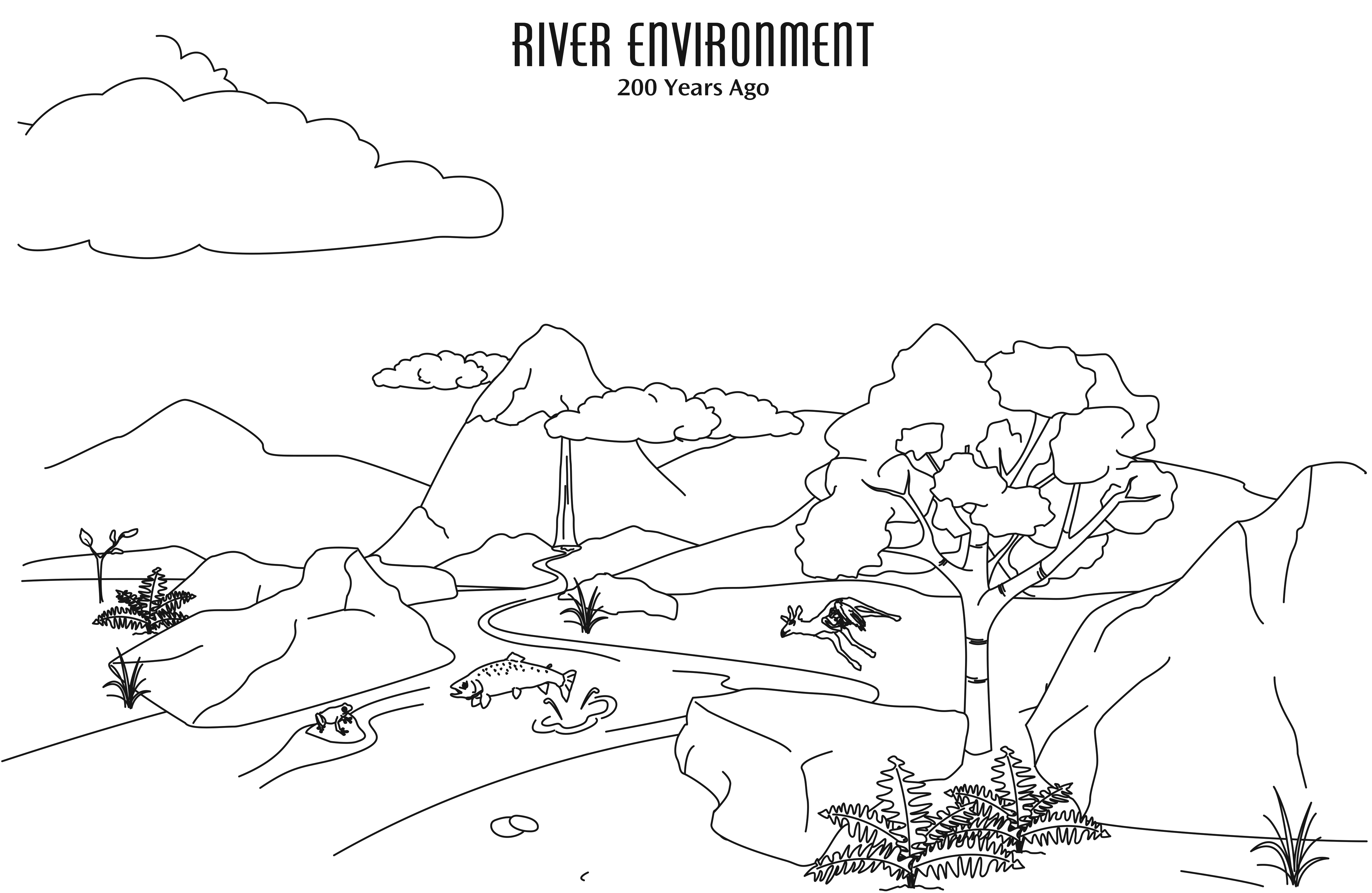
**Unit Essential Question:** *How does energy and matter flow within natural and designed ecosystems?*

**Engage**

Through previous tasks, you have recorded all the different changes you observed in the river environment over time. You may remember that some off these changes involved plants and animals of different sizes. Why do you think this is the case?



**Energy and Matter**: With a partner, discuss the following questions:

1. What do you think causes animals to grow and make energy?
2. What do you think causes plants to grow and make energy?

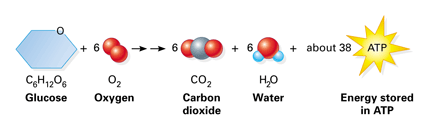
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**Explore**

In order to figure out what animals and plants need to survive and grow, and how these organisms must interact with their environments to get what they need, let’s conduct some investigations!

**Investigation 1**:

****In the last task, you modeled an important chemical reaction in ecosystems—cellular respiration. With your group, do a short investigation to provide evidence that this chemical reaction occurs in organisms! First, recall the chemical equation for cellular respiration, which is shown below:



Procedure

1. Retrieve a straw and a small beaker of Bromothymol Blue (BTB) solution.
   * Bromothymol Blue (BTB) is an indicator, meaning it “indicates” when a specific substance is present by changing color.
2. One group member: place the straw into the BTB solution and blow softly for as long as possible until you see a color change. DO NOT SUCK IN ON THE STRAW.
3. Record data below:

|  |  |
| --- | --- |
| Original Color | Color After Exhaling |
|  |  |

Data Analysis

1. Based on your prior knowledge and the chemical reaction for cellular respiration, what substance do you think Bromothymol Blue (BTB) indicates is present in the solution after you blow into it?

**Investigation 2**

If you hypothesized that Bromothymol Blue (BTB) is an indicator for carbon dioxide, you were correct! Bromothymol Blue turns yellow when carbon dioxide is present and returns to blue when carbon dioxide is removed. Let’s use this same indicator to investigate another essential process for ecosystems that happens in plants.

As a group, follow the procedure on the investigation card provided by your teacher to set up your experiment. Record your observations immediately after setting up your investigation, and again after 24 hours. Draw your observations in the table below, and be sure to include labeled and colored sketches.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Light** | | **Dark** | |
| **Before** | Observations | Sketch | Observations | Sketch |
| Predict color of the BTB solution after 24 hours: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | Predict color of the BTB solution after 24 hours: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
| **After** | Observations | Sketch | Observations | Sketch |

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

**Explain**

**Energy and Matter:** In Investigation 1, you were familiar with the chemical reaction happening—cellular respiration. But what was happening in Investigation 2? Individually, read and annotate the article below to learn more about another essential process in ecosystems—photosynthesis.

|  |
| --- |
| As you learned in the last task, all living organisms do **cellular respiration** to convert the food they eat into the energy they need. In Investigation 1, you saw evidence of one byproduct of cellular respiration. Circle the substance that made your BTB solution turn yellow in the chemical reaction below:  https://lh5.googleusercontent.com/b5iwsx5XsAC-sizQTflOTvjkRCGPJBB4iEwtd-JANIyHnygFqKe3Ezjgw-uPQHfxAHyEj-WpRL3oL1ad9ZrOIkavuIWYVjSJhlmdyy-RHGuvrBD7cOo5xSYhomi8JDMi034YVYcV  Plants, like other living organisms, do cellular respiration, but they also conduct another important chemical reaction for ecosystems, called **photosynthesis**. During photosynthesis, plants use energy from the sun, as well as atoms from water and carbon dioxide, to build a molecule called glucose, releasing oxygen in the process. This creation of glucose is what allows plants to grow! The photosynthesis chemical reaction looks like this:    Glucose stores the energy that was originally from the sun in chemical bonds until it is needed. To access this energy, plants break down glucose through the process of cellular respiration…just like animals do! The only difference is that animals have to eat food to get the glucose first. |

In pairs, complete the lab conclusions questions below:

1. **Constructing Explanations**: Based on what you have learned from the article, explain what happened in the second investigation:
2. **Developing and Using Models:** To better support your explanation, draw models of each experimental set-up to show the cycling of matter and flow of energy through the Elodea plant.

* Use arrows and labels to show all parts of each experiment, including the relevant molecules involved in each setting (CO2, H20, and O2).

|  |  |
| --- | --- |
| Elodea in the light | Elodea in the dark |
|  |  |

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

**Elaborate**

You just used what you learned from an experiment and an article to draw a model of photosynthesis, which is a very important reaction in ecosystems. However, we also know that cellular respiration is very important! How do you think photosynthesis and cellular respiration work together to make ecosystems function properly? Imagine you added a fish to your Elodea experimental set-up and placed it in the light. Individually, respond to the following questions:

1. What color do you think the solution would be after 24 hours? Why?
2. **Developing and Using Models:** Draw a new model that shows a fish and Elodea plant in BTB solution, placed in light. Use arrows and labels to show how energy and molecules cycle into and out of these organisms.

|  |
| --- |
|  |

* 1. How does this model show how cellular respiration and photosynthesis work together to keep matter cycling through an ecosystem?
  2. How does this model show how cellular respiration and photosynthesis work together to keep energy flowing through an ecosystem?

1. **Energy and Matter**: What energy, or energy source, do you think drives this whole system? If you left it out of your model, add it now!

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

**Evaluate: Connecting to the Culminating Project**

You have been asked to create a sustainable aquaponics system that mimics the properties of the river environment, including any chemical reactions that may occur. 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?

This should be individually completed in your Project Organizer.

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

**Reflection**

Individually reflect on Task 3, using the questions provided:

1. At the beginning of this task, you were asked to use your prior knowledge to explain why you think plants and animals grow over time. Look back at your explanations: after exploring photosynthesis and cellular respiration today, how would you change or add to your explanations? Use evidence from the task to justify your changes or additions and record below.
2. In this task, we focused on the crosscutting concept of:

* **Energy and Matter**: The transfer of energy can be tracked as it flows through a system, is conserved, and drives the cycling of matter.

Where did you see examples of **Energy and Matter** in this task?

1. Now that you have learned more about how cellular respiration and photosynthesis cycle matter and energy amongst living things in an ecosystem, what questions do you still have?