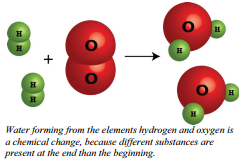
**Unit Essential Question:** *How does energy and matter flow within natural and designed ecosystems?*

**Engage**

In Task 1, you investigated different types of changes that happen in an environment—both physical and chemical changes. When a chemical change, or chemical reaction happens, the initial molecules form new molecules, but we can’t see this happening! In this task, you will explore different chemical reactions and develop a model to show what happens when an important chemical reaction in ecosystems occurs.

Remember this model of a chemical reaction from Task 1?



With a partner, analyze the model by responding to the questions below:

1. How do the molecules on the left side of the arrow differ from the molecules on the right side of the arrow?
2. Do you notice any similarities between the left side of the arrow and the right side of the arrow?

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**Explore**

Let’s investigate chemical reactions with a familiar example—a burning candle. When a candle burns, the methane gas from the melted candle wax is reacting with the oxygen in the air. This results in a flame, carbon dioxide, and water. Watch as your teacher covers the candle with a jar and record your observations below:

In order to figure out the mystery of the extinguished candle, we need to better understand the chemical reaction occurring. This means looking at a chemical equation!



**CH4  + 2O2  CO2 + 2H2O**

**Developing and Using Models:** As a group, count the atoms on the left side of the arrow and record in the table below. Then count the atoms on the right side of the arrow and record in the table below.

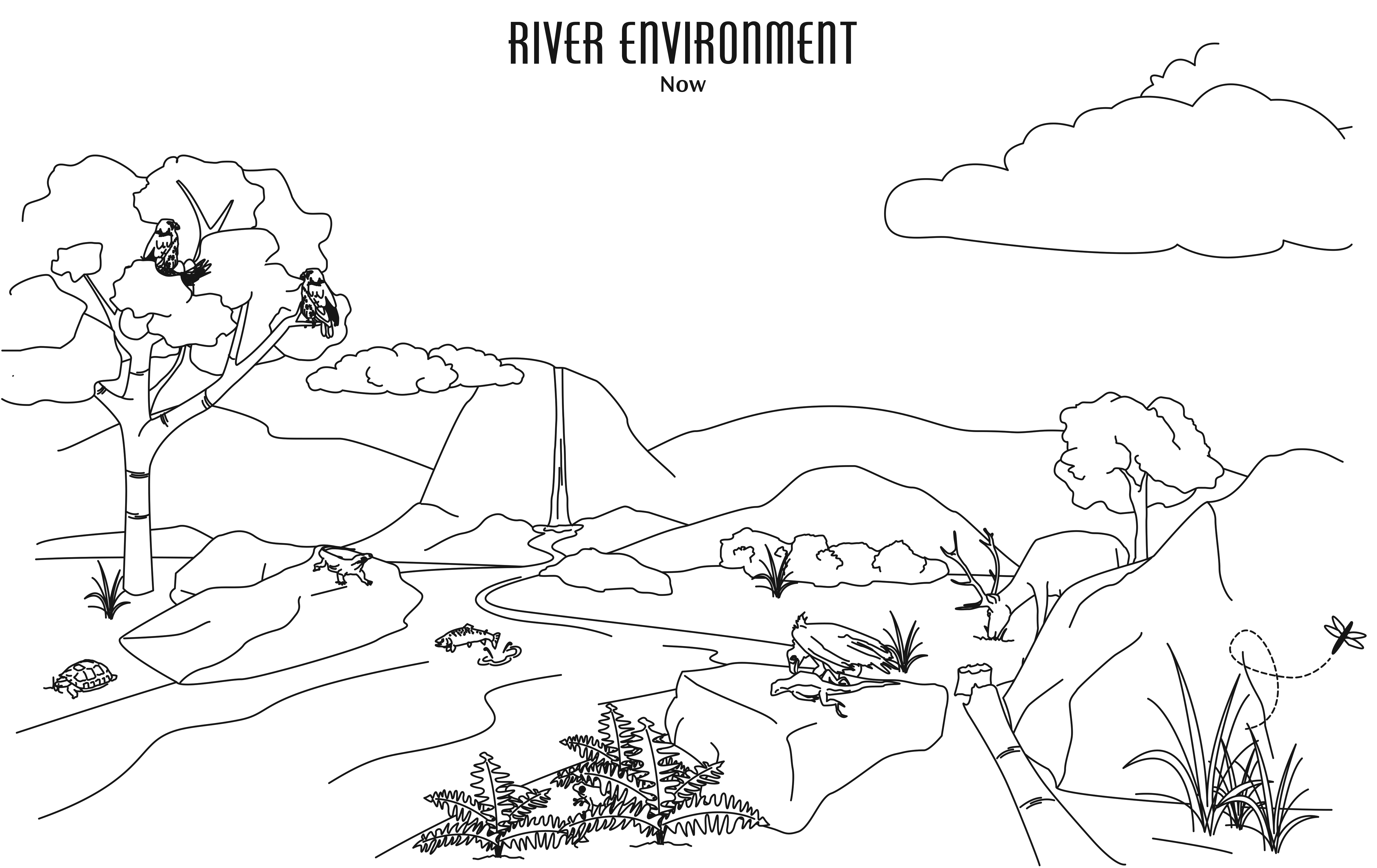
|  |  |  |
| --- | --- | --- |
|  | **Left Side** | **Right Side** |
| **Carbon (C)** | 1 | 1 |
| **Hydrogen (H)** |  |  |
| **Oxygen (O)** |  |  |

**Energy and Matter**: Can you now explain the mystery of the extinguished candle? With a partner, discuss:Why do you think the flame went out when the jar was put over the candle? (Hint: what molecule on the left did we take away by placing the jar on top?)

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

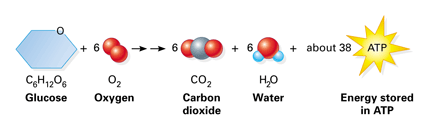
**Explain**

Now that we better understand how chemical reactions work, let’s apply it to one we see in our river environment. In the present-day river environment, you may have noticed a fully-grown deer.

Discuss with a partner: What do all animals need in order to grow and do their daily activities?

Animals, like deer, eat food to grow and get the energy they need. However, food needs to first be broken down into a form of energy that animals can use! This requires a chemical reaction known as cellular respiration.

Below is the chemical reaction for cellular respiration: Glucose is the sugar in the food we eat. ATP is the type of energy made and used by our body to do its many jobs.



1. **Developing and Using Models**: As a group, use the “Atom Pieces” and scale provided to develop a physical model of the cellular respiration chemical reaction above.
   1. Pick one color for each type of atom and record below:

|  |  |
| --- | --- |
| **Atom** | **Color** |
| Carbon |  |
| Hydrogen |  |
| Oxygen |  |

* 1. **Energy and Matter:** Place the atoms for the left side of the equation on the left side of the scale. Place the atoms for the right side of the equation on the right side of the scale. Observe what happens.

1. Individually, make a drawing of the model you just built with the scale and “Atom Pieces”, using pictures, arrows, and labels. Then write a paragraph to explain it. Be sure to include the following in your drawing and/or explanation:
   * All the molecules involved in cellular respiration
   * The number and types of atoms before and after the reaction
   * How matter is rearranged during the reaction
   * Energy created by the reaction
   * A comparison of mass before and after the reaction (Draw the scale!)

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| --- |
| Cellular Respiration Model (Visual Diagram) |
| Written Explanation of Cellular Respiration Model |

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

**Elaborate**

To help you refine your cellular respiration model and explanation, use the Stronger Clearer protocol to gather feedback from your peers.

1. **Individual Think Time:** Fold your last page in half so that you cannot see your explanation. Take a minute to think about how you will explain your model to a partner.
2. **Partner Discussion 1:** You will work in pairs with another student in a different group. One of you will be Student A and the other Student B. Student A will start first:

* **Student A:** Without reading your explanation, describe your model using as many of the scientific concepts as you can remember.
* **Student B:** Listen and ask clarifying questions. Ask questions to help Student A explain cellular respiration. For example, you might ask, “How does your model compare the reactants and the products of cellular respiration?” or “In your model, do you have all the relevant molecules?”
* **Both Student A and Student B:** Write down any notes, thoughts, or questions that came up in this discussion.

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Now switch roles and repeat the steps above.

1. **Partner Discussion 2:**  Repeat the partnering process with another student. Remember to try to clarify your explanation in order to strengthen your model. Write down new notes, insights, and questions.

|  |
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1. **Partner Discussion 3:** Repeat the partnering process with another student. Remember to try to clarify your explanation in order to strengthen your model. Write down new notes, insights, and questions.

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1. **Revision**: After you have worked with partners to clarify your model and explanation, review your notes. Then revise both your model and explanation based on what you learned from your partners.

**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 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.

This should be completed individually in your Project Organizer.

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

**Reflection**

1. At the beginning of this task, you were asked to analyze a model of a chemical equation and compare the two sides of the equation. Look back at your comparisons: after exploring chemical reactions today, how would you change or add to your comparisons? 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**: Matter is conserved because atoms are conserved.

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

1. Now that you have learned about another important chemical reaction in environments—cellular respiration—and how matter is conserved in these types of reactions, what questions do you still have?