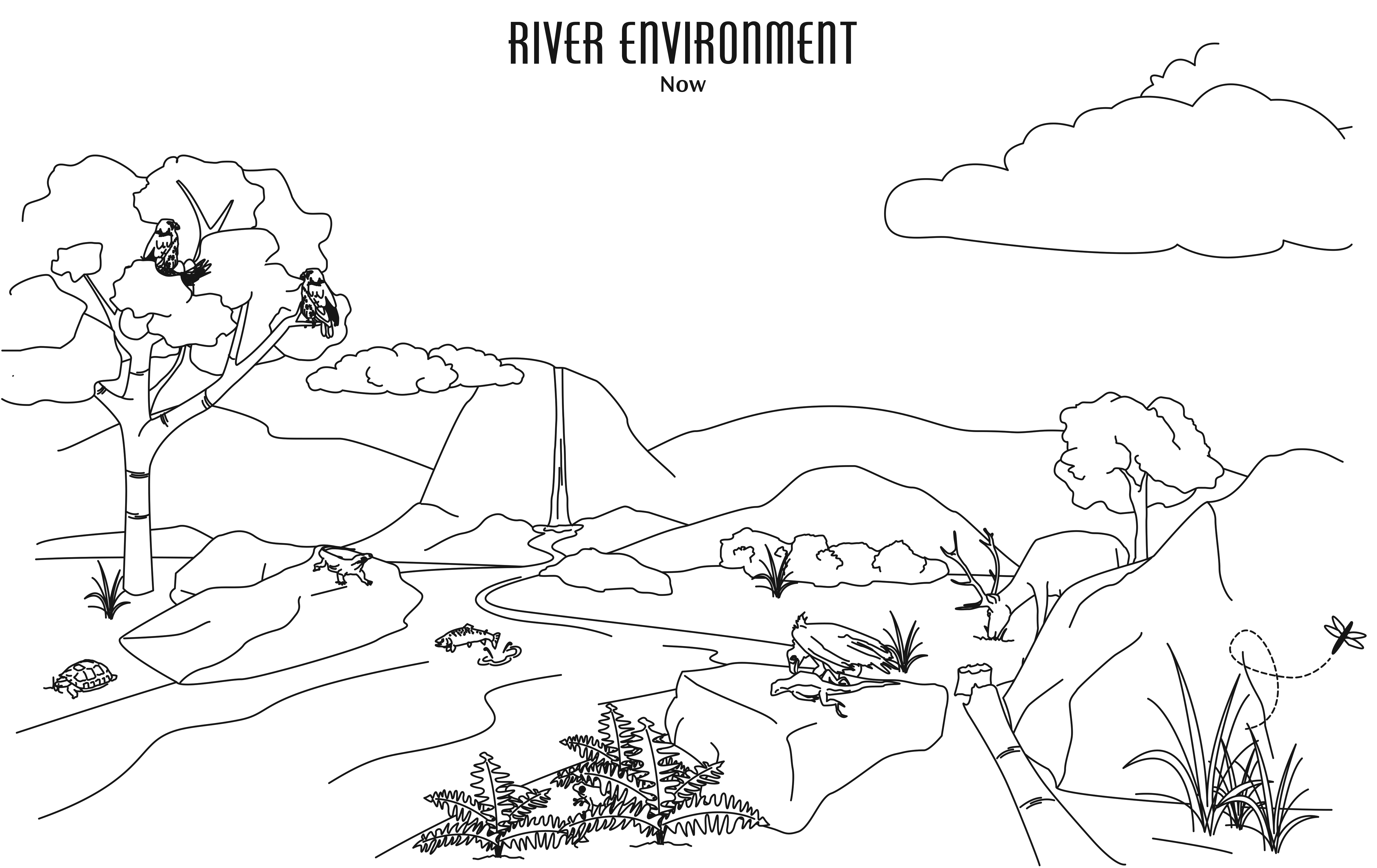
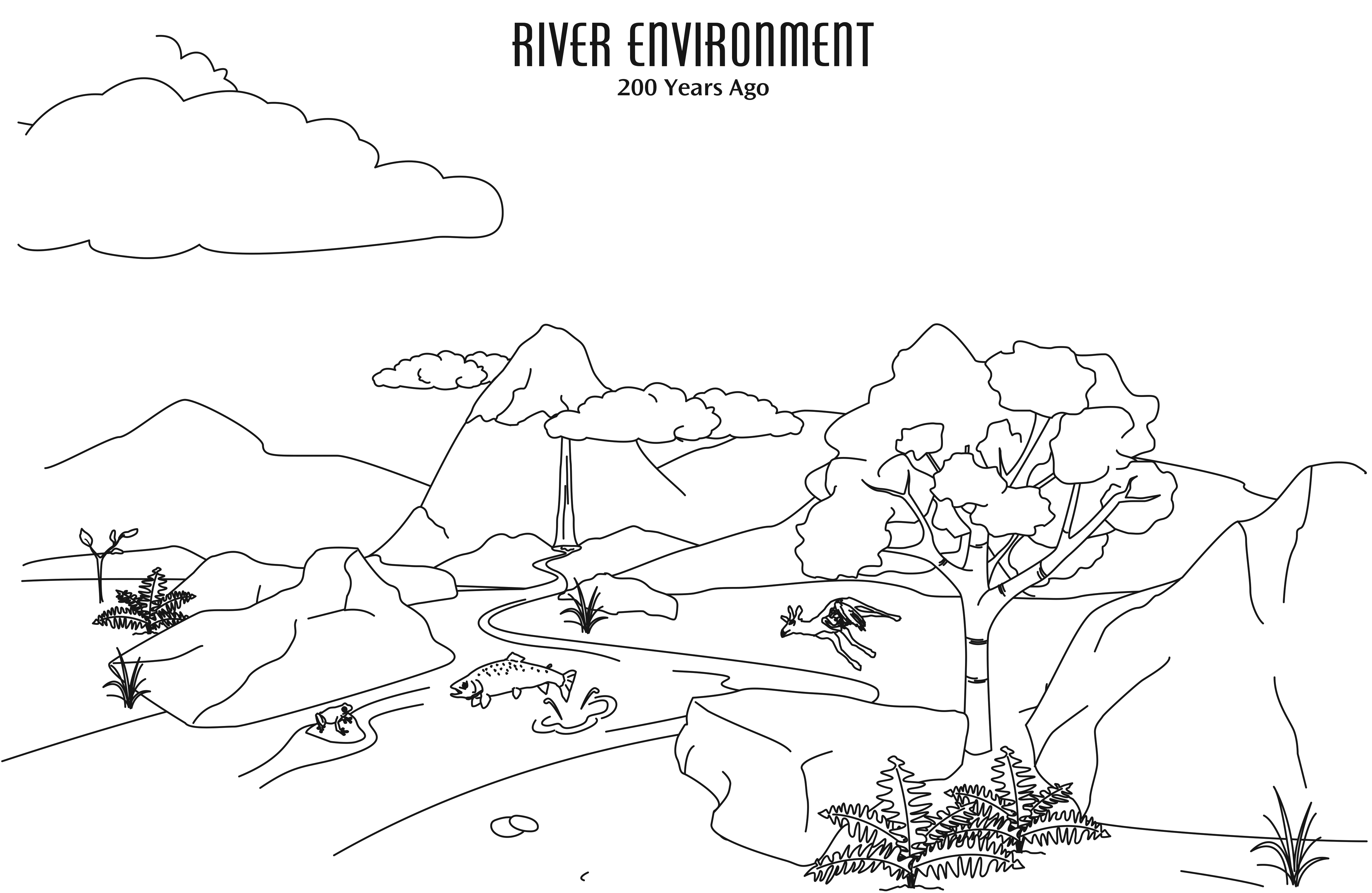
**Unit Essential Question:** *How does energy and matter flow within natural and designed ecosystems?*

**Engage**

In the Lift-Off Task, you likely observed many differences between the river environment 200 years ago and the river environment today. What processes are behind these differences? In this task, you will investigate the kinds of changes that happen in environments over time.



A river environment with diverse forms of living and nonliving matter. Source: Making Sense of Science Earth Systems course, courtesy of WestEd.

With a partner,

1. Make a list of all the differences you observe between the two images of the river environment.
2. Group the differences into similar types of changes and record those groupings below.

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**Explore**

As you saw in the river environment images, there are many different examples of changes that happen in environments over time. To investigate the processes involved in these changes, let’s look at the data for two common changes in environments: Plant growth and fog rising off water.

**Analyzing and Interpreting Data**: As a group, analyze the data tables below and respond to the questions that follow.

**Data Set 1 - Plant Growth:** Plants use energy from the sun to create their own food.

|  |  |  |  |
| --- | --- | --- | --- |
| Reactants  substances at beginning of reaction | | Products  substances at the end of the reaction | |
| Carbon Dioxide (in air)  (CO2) | Water (liquid)  (H2O) | Glucose (in plant)  (C6H12O6) | Oxygen (in air)  (O2) |
| Properties  density: 1.98 kg/m3  melting point: -56.6 C  boiling point: -78.5 C | Properties  density: 1 g/cm3  melting point: 0 C  boiling point: 100 C | Properties  density: 1.54 g/cm3  melting point: 146 C  boiling point: decomposes before boiling | Properties  density: 1.43 g/L  melting point: -218.8 C  boiling point: -183 C |

1. What are the reactants in this change?
   1. Where would you find each reactant in an environment?
2. What are the products in this change?
   1. Where would you find each product in an environment?
3. Compare the properties of the reactants to the properties of the products. How are they the same or different?

**Data Set 2 - Fog Rising Off Water:** Water evaporates from the pond’s surface and cools, condensing into a fog that looks like steam.

|  |  |
| --- | --- |
| Reactants  substances at beginning of reaction | Products  substances at the end of the reaction |
| Pond Water (liquid)  (H2O) | Fog - Water (gas)  (H2O) |
| Properties  density: 1 g/cm3  melting point: 0 C  boiling point: 100 C | Properties  density: 1 g/cm3  melting point: 0 C  boiling point: 100 C |

1. What are the reactants in this change?
   1. Where would you find each reactant in an environment?
2. What are the products in this change?
   1. Where would you find each product in an environment?
3. Compare the properties of the reactants to the properties of the products. How are they the same or different?

|  |
| --- |
| How does fog rising off water compare to plant growth? |

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

**Explain**

One of the changes you observed in the *Explore* is known as a physical change and the other change you observed is known as a chemical change. Take a look at the models below that show a physical change vs. a chemical change.

|  |  |
| --- | --- |
| **Physical Change** | **Chemical Change** |
| https://lh6.googleusercontent.com/Q6ceEtiVz1ejwi0zelmP1ifXiugEgRBfJsTqarHWUHDcnPtgV3CcrdMEJ48xQhUNuDKTCAFuCWnTKyyXBwRlUoM3PbvOA_UIEXi-57HTjV2DfmJAqGgYCGoib1exNdcNNZOfVYSK | Macintosh HD:Users:laurenstoll:Downloads:CK12 Screenshot 7-1-3.png |

With a partner, discuss and respond to the following questions:

1. Based on the models above, what seems to be the biggest difference between a physical and chemical change?
   1. Write your own definition for physical change.
   2. Write your own definition for chemical change.
2. **Patterns:** Look back at the data from the *Explore*.
   1. What difference(s) did you notice between Data Set 1 (Plant Growth) and Data Set 2 (Fog Rising From Water)?
   2. Which change do you think is a physical change? Explain why.
   3. Which change do you think is a chemical change? Explain why.
3. Now return to your lists from the *Engage* of the differences between the past and present images of the river environment. Which changes do you think may have been physical and which do you think may have been chemical? Fill out the chart below:

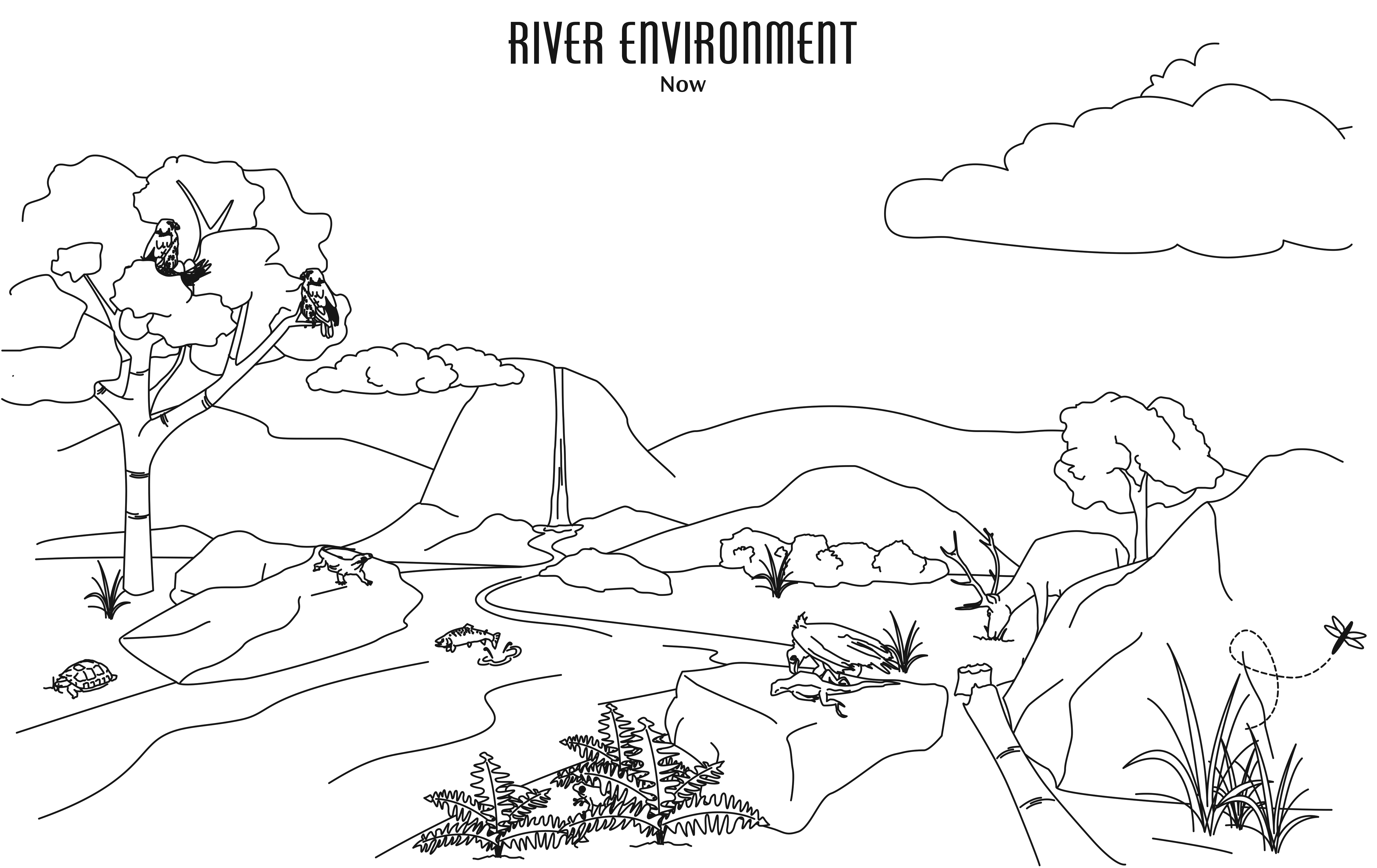
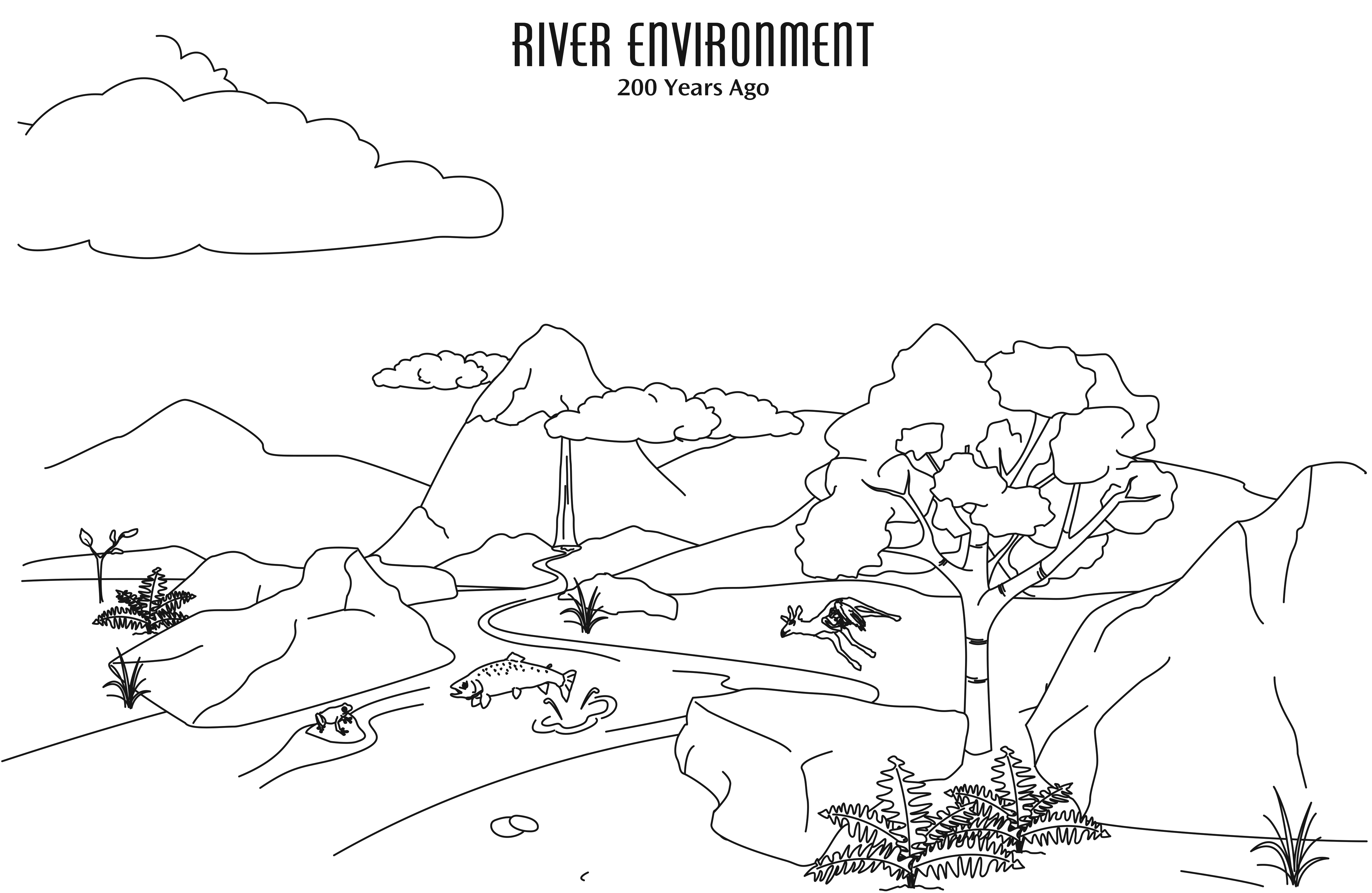
|  |  |
| --- | --- |
| Examples of Physical Changes | Examples of Chemical Changes |
|  |  |

* 1. Pick one example from each of the above columns and explain why you have categorized each as a physical or chemical change.

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

**Elaborate**

Return to the before and after pictures of the river environment. You may have noticed that there is a deceased deer in the first picture that is no longer present in the picture 200 years later. This is because the deer decomposed; in this process, fungi and bacteria break down dead organisms into smaller products.



For example, in every living organism, there are small molecules called amino acids. Decomposers break these molecules apart, releasing even smaller molecules like nitrogen into the soil. This is great because all plants need nitrogen to grow! However, it needs to be in a certain form. **Analyzing and Interpreting Data**: Take a look at one of the changes that occurs in this process and use your new knowledge to individually identify this type of change.

|  |  |  |  |
| --- | --- | --- | --- |
| Reactants  substances at beginning of reaction | | Products  substances at the end of the reaction | |
| Ammonia  (NH3) | Oxygen  (O2) | Hydroxylamine  (NH2OH) | Water (liquid)  (H2O) |
| Properties  density: 1.98 kg/m3  melting point: -56.6 C  boiling point: -78.5 C | Properties  density: 1.43 g/L  melting point: -218.8 C  boiling point: -183 C | Properties  density: 1.21 g/cm3  melting point: 33 C  boiling point: 58 C | Properties  density: 1 g/cm3  melting point: 0 C  boiling point: 100 C |

1. **Patterns:** Is this a physical or chemical change? Use information from the *Explain* and the data table above to explain your choice.

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

**Evaluate: Connecting to the Culminating Project**

You will be creating a sustainable aquaponics system that mimics the properties of the river environment, including any physical and chemical changes that may occur. 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.

This should be completed individually in your Project Organizer.

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

**Reflection**

Individually reflect on Task 1, using the questions provided:

1. At the beginning of this task, you were asked to group the types of changes you observed in the river environment. Look back at your groupings: are they similar to groupings of physical vs. chemical changes? Explain how they are similar or different.
2. In this task, we focused on the crosscutting concept of:
   * **Patterns**: Macroscopic patterns are related to microscopic structure.

Where did you see examples of **Patterns** in this task?

1. Now that you have learned more about two types of changes in environments, what questions do you still have?