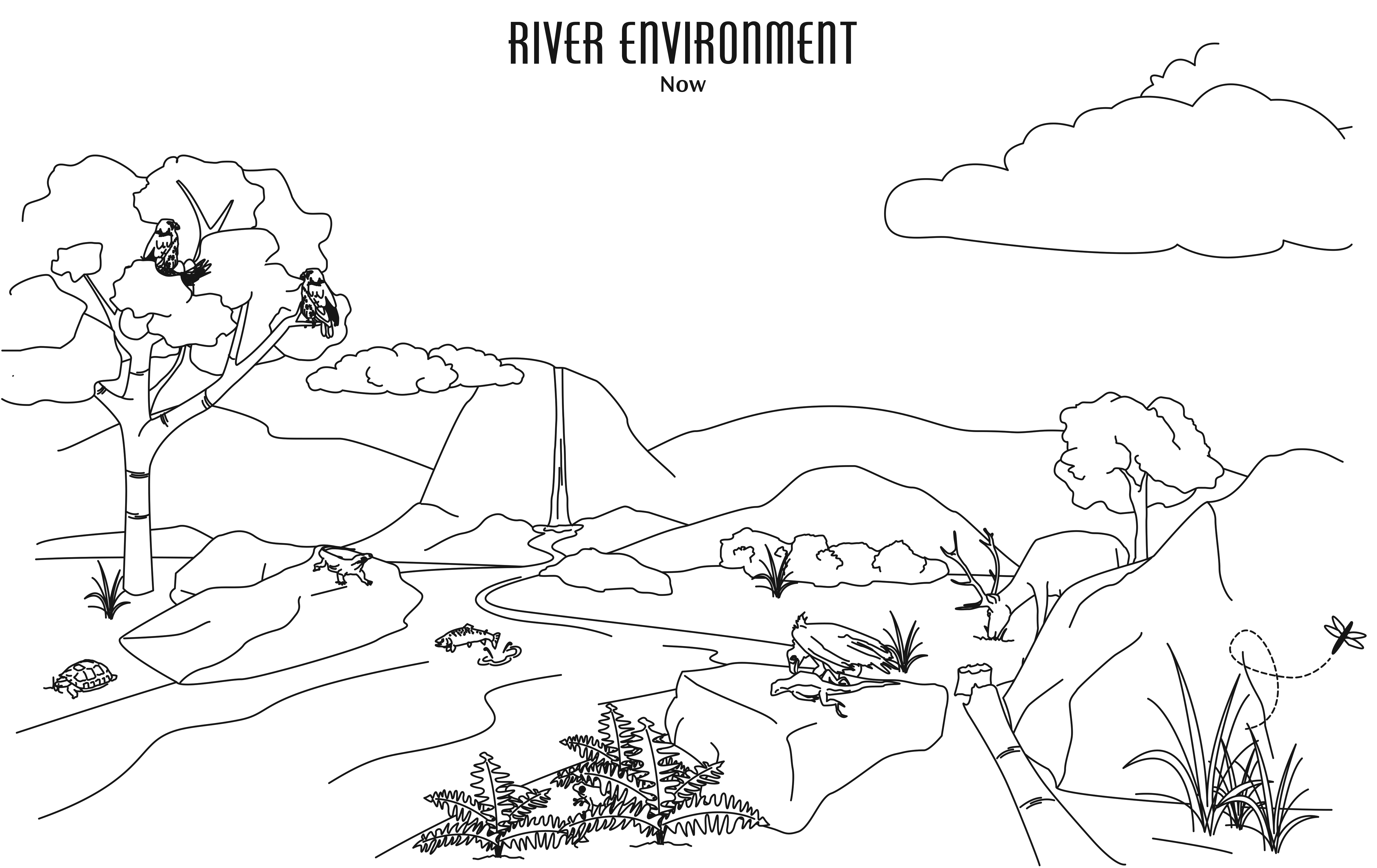
**Unit Essential Question:** *How does energy and matter flow within natural and designed ecosystems?*

**Engage**

Throughout this unit, you have seen that heat is either absorbed or released in the chemical reactions you have observed. Today we are going to use this knowledge to help address a problem that the river environment is facing today.

Blue catfish, as shown in the picture below, are very important to the river environment. However, in recent years the river environment has experienced climate change, leaving the river water a few degrees colder than normal. It turns out that colder water interferes with fish spawning, which only happens at a certain range in water temperature.



With a partner, hypothesize:

1. What happens if fish can’t spawn (lay eggs)?
2. What other “domino” effects might this have on the river environment?

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

**Explore**

Your job will be to design devices that can keep the river water warm enough for fish spawning. For inspiration, let’s think about how hot packs and cold packs work. Many instant hot packs and cold packs work by using chemical reactions that either absorb or release heat. Each of them uses different substances that when combined causes a chemical reaction to occur.

In groups, use the materials and Resource Card provided at your desk, and test each of the substances provided to decide which ones create chemical reactions that release heat and which ones create chemical reactions that absorb heat. You will be able to use this data in the design of your device!

|  |  |  |
| --- | --- | --- |
| **Substances Combined** | **Observations** | **Energy and Matter**:  Does this reaction release heat or absorb heat? |
| Calcium Chloride and Water |  |  |
| Sodium Bicarbonate and Water |  |  |
| Potassium Chloride and Water |  |  |
| Sodium Bicarbonate and Calcium Chloride and Water |  |  |
| Sodium Bicarbonate and Vinegar |  |  |

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

**Explain**

**Designing Solutions:** The Blue Catfish spawns in river water at 70-75 degrees Fahrenheit, but the pool where they spawn is currently at a temperature of 68 degrees Fahrenheit. Building on what you learned from the lab exploration, design a heat-regulation device as a group using the design questions below:

1. Before you begin designing your device, consider design criteria and constraints:
   1. **Criteria**: What does your device need to do? How will you measure its success?
   2. **Constraints**: How will you minimize the impact on the river environment? (Hint: you can’t just pour chemicals straight into the river).
2. **Analyzing and Interpreting Data**: Which combinations of substances from the Explore would work best for a device that meets the criteria you described above? Why?
3. **Developing and Using Models**: Pick one chemical reaction from your above list. Using the list of materials provided by your teacher, design and draw models of two different heat-regulation devices that use the same chemical reaction, but have a different structure or material. **Energy and Matter**: In your model, include labels to show inputs and outputs, and captions to describe how each device would work. You will build and test these in the next part of this task.

|  |  |
| --- | --- |
| Design Solution 1 | Design Solution 2 |
|  |  |

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

**Elaborate**

Now that you have used data from the *Explore* to design two potential heat-regulation devices, let’s test and revise them to create the best device possible! As a group, use the Design Card and materials provided to build and test your devices.

1. Remember that the Blue Catfish spawns in river water at 70-75 degrees Fahrenheit, but the pool where they spawn is currently at a temperature of 68 degrees Fahrenheit. Use this information to test your two devices.
   1. Draw your experimental setup below, including labels that show all the materials used.
   2. Describe how you will run your experiment.
2. Run your experiment and collect data in the table below:

|  |  |  |
| --- | --- | --- |
|  | **Temperature at Start** | **Temperature at End** |
| **Design Solution 1** |  |  |
| **Design Solution 2** |  |  |

1. **Analyzing and Interpreting Data**: Which device worked better to meet the criteria of the problem? How do you know? Cite relevant data.
2. **Analyzing and Interpreting Data**: Other groups tested different materials, chemical reactions, and structures. You can learn from others’ data to modify your own device. As other groups share, record features about designs you like, including the data to support them, in the space below:
3. Using what you learned from other groups’ data, revise your device to combine best characteristics of designs you’ve seen. For your device that worked better, what adjustments can you make (types of materials, amount of substances used, structure of the device, etc.) so your device best meets the criteria and constraints of the problem? Draw a labeled model of your revised device below.
   1. Build and test your revised device to make sure it works. Record data below:
   2. If you could redesign your device again, what improvements would you make and why?

**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 and regulates the temperature of the fish tank. 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 device that will work to maintain the temperature of your aquaponics fish tank.

* Draw your 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.

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 5, using the questions provided:

1. At the beginning of this task, you were asked to consider the effects if fish can’t spawn in the river environment. After designing a heat-regulation device today, how will these effects be reduced? Use evidence from the task to back up your explanation.
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 we can use chemical reactions to regulate temperature, what questions do you still have?