

Mahope O Ke Kula Ke A'o Mau Ana Program

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Birth Date: \_\_\_\_\_

School: \_\_\_\_\_

Zip Code: \_\_\_\_\_

## In the Heat of the Moment

### Lesson 1. So What is "Living"?

#### Discuss

Discuss the questions below with those around you. Use your own knowledge and the thoughts of those around you to form an answer. After forming your thoughts, you will discuss them as a whole class and see if there are any new details you picked up on.

**Do all living organisms move in some way, shape, or form?**

**If so, what enables them to move and is it the same for every living organism?**

## Lesson 2. Do Plants Have Brains?

By now, you've probably made the connection that living organisms move. However, all living organisms do not use the same means to move. For example, a person is able to run because their brain is sending different signals throughout their body. So...what about plants? First, we know that they can move. A good example of this phenomenon is the Venus flytrap. It is known for trapping unsuspecting insects and eventually digesting them. This is a movement that takes place quickly and right before our eyes. A lesser-known fact about the Venus flytrap is that it also has the ability to count. Opening and closing the flytrap takes a great amount of the plant's energy, so this only occurs a small number of times in its lifetime. Because of this, the plant wants to make absolutely sure that there is an insect to capture when it closes. When something lands inside of the flytrap and brushes against its tiny hairs, it begins a twenty-second countdown. If the plant detects another movement within the next twenty seconds, it will close and begin the digestion process. All of this movement and activity takes place without a brain. How is this possible? As it turns out, plants use their nervous system to send signals throughout their body. In the case of the Venus flytrap, a surge of energy is sent from the hairs to the other parts of the plant to tell it that prey has been detected. After this surge of energy, the plant begins the countdown. While the plant does not count in the same manner a human would, it does keep track of the time that passes between the first sensation it detects and those that follow. This ensures that the plant does not waste any of the energy needed to close, digest the trapped prey, and open up again.

### Respond to Reading

#### Directions

Respond to the questions below. Underline and identify specific lines from the passage that support your claim.

How do Venus flytraps use and conserve energy?

What are some examples of the Venus flytrap movement?

### Lesson 3. The Sun and Photosynthesis

Topic: The importance of heat in photosynthesis

Materials:

- Plant of choice - 2
- Planter Box
- Closet or dark space without access to light
- Planter with soil
- Ruler
- Scale

Procedure:

For this experiment, you will test the importance of the sun in the growth of plants. We have already established that plants are alive and have energy, but where does this energy come from and does the presence of sunlight influence this?

Using the plant of your choice, you will plant one in your outdoor planter box and another in a dark area without access to light. You will determine how long you will monitor the growth of these plants and what data you will collect. You will also be responsible for watering your indoor plant.

### Control Elements

Date/Time Planted: \_\_\_\_\_

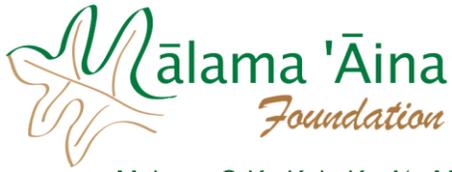
Type of Plant: \_\_\_\_\_ Moon Phase: \_\_\_\_\_

### Data

Length of testing period: \_\_\_\_\_ days

Type of data (including measurements): \_\_\_\_\_

ex. Weight (oz), Stem Length (inches), Leaf Size (cm)



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### Post-Experiment Reflection

Directions: Answer the reflection questions below. Explain your reasoning using the data you collected and the line graph you created.

Using the data you collected, explain some of the major differences between the two plants.

Which plant had the most successful growth and how did you determine this?

Consider the plant that was grown without access to sunlight. Did the lack of sunlight have a positive or negative impact on plant growth?

What are some of the limitations of your investigation? Did these limitations affect the results?

## Lesson 4. Heat and Photosynthesis

It is a well-known fact that plants require air, water, and sunshine to create their own food through photosynthesis. However, in order for plants to grow well, they also require the right amount of heat. When an environment is too cold, it will slow down a plant's life processes and the plant will eventually wither away. Some studies have found that very warm environments can potentially hinder photosynthesis. Plants that grow in very cold or very warm habitats have evolved to avoid this process. When a plant grows in the optimal temperature, it enhances transpiration and helps the plant to maintain its water content.

What are some examples of plants from very cold or very warm habitats that have evolved to survive harsh conditions?

The planter box with living soil also benefits from the right amount of heat. This is part of the reason why the planter box with the living soil needs to be placed in direct sunlight. The heat and light from the sun enhances plant growth and creates a beneficial environment for the microbes in the living soil. Increasing temperatures can increase enzyme activity. However, similar to the plants themselves, the living soil does not benefit from extreme conditions.

Which features of the planter box help it to maintain the proper temperature for the plants and living soil to thrive?

## Lesson 5. Thermal Energy

The total amount of energy in our universe today has remained consistent. The reason for this is that energy cannot be created nor destroyed. Energy can also change form and transfer between objects. A common example of energy transfer is thermal energy, which is related to temperature. When the temperature of a substance rises, the molecules in it move faster and gain thermal energy through heat transfer. There are three ways in which thermal energy transfers, conduction, convection, and radiation. **Conduction** describes when thermal energy is transferred between molecules that are in contact with each other. An example of this is heating a pan on the stove. **Convection** only occurs with liquids and gases. An example of this is a hot air balloon. The heated air in the balloon is less dense which causes the colder air to fall beneath it, this pushes the warm air upwards along with the balloon. **Radiation** is probably the most important, as it helps to sustain life on Earth. Radiation transfers heat through the vacuum of space. An example of this is the thermal energy the Earth receives from the Sun. The Sun transfers energy to the surface of the Earth in the form of electromagnetic waves. The visible light we see from Earth are considered waves of energy.

### Respond to Reading

#### Directions

Respond to the questions below. Underline and identify specific lines from the passage that support your claim.

Which method of thermal energy transfer (**conduction, convection, & radiation**) is used in the process of photosynthesis?

Is photosynthesis possible without thermal energy transfer? Explain your answer.

## Lesson 6. Stress and Heart Rate (Breathing Exercises/Stretching)

Think back to a moment where you had to give a presentation or perform in front of an audience. What did your heart feel like during those last moments of anticipation? Was it racing? If you have experienced this feeling before, it is a typical response to a nervous situation and it is usually harmless. However, constant stress can be detrimental to the body and cause long-term health effects. There are different strategies you can use when dealing with this type of stress, that will help to calm you, and keep your body healthy.

### Breathing

The **4-7-8 Breathing Technique** is used to help your body relax when stressed. It involves **breathing in through the nose for 4 counts, holding the breath for 7 counts, and exhaling through the mouth for 8 counts**. This breathing method has been useful for those suffering from anxiety and can help control emotional responses like anger.<sup>1</sup>

### Stretching

Stretching is another effective strategy that can be used for stress management. These stretches can be done while seated.<sup>2</sup>

#### Torso Stretch<sup>2</sup>

- Sit tall with feet flat on the floor, shoulder-width apart
- Place hands behind your head with elbows out to the side
  - Variation: You can also cross your arms over your body or leave them at your sides
- Bend your body to one side, bending at the wrist. Keep your head facing forward. Hold for 5 seconds.
- Return to the starting position. Repeat on the other side.
- Repeat 6-8 times on each side. Rest, then do a second set.

#### Neck Stretch<sup>2</sup>

- Sit tall, feet flat on the floor, shoulder-width apart
- Slowly turn your head to look over your shoulder. Keep your back against the chair and your shoulders facing forward. Hold the position for 10-30 seconds.
- Return to the starting position. Repeat on the other side.
- Repeat 6-8 times on each side. Rest, then do a second set.

<https://www.heart.org/en/health-topics/cardiac-rehab/getting-physically-active/stretching-and-flexibility-exercises>

<sup>1</sup> Gunderson Health

<sup>2</sup> American Heart Association

## Lesson 7. Mo'olelo - Maui and the Sun

On the Wailuku River, not far from Rainbow Falls, lived the half-god Maui. His mother, the goddess Hina, lived behind the falls in the Cave-of-Mists. In those times the days were short, but Maui found a way to lengthen them.

Maui was a young man of strength and courage. He had a magic club, a magic spear, and a magic canoe paddle, all given to him by his grandmother. In addition to these, he had special powers because he was the son of a goddess. He was very fond of his mother, Hina, and visited her nearly every day; for his stepfather, Aikanaka-the-Wanderer, was often away from home.

The goddess Hina was known throughout the islands for her beauty and for the fine bark cloth she made. From the time Sun came through the eastern gate until he went through the western gate, Hina worked at her tapa. She gathered the bark herself from the mulberry trees. She brought sea water in which to soak it. She pounded the wet bark on her tapa log.

One time when Maui was watching her, he said, "You spend all your days making tapa." Hina laid aside her wooden beater, smiling in a sad way. "For those who make tapa, the day is never long enough. This piece is ready to dry but already Sun turns toward the west. My tapa will still be damp when Evening Star hangs in the sky."

"This is Sun's fault. He travels too swiftly. I shall find him and tell him so!"

"O Maui, Sun is a god."

"We are gods, too." Maui said.

"But small ones, with small power. And you are but a half-god," his mother reminded him. "Sun has great powers. No one has ever gone close to him and lived

"Then I shall be the first!" Maui boasted. "I shall catch Sun and make him promise to go more slowly."

Hina warned, "Take your magic club and paddle. You will surely need all the power you have."

What problem is Hina experiencing and what is Maui's solution?

First, Maui made snares. He gathered coconut fiber and twisted eight strong cords. At the end of each he tied a noose. Then, as Evening Star appeared in the sky, he coiled his snares in his canoe, laid his magic club beside them, and picked up his magic paddle. One stroke carried him down the river, a second stroke to the island where Sun made his home in the crater of a dead volcano.

Maui left his canoe, took his eight snares and his magic club, and started up to House-of-Sun. Swiftly he climbed up the grassy slope. Slowly he climbed the steep side of the volcano. At the top, in the crater, Sun lay fast asleep under a blanket of clouds. Silently, Maui laid his snares. Then he hid behind a lava rock and slept through the night.

Before daybreak, Maui woke. Clouds were just beginning to roll out of the crater. Soon over its rim came Sun's longest leg, his first glittering ray of sunrise. Down the slope it came and into the center of Maui's snare it stepped. Maui drew the cord tight and fastened it to the rock.

"What is this?" roared Sun.

"You are my prisoner," said Maui.

"Let me go at once!" Sun commanded. "I have a long journey to make."

"You will journey nowhere until you promise to travel more slowly," said Maui.

"I go swiftly so might night's rest will be longer. Why should I promise such a thing?" Sun demanded.

Maui picked up his magic club before he answered. "Because my mother Hina needs more time to dry her tapas."

"Tapas! I have no time for such things!"

Maui said no more. He swung his magic club against Sun's longest leg, breaking off a piece. Sun screamed in pain and anger. He scrambled to get three more legs over the rim of the crater. But Maui laid his snares wisely and each leg was caught fast. Sun thrashed about, blowing his fiery breath. Maui backed off and tied the three cords fast.

How did Maui capture the sun? What did he use?

Four legs crawled over the crater's rim. Four more legs were caught. Now Sun was frightened. The more he struggled, the tighter the nooses became. One leg was broken and seven more tied fast. He began to bluster.

"You dare not kill me! Without my light, plants and trees would die! Without plants, your people will die!"

Maui looked up from the cord he was tying. "Sun, let us bargain. Promise to travel more slowly for part of the time and I shall let you go."

"Ae. I promise," said Sun crossly.

With his magic club, Maui broke the cords. Sun hurried off across the sky, and Maui paddled back with the good news for Hina.

After that, for part of each year, Sun traveled at his usual speed. Days were short and darkness came early. But the rest of the year, Sun traveled more slowly. Then the days were long and filled with sunshine, and Hina was able to dry her tapas.

Sun kept his promise. If there were times when he wanted to hurry, his broken ray reminded him of the strength and courage of the young half-god, Maui.

In which season do you think the sun "travels slowly"? What do you think the weather is like? Do you think this would be a good time for planting? Explain why or why not.

### **Lesson 8. Reflection**

Considering what you learned in this unit what can we gather about the sun's role in photosynthesis? How can this be applied to growing plants?