SCIENCE·3D

RAINFOREST LIFE

In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **STEM Project**, students will explore gravity and balanced and unbalanced forces in the rainforest. They will use this knowledge to create their own designs for getting equipment into the rainforest canopy.

They will use the animals of the rainforest to learn about balanced and unbalanced forces, and use their math skills to predict what will happen in certain situations. This activity is best completed in group settings. Have students work together in groups are as a whole class to choose the correct answers.

Activity 1: Gravity

A force is a push or a pull. Forces are very important to animals in the rainforest. They are also important to scientists.

Gravity is one of the most important forces. Gravity is the force that pulls objects toward the Earth. To fly, animals need to create more force to lift into the air than the force of gravity pulling them down.

Two forces working on an object can be unbalanced or balanced. If one force is stronger than another force, then they are **unbalanced forces**. The object will move in the direction the stronger force is pushing or pulling it. If the forces are the same strength, then they are **balanced forces** and the object will not move.

Let's apply some math. If forces are working in opposite directions, we can determine if forces are balanced or unbalanced by subtracting one from another. The result is the **net force**. If the net force is 0, the object does not move. They are balanced forces. If the net force is not 0 the object will move in the direction of the stronger, or bigger force.

Look at each picture on the following pages. Then complete the statements by **filling in the blanks** or **circling the correct term.**

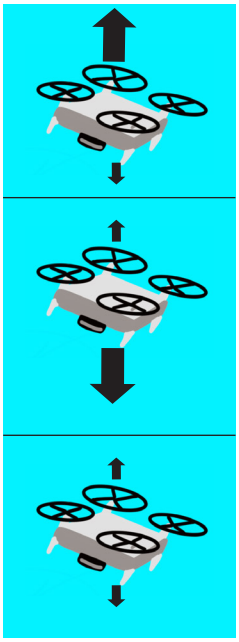
1. 5 units – 5 units = 0 units. This force is **balanced**/**unbalanced**.

The bat will **fly up**/**fly down**/**stay in the same place**.

2. 10 units – 1 unit = 9 units. This force is **balanced**/**unbalanced**.

The audio recorder will **go up**/**fall down**/**stay in the same place**.

To film the rainforest video, the team flew a drone. The drone has four rotors. The pilot can change the force of the rotors to fly. Complete the sentences below to describe the forces that the rotors need to create.



3. For the drone to fly up, the rotors need to create a force that is **balanced**/**unbalanced** with gravity. The force the drone creates needs to be **bigger than**/**smaller than**/**the same as** the force of gravity.

4. For the drone to fly down, the rotors need to create a force that is **balanced**/**unbalanced** with gravity. The force the drone creates needs to be **bigger than**/**smaller than**/**the same as** the force of gravity.

5. For the drone to hover, or not move up or down, the rotors need to create a force that is **balanced**/**unbalanced** with gravity. The force the drone creates needs to be **bigger than**/**smaller than**/**the same as** the force of gravity.

6. The force of gravity on the drone is 5 units. The team wants the drone to come down slowly. The pilot can choose to use 6, 5, 4, or 0 units of upward force. What would happen at each of these units of force? Use these terms to complete the table: **rise, hover, come down slow, crash down.** Encourage students to show their work.

Table 1. Response of the drone to different lift forces

Force	What the drone will do
6 units	rise
5 units	hover
4 units	come down slow
0 units	crash down

Activity 2: Lift it Up!

To get instruments or people into the canopy, enough force needs to be applied to overcome gravity. Below are some things that scientists want to get into the canopy.

Table 2. Gravity force units pulling on different objects

What needs to be lifted	Force units of gravity pulling down
Audio recorder	1
Wooden platform	40
Scientist	140

One way to lift things into the canopy is by flying them up in a drone. Another is to use ropes that people can pull on to lift the items. How do we decide the best way to lift things? One thing to consider is the object's lift force.

A drone can lift 10 units.
A person can lift 50 units using rope.

To reinforce math concepts, ask students to show their math work and calculate net force.

1. What would you use to lift the audio recorder? **Describe** why you chose that option. Use evidence from Table 2 and the lift forces of drones and people.

I would use the drone. It can lift more than one unit. It is easier than using ropes.

NOTE: A person is a reasonable selection too if students provide a good explanation.

2. What would you use to lift the wooden platform? **Describe** why you chose that option. Use evidence from Table 2 and the lift forces of drones and people.

I would use a person pulling a rope. A drone can't lift the platform. A person can lift the platform because they can lift 50 units, and the platform has 40 units of gravity pulling on it.

3. Can one person pulling on a rope lift another person such as the scientist? Use evidence from Table 2 and the lift force of people to support your answer.

No, gravity is putting more force on the scientist (140 units) than another person can lift (50 units).

4. How many people do you think it would take to lift the scientist into the canopy? Use math to show your work. Use evidence from Table 2 and the lift force of people to support your answer.

I think it would take three people. The lift force needs to be over 140 units. 50 + 50 + 50 = 150 and 150 – 140 = 10. That means that the scientist would be pulled up by three people.

Note: Students have not been told that they can add forces together. This is an opportunity for them to think strategically about how they would solve the problem. Focus less on getting the correct answer and more on their problem-solving skills. Some might think that they cannot add the forces up or suggest that they would want to have far more people than needed to be safe.

Extend the lesson: Have students think about the forces that are important in their lives aside from gravity. Have them make a poster that shows these forces. Some examples include pulling objects on a sled or in a wagon or opening doors of different weights and sizes.

Activity 3: Design it!

This is a great group activity. Make sure students brainstorm solutions together and work as a team to come up with one design. You can have students present these designs to the class and have other students give their feedback. Then, encourage students to use the feedback to improve their designs.

Depending on the time you want to devote to the activity, you could give students materials to create models of their designs to test if they work.

It's time to design some solutions for our research team. The team wants to put cameras up in the canopy. But, they don't want to have to climb up into the trees all the time. They want to be able to get the cameras down without climbing.

1. **Define** the team's problem.

They need to get cameras into trees and back down without climbing.

2. **Brainstorm** ideas for a solution to the problem. Use the space below to **draw** a possible solution to the problem.

Accept reasonable answers. Some students may come up with ropes that they use to raise and lower the cameras. Others may think of drones that could place and retrieve the cameras. Encourage completely original ideas!

3. **Describe** how would you test your design.

Students might suggest making a model or building it and trying it in the field before making improvements.