

Engagement Phase: Amazon Expedition

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Overall Lesson Objective: Students construct a hypothesis, design an experiment to test their hypothesis, and collect and analyze data to identify which light qualities best promote plant growth.

Purpose of Amazon Expedition Activity: The purpose of the *Amazon Expedition* activity in the Engagement phase is to bring awareness of how everyday environments may affect plant growth. Students are introduced to Dr. Doust, an intrepid international plant collector. He requests students to assist him in preparing an environment in his lab to support the growth of a mysterious plant he discovered from the Amazon rainforest. Students are presented with pictures of five different radish plants grown under different lighting conditions. Students consider how these different lighting conditions may affect the radishes, and then extrapolate how different environmental lighting may influence the mysterious Amazonian plant. In groups, students are tasked to determine how to mimic the plant's home environment in a laboratory, then generate questions about how plants grow and potential optimal growing conditions.

Learning Objective Addressed in the Engagement Phase: Students identify environmental factors that may positively or negatively affect plant growth.

Driving Question: How can different light colors affect plant growth?

Time in Minutes: 30

Materials

Student Materials: StudentHandoutEngagement1_AmazonExpedition
Technology (iPads, laptops, etc.)

Teacher Materials: TeacherHandoutEngagement1_ AmazonExpedition
TeacherHandoutEngagement2_PowerPoint
Padlet membership

Set-up:

During the Engagement phase, there are two materials that need preparation before class: 1) a PowerPoint presentation, and 2) a Padlet discussion board.

- 1) Before class, prepare the PowerPoint provided in TeacherHandoutEngagment2_PowerPoint. On the last slide, I placed a link to the Amazon Expedition Activity Padlet as a quick transition to the next part of the Engagement phase.
- 2) Padlet is a blank-canvas site that allows users to create a board for others to make posts on. It is entirely free, and incredibly useful in creating digital question boards for use in the classroom. To learn more about what Padlet has to offer or to create a Padlet account, follow this [link](#). After making an account, create a Padlet board in the “Wall” format, then title it as “Amazon Expedition Activity.”

Tips for technology: Concerning the use and setup of the Padlet board, I have some suggestions to make the board easy to navigate and easily accessible for students. I highly suggest that you filter student responses under “Content Filtering” in the “Settings” tab. By selecting “Require Approval” and “Filter Profanity,” you can admit appropriate student responses onto the board and reject inappropriate responses, as well as replace any bad words with emojis. Under the “Share” tab, I set privacy to “Members only” and added each of my students’ emails in the “Add Members” section. You can also send the Padlet link in an email to your entire class or share on Google Classroom, which I found useful.

Procedure – Part 1: PowerPoint Presentation and Dr. Doust’s Lab

Begin class with the PowerPoint presentation. Available in TeacherHandoutEngagement2, the PowerPoint describes the narrative that directs the entirety of the *Rainbow to Grow* lesson.

Students are presented with the following narrative in PP-Slides 1-4: “We received a letter from Dr. Doust, an intrepid international plant collector. He and his team recently returned from an expedition in the Amazon rainforest, and they brought back some seeds from a mysterious, bright blue-green plant they discovered during their mission. Dr. Doust wants us to help him determine how we can mimic the plant’s home environment in his lab! To observe how different factors could influence plant growth, Dr. Doust planted various radish plants under different lighting conditions inside his lab and in his outdoor garden.”

Images of these radishes are provided on PP-Slide 5-9. On PP-Slide 10, I task students to consider the following:

- How would you describe the radish plant’s growth in each of these images?
- How do the radish plants’ growth compare with one another? How are they similar? How are they different? In what way(s)?
- What do you think would happen if we planted the mysterious seeds under the various lighting conditions that Dr. Doust prepared for these radish plants?
 - Would they grow similarly to the way the radishes grew under the same lighting conditions? Would they grow differently?
- What would a plant need to be successful in ANY environment?

Note: As students discuss these questions, I suggest that the only differences between the radish plants' environment can be determined by **what we see and know from the pictures**. This means that other conditions and factors (such as soil, moisture, or temperature) that could influence plant growth are assumed to be the same for each environment. This allows students to focus on the different conditions of light available in each environment, as well as the impact on plant growth. Furthermore, this discussion helps me to address the common misconception that light conditions are the **only** influence on plant growth in these environments.

Allow students to respond to or reference the responses of others (such as rephrasing a peer's response to better understand what they said) as the class engages in discussion. Use the previous questions to redirect conversation to stay on topic.

Management Tip: Students may have specific classroom needs, where they may need additional assistance in sharing their responses during discussion. These needs can be mediated by using white boards to hold up answers, electing a spokesperson, preferential seating, or using a microphone to ensure that students can participate in discussions and develop comprehension along with their peers.

Procedure – Part 2: Driving Question Board and Transition to Exploration Phase

Once students have had the opportunity to discuss the questions concerning radish growth under different lighting conditions, continue to PP-Slide 11. With this slide, students learn that while botanists may understand how the amount of light and the direction of light may influence plant growth, they may know little about the role of light color on plant growth. Reading from the slide, “Dr. Doust explains in his letter that the color of light in the rainforest is affected by all of the plants growing there, but he is not sure how to replicate the color conditions in his lab to BEST support the mysterious Amazonian plant.”

Transition to PP-Slide 12, where Dr. Doust asks, “What do I need to know that will help me identify an environment with the BEST growing conditions for our mystery plant?” I ask students, “what does Dr. Doust mean by ‘best?’ How do we define what ‘best’ plant growth looks like? Student responses vary, including how taller plants, greener plants, or plants with the most leaves may be ‘the best.’ Explain that, based on the light provided in an environment, a plant’s growth response may change. An environment not only affects how a plant may grow, but it also affects what opportunities will allow a plant to grow.

Organize students into groups of 4. In groups, students select a Spokesperson. Groups are prompted to generate a question about plant growth and optimal growing conditions. I give my students five minutes to discuss the previous discussion points, formulate their question, and record their question in StudentHandoutEngagement1_AmazonExpedition.

Management Tip: Strategic grouping of students can allow for all skill levels of students to be attended to, such as pairing students with higher skillsets with students with lower skillsets to promote peer learning within each group.

As students collaborate, display the link to the Amazon Expedition Padlet on PP-Slide 13 for students to access. When a group has developed a question, the group's Spokesperson submits the question to the Padlet for the teacher to review and then the class to see.

Note: Here, I stress that **questions are not incorrect for being different**, and I use this opportunity to discuss how science progresses because of the different ideas, perspectives, and interpretations that individuals have. Science is a human endeavor, and our understanding of scientific knowledge stems from our social and cultural backgrounds and biases. The social and cultural embeddedness of scientific knowledge play a major role in the understanding and acceptance of scientific endeavors. Here, I note that different ideas and questions stem from differences in interpretations (which may ultimately stem from differences in social and cultural backgrounds), and a student's understanding is not wrong merely because it is different.

Once each group has submitted a question, I display the Padlet to the class, then review with my students the different types of questions they submitted. Their questions usually vary, but I focus on student questions that incorporate light color and its impact on plant growth.

To transition into the Exploration phase and the Driving Question, I state the following: "With the questions you provided, I am noticing that many of these questions relate to light color. So, based on your questions, do you think different colors of light affect plant growth differently, and if yes, then which will promote the greatest plant growth? Today, we can begin looking for an answer." I collect StudentHandoutEngagement1_AmazonExpedition from students, then begin the Exploration phase.

Engagement Phase: Amazon Expedition Activity PowerPoint

Slide 1

You've got mail!



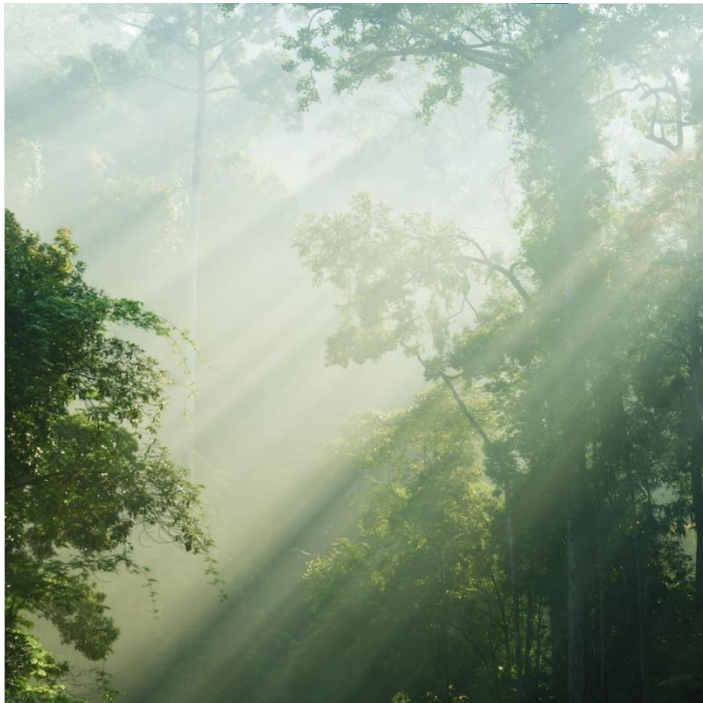
We just received a letter, addressed to our class.

The letter is from Dr. Doust, an intrepid international plant collector and plant biologist from Australia.

Let's see what he has to say!



Slide 2



In the letter ...

Dr. Doust explains that he and his lab team recently embarked on an expedition to the Amazon rainforest.

While trekking through the foliage, they encountered a mysterious, bright blue-green plant.

Dr. Doust decided to collect some seeds from this plant before he and his team returned to their laboratory in Australia.



Slide 3



Dr. Doust needs your help!

He wants to determine how he can mimic the mysterious plant's home environment in his lab.

But ... What would this plant need to succeed in his lab? What factors may influence the plant's growth?



Slide 4

Environmental Influences on Plant Growth

To observe how different factors could influence plant growth, Dr. Doust planted various radish plants in different environments inside his lab and in his outdoor garden.

The next five slides will display images of Dr. Doust's radish plants growing in a variety of lighting conditions.



Slide 5



Image #1

The leftmost radish plant was germinated in the dark, the middle radish plant was germinated in dim light, and the rightmost radish plant was germinated in bright light.



Slide 6

Image #2

Radishes grown under red and blue LED lights.



Slide 7

Image #3

Radishes grown under white fluorescent lights.



Slide 8

Image #4

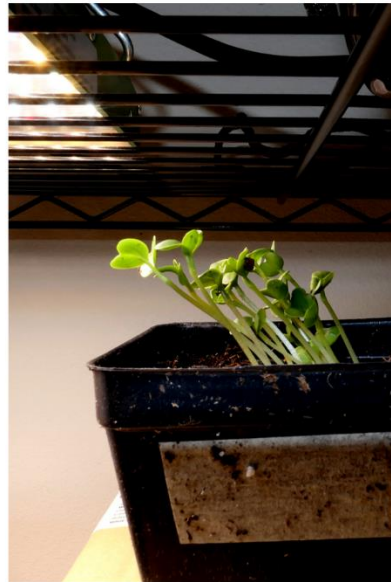
Radish grown outdoors, turned sideways during growth.



Slide 9

Image #5

Radish seedlings growing indoors, with a light source to the side of the plant.



Slide 10

- How would you describe the radish plant's growth in each of these images?
- How do the radish plant's growth compare with one another? How are they similar? How are they different? In what way?
- What do you think would happen if we planted the mysterious seeds under the various lighting conditions that Dr. Doust prepared for these radish plants?
 - Would they grow similarly as the radishes did? Would they grow differently?
- What would a plant need to be successful in ANY environment?



Slide 11



Dr. Doust explains in his letter ...

Botanists know a lot about how the amount of light and the direction of light may affect a plant's growth.

However, scientists understand relatively little about the role of the color of light.

The color of light in the rainforest is affected by all of the plants growing there, but he is not sure how to replicate the color conditions in his lab to BEST support the mysterious Amazonian plant.

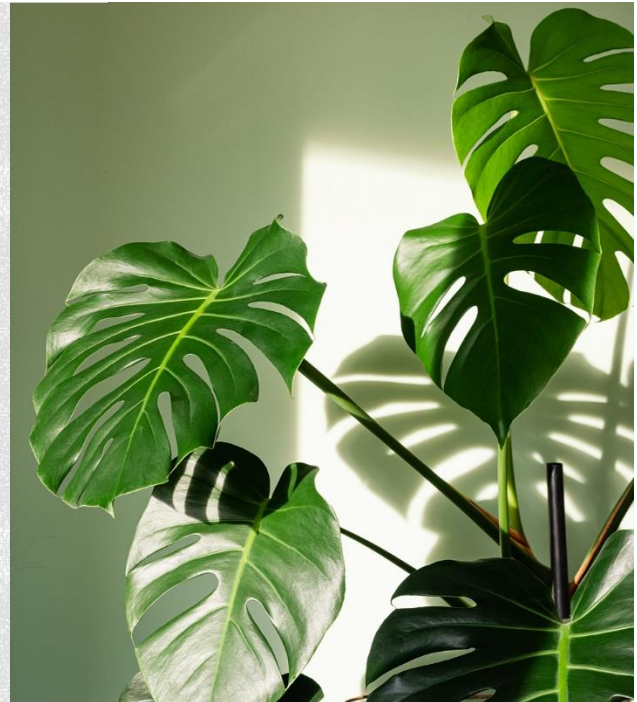


Slide 12

Dr. Doust asks ...

What do I need to know that will help me identify an environment with the BEST growing conditions for our mystery plant?

- In groups, generate a question relating plant growth and the environmental conditions a plant needs to grow.
- Elect a spokesperson in your group. They will submit your group's question to our virtual question board!
- Record your question and the name of your spokesperson on the provided handout.





padlet

PADLET LINK:

insert link to Doust Lab Padlet here

insert QR Code to Doust Lab Padlet here



Student name: _____ Date: _____

Amazon Expedition Activity

Dr. Doust asked you, “What do I need to know that will help me identify the environment with the best growing conditions for our mystery plant?” In your group, generate a question about plant growth and what conditions a plant needs to grow. Record your question in the space below.

Spokesperson for your group: _____

Once your group has generated a question, the Spokesperson will submit the question to the “Amazon Expedition Activity” Padlet.

Recall, from the class discussion, the questions your peers submitted to the Padlet board. Did all groups have the same question? Why or why not?
