PHOTOSYNTHESIS IN SCRATCH JR.

Grade 3 Life Systems Demonstration Task

By Gabriela Bowen

Created by Gabriela Bowen, STEM-SAT HWCDSB

Preamble

This slideshow provides an example of a Grade 3 coding demonstration task that integrates concepts from Strand B, Life Systems as well as coding concepts from the Ontario Mathematics Curriculum.

The Coding Photosynthesis Demonstration Task featured asks students to demonstrate their understanding of the process of photosynthesis by writing a program for an automated digital story using Scratch Jr. The story explains how photosynthesis provides the energy necessary to help a plant to grow.

The lesson slideshow is broken up into three main sections: Minds-On, Background Knowledge and Activities, and the Coding Photosynthesis Demonstration Task.

The first two sections are designed to introduce students to the study of plants and to provide the necessary learning for students to understand the purpose, process, and products of photosynthesis. The last section, is an explanation of the coding demonstration task that will act as a consolidation of the concepts covered in the unit.

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Contents

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Science Curriculum Expectations

A1. Stem Investigation and Communication Skills
A1.5 communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes
A2. Coding and Emerging Technologies
A2.1 write and execute code in investigations and when modelling concepts, with a focus on testing, debugging, and refining programs
B1. Life Systems – Relating Science and Technology to Our Changing World
B1.1 assess ways in which plants are important to humans and other living things, taking different perspectives into consideration, and identify ways in which humans can protect native plant species and their habitats
B2. Life Systems – Exploring and Understanding Concepts
B2.1 describe the basic needs of plants, including the need for air, water, light, heat, nutrients, and space, and identify environmental conditions that may threaten plant survival **B2.5** demonstrate an understanding that most plants get energy directly from the Sun through the process of photosynthesis, which involves the absorption of carbon dioxide and the release of oxygen **B2.8** describe ways in which plants and animals, including humans, depend on each other

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STEM Integration: Coding in Math

In the case of this coding demonstration task, students are encouraged to use **sequential, concurrent and repeated events** to model the science concept of photosynthesis. These coding concepts are included in the mathematics curriculum expectations (C3. Coding). In mathematics, students can model math concepts through the use of these constructs as well so that though this activity, students integrate both their science and mathematics learning.

C3. Coding
C3.1 solve problems and create computational representations of mathematical situations by writing and executing code, including code that involves sequential, concurrent, and repeating events C3.2 read and alter existing code, including code that involves sequential, concurrent, and repeating events, and describe how changes to the code affect the outcomes

MINDS ON

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Activating Prior Knowledge (Outside)

Go for a nature walk around the school grounds or neighbourhood.

Prior to the walk, discuss what students already know about plants.

- What do you think plants need to grow?
- What are some indoor/outdoor plants? What is the same/different about these plants?
- Provide students with paper and clipboards to write down all of the different plants that they see on their walk. As you walk, stop and observe different plants and talk about what they notice about each plant. Have students record their observations and their questions.

Draw student attention to the different parts of each plant and how they differ. Draw their attention also to how the plants differ in their growth and where they are planted.

What do you notice?
What do you wonder?

What do all the plants have in common?

What makes each plant different?

Are these the same or different than the plants you have around your home?

How might the plants be the same or different in a warmer country?

In a colder country?

Activating Prior Knowledge (Inside)

Show students the pictures on the following slide (indoor flowers and an outdoor tree).

Question Prompts:

"How are these plants the same? How are they different?"

"What do these plants need to continue to survive and grow?"

"How to they get what they need to survive and grow?"

Brainstorm student answers and listen for understanding and misconceptions.

Potted Gerbera Daisies

Maple Tree

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BACKGROUND KNOWLEDGE AND ACTIVITIES

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Basic Needs of Plants

Did you know?

Young sunflowers will turn to follow the sun as it moves through the sky. This cool ability is called **heliotropism**.

Plants are living things. All plants require these basics to survive:

1. **Air:** Plants need the carbon dioxide gas in the air to make their own food.
2. **Water:** Plants are mostly made of water. They must be watered regularly as it helps transport nutrients throughout the plant parts.
3. **Light:** Sunlight is needed for a special process that plants use to make their own food.
4. **Heat:** Different plants require different temperatures to grow but all need some form of heat to stay alive.
5. **Nutrients:** Minerals found in the soil are important to keep a plant strong and healthy.
6. **Space:** Different plants require different amounts of space but all plants need enough space to allow their roots to spread out and anchor them to the ground.

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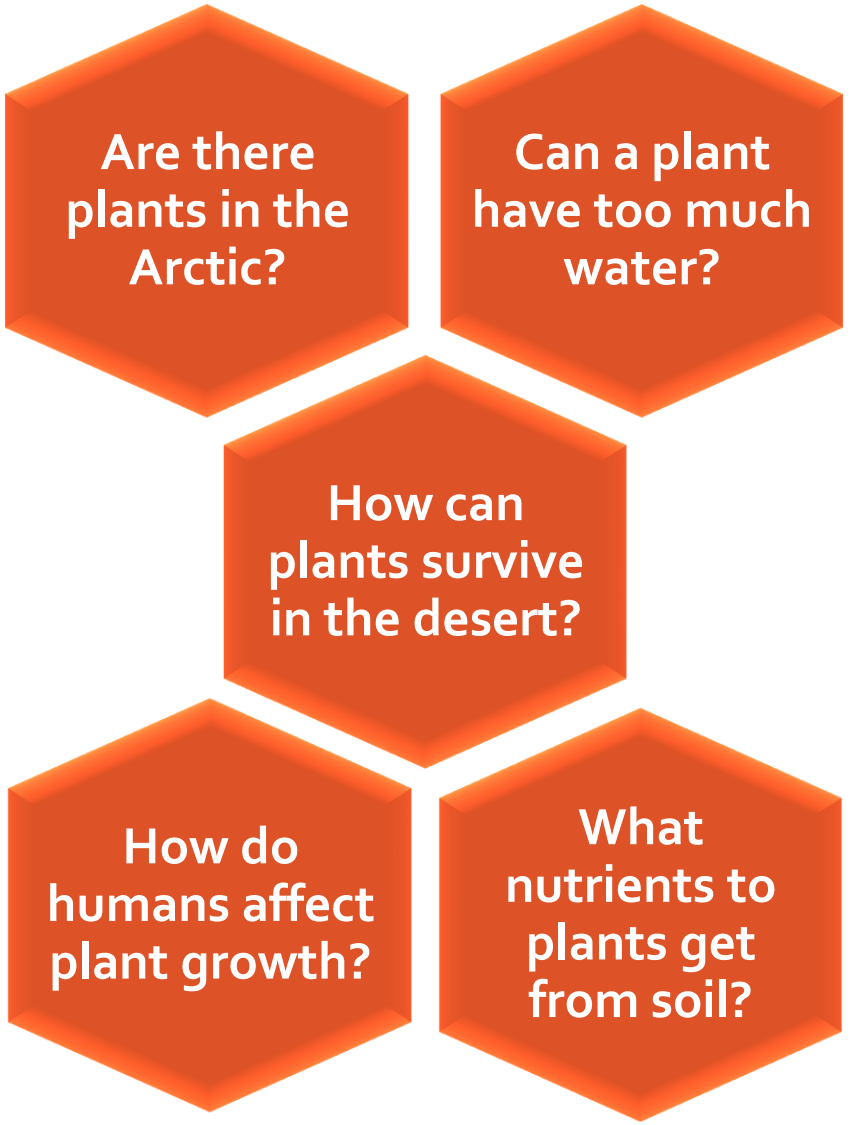
I wonder…

After reviewing the basic needs of plants, brainstorm further questions that students may have (see examples).

Use Pebble Go, Epic Books, videos, or other library resources to search up answers. Consider testing out some of the answers with mini-experiments or demonstrations.



Producers vs. Consumers

Along with water, sunlight, and air, plants need energy (food) to survive but they can't eat the same way that humans can eat. If they are hungry they can't go and get their food, they must **make** the 'food' they need to survive.

PRODUCERS

Plants are '**producers**' because they make or produce their own 'food'. The food that plants produce that gives them energy is a simple sugar called '**glucose**'.

CONSUMERS

Organisms such as mammals, birds, etc., that eat other living things are known as '**consumers**' because they must find and eat – or **consume** – their food.

Sort the organisms on the following slide as either PRODUCERS or CONSUMERS.

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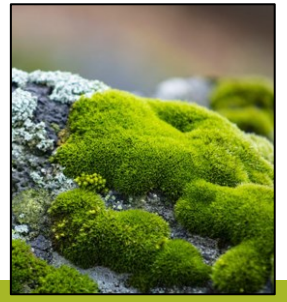
Producers	Consumers

WOLF

MOSS



CHILD

SEAWEED

MUSHROOM

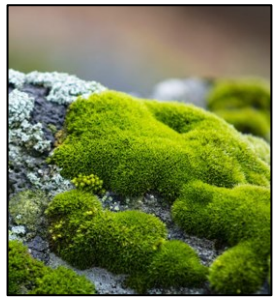
COW

WORM

FLOWER

Producers

MOSS



SEAWEED

FLOWER

Consumers

WOLF

CHILD

MUSHROOM

COW

WORM

Did you know?

Mushrooms are not producers because they are **decomposers**. This means that they consume dead or decaying material to get the food that they need to grow and survive. This is why you will find mushrooms growing where plants have died!

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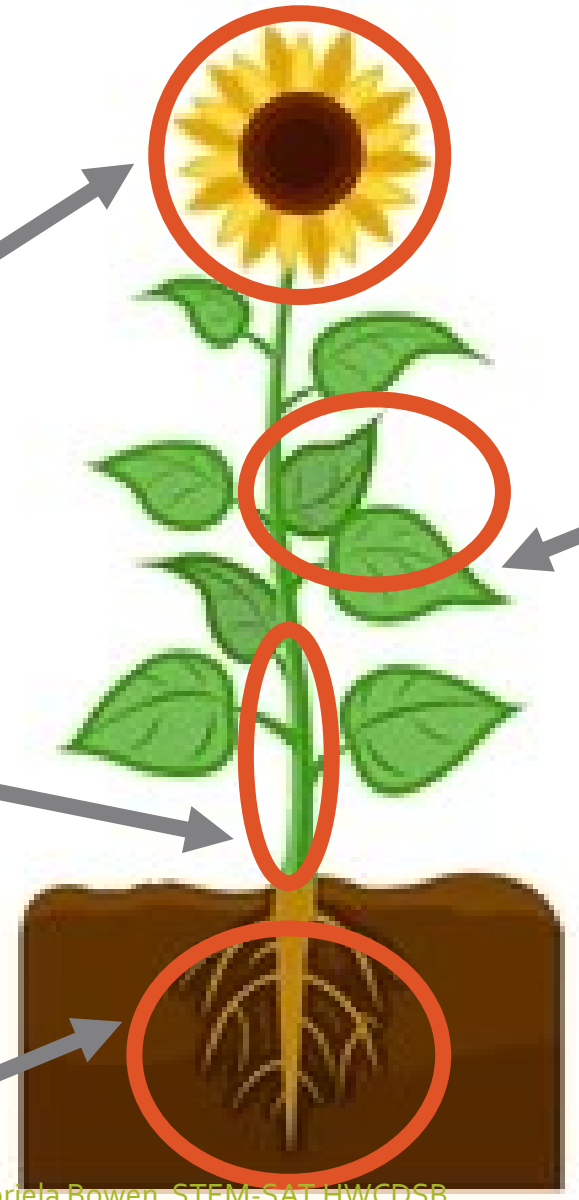
Parts of a Plant

Flowers: Produce the seeds that can become new plants. Most plants, including many trees, grow some kind of flower.

Stem: sucks all the food and water up to the rest of the plant. The stem also holds up the leaves, flowers, and fruit.

Roots: absorb all the nutrients and water from the soil. Roots anchor the plant in the soil so it doesn't get blown or washed away.



Leaves: Make food for the plant by using sunlight, water, carbon dioxide in a process called **PHOTOSYNTHESIS**.

Parts of a Plant

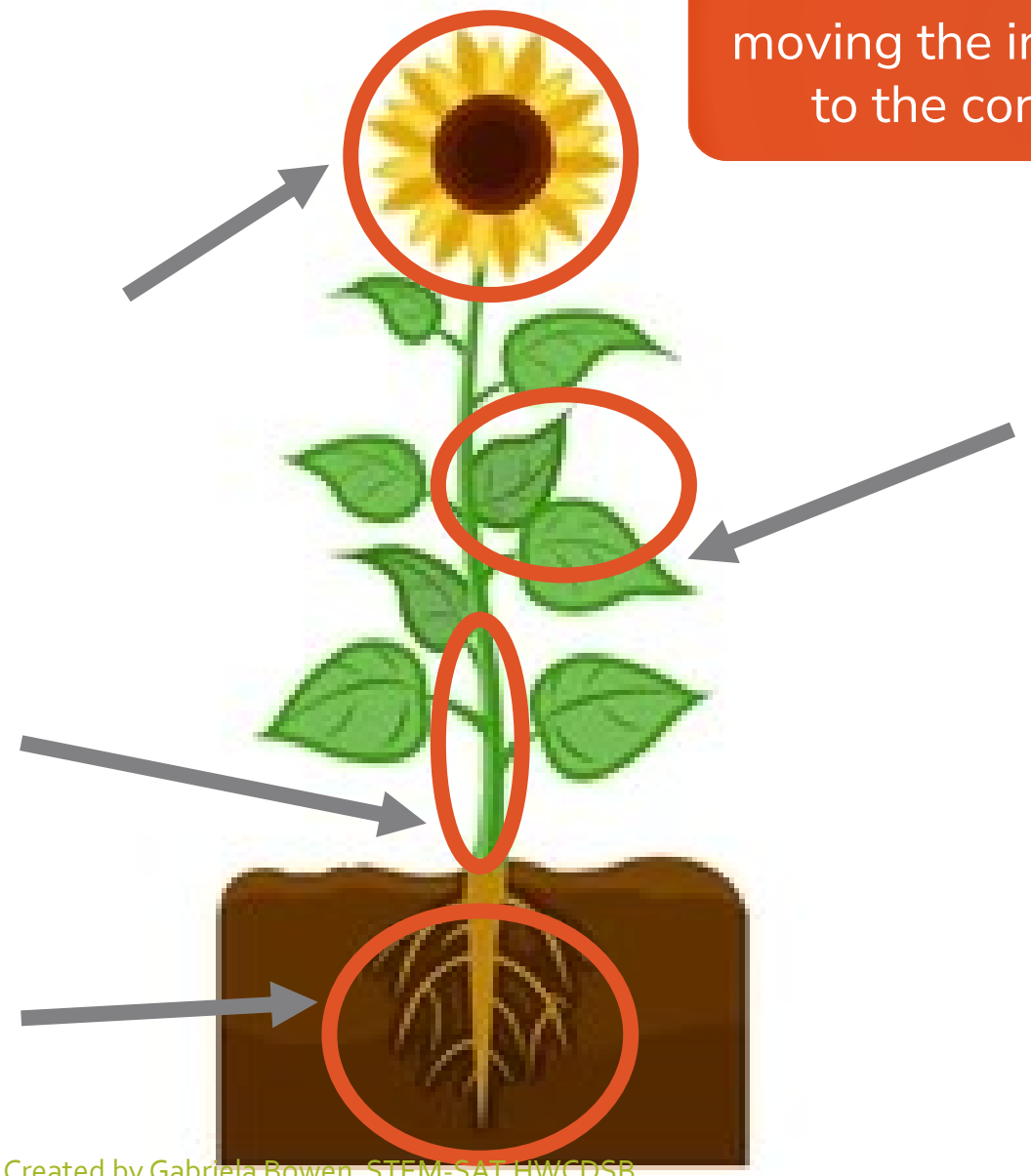
Directions: Label the plant by moving the interactive blocks to the correct location.

Stem

Flowers

Leaves

Roots



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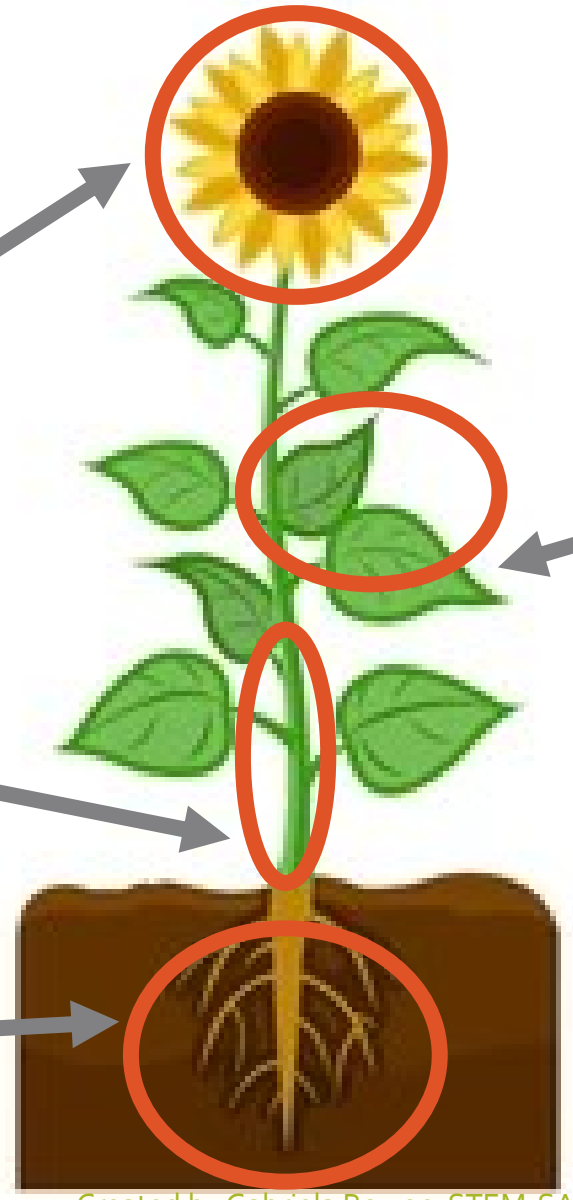
Parts of a Plant

Solutions



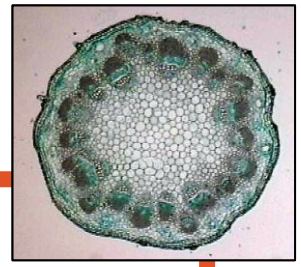
Flowers

Leaves

Stem

Roots

Stem Cross-Section



Did you know?

Roots draw water from the soil up through the stem into the leaves and flowers. The stem has **veins** (like humans!) that help transport the water and nutrients throughout the plant.

What is Photosynthesis?

PHOTO → LIGHT

SYNTHESIS → TO PUT TOGETHER

Photosynthesis means to **put together** with **light**.

Green plants use energy from the Sun to transform water, carbon dioxide, and minerals into **simple sugars** and oxygen. This is like a recipe for **ENERGY** for the plant!

Photosynthesis gives the plant the food it needs to grow and thrive. It also provides us most of the oxygen we need in order to breathe. We, in turn, exhale carbon dioxide that is needed by plants.

Did you know?
Tiny green organs called **chloroplasts** are in the leaves. Chloroplasts work to convert light energy of the Sun into sugars that can be used by cells. They make leaves green!

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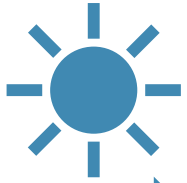
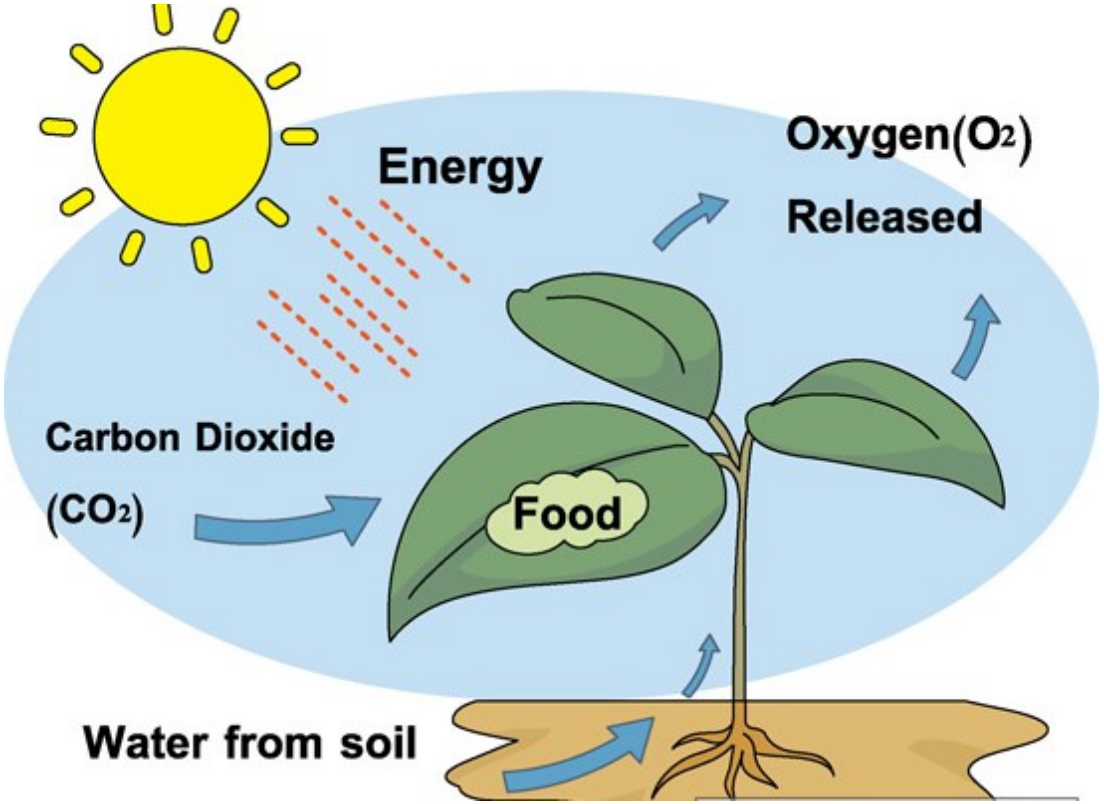
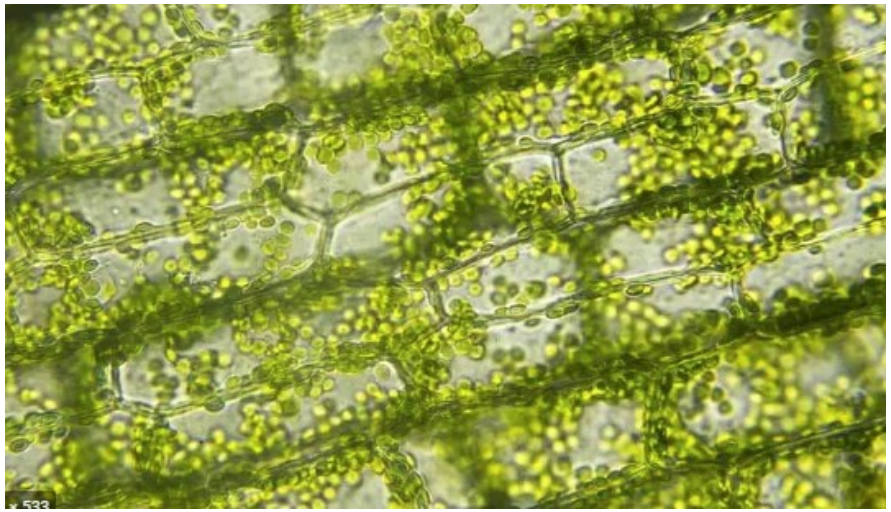


CARBON DIOXIDE + WATER LIGHT **SUGAR (GLUCOSE) + OXYGEN**



Plant cells with chloroplasts inside.



Ideas for Hands-On Tasks

- Using a flower like a lily, allow students to examine the plant parts and to take the flower apart. Lilies have pollen on the stamen and this can lead to a discussion about the importance of pollen and pollinators like bees.
- Bring in a potted plant. Take the plant out of the pot and break the soil apart to allow the students to examine the roots of the plant. Point out the different thicknesses and how abundant the roots are (to increase the ability to absorb nutrients).
- Germinate a bean or another seed in a plastic bag (this takes about 2-3 weeks). This will allow students to see the seed open, develop a root, and even develop early leaves. This is also a great way to show students what is needed to make a plant grow. If time permits, plant the seeds in small pots and watch them grow. (TASK idea)
- For photosynthesis, consider a simple experiment where you grow plants without sunlight. Obtain 3 small plants that have already been growing. Place 1 plant, the control, in an optimal growing space. Place a second plant on a windowsill that gets more than the required sunlight. Place a third plant in a cardboard box where it receives little or no sunlight. Have students hypothesize what will happen to each plant. Continue to water the plants equally and have students record observations over a couple of weeks. Discuss results.

CODING PHOTOSYNTHESIS TASK

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Coding Demonstration Task - Photosynthesis

Coding is an effective and engaging way for students to develop and demonstrate their understanding of science concepts and in this case, photosynthesis. Students can use Scratch Jr. to create a program that demonstrates their understanding of how the reactants in photosynthesis help plants make the glucose they need to survive.

Coding photosynthesis using Scratch Jr.:

1. Review the purpose of photosynthesis.
2. Review the reactants and products of photosynthesis.
3. Students will write a program in Scratch Jr. to demonstrate their understanding of the process of photosynthesis and what plants need to survive.

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Learning Goals:

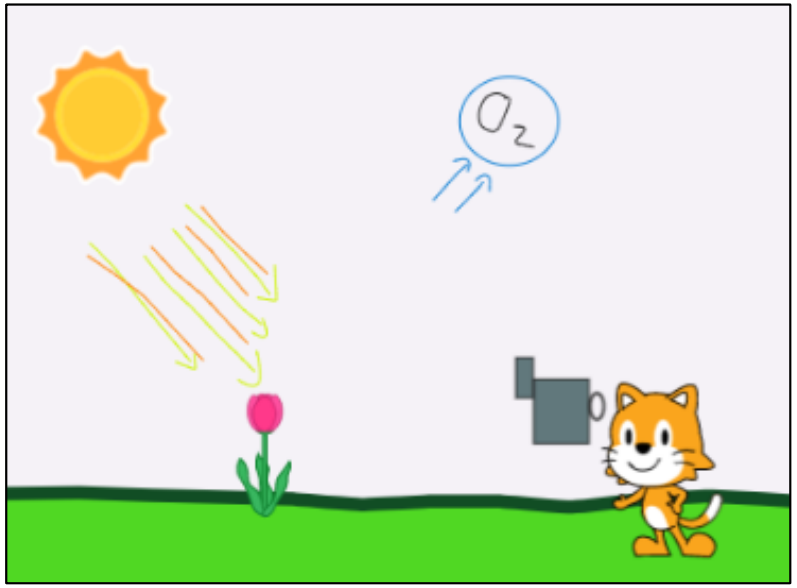
In this task, students will:

- Create **sequential** code for each sprite.
- Create **concurrent** events. Several sprites must work in tandem to demonstrate the process of photosynthesis.
- Use **repeat loops** so certain programs repeat. For example, the sun may shine rays on a plant and the code for the shining effect must repeat throughout the demonstration.
- **Test, debug, and refine** their programs.
- Create their own sprites and backgrounds. While Scratch Jr. has many options, students may choose to create their own sprites, for example, to represent elements like carbon dioxide, a watering can, sun rays, etc.
- Demonstrate an understanding of the reactants, products, and purpose of photosynthesis.

Success Criteria:

In my Scratch Jr. program I…

- ❑ included more than one character (sprite) in my program.
- ❑ created sequential code for each sprite.
- ❑ used at least 1 repeat loop in my code.
- ❑ tested my program to make sure there are no 'bugs' or 'errors'.
- ❑ refined my program to make it as good as I can (good copy!)
- ❑ created or edited at least 1 sprite for my program.
- ❑ created or edited a background.
- ❑ included all of the reactants and products of photosynthesis (carbon dioxide, water, light, sugar, and oxygen).
- ❑ show how photosynthesis helps a plant produce food and grow.



Coding Prior Knowledge

To complete this task, students must have a basic understanding of the Scratch Jr. program.

Students should be able to:

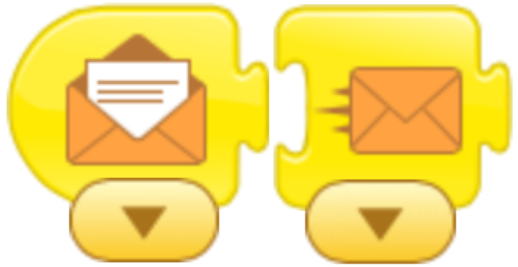
- Understand the function of the basic blocks in Scratch Jr.
- Add sprites and change backgrounds.
- Write sequential code for a single sprite.
- Understand the function of a few of the different start blocks.

Start Blocks

Advanced Blocks

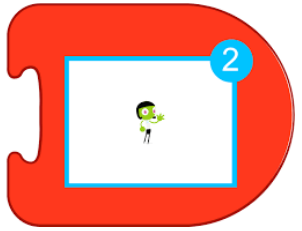
The following are links that may help you understand how to use some more advanced blocks in Scratch Jr. These blocks will help your students create more dynamic programs:

- Messaging Blocks
- Using Bump Start Block
- Changing Scenes Block



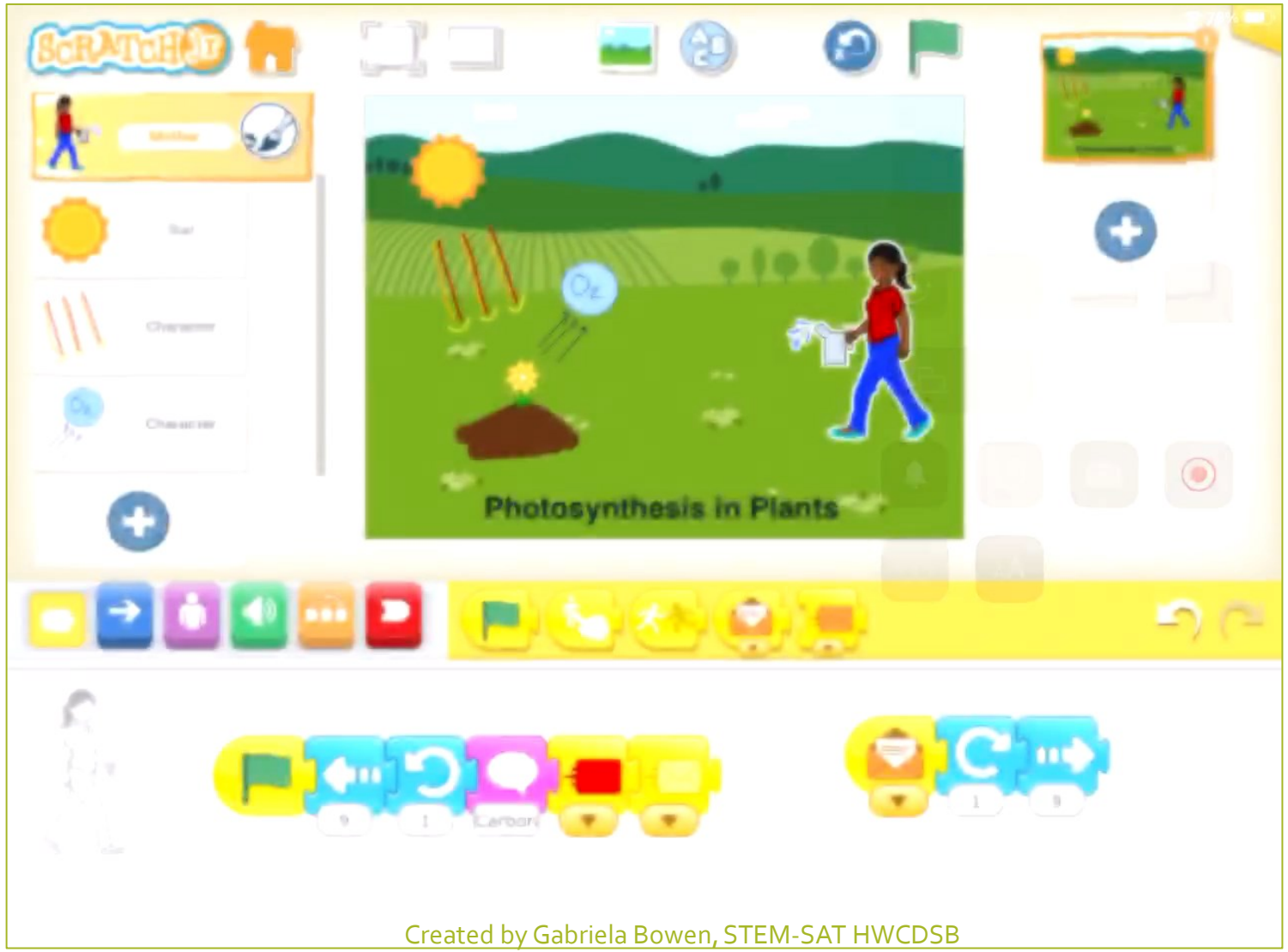
Messaging Blocks

Bump Start Block



Changing Scenes

Sample Video



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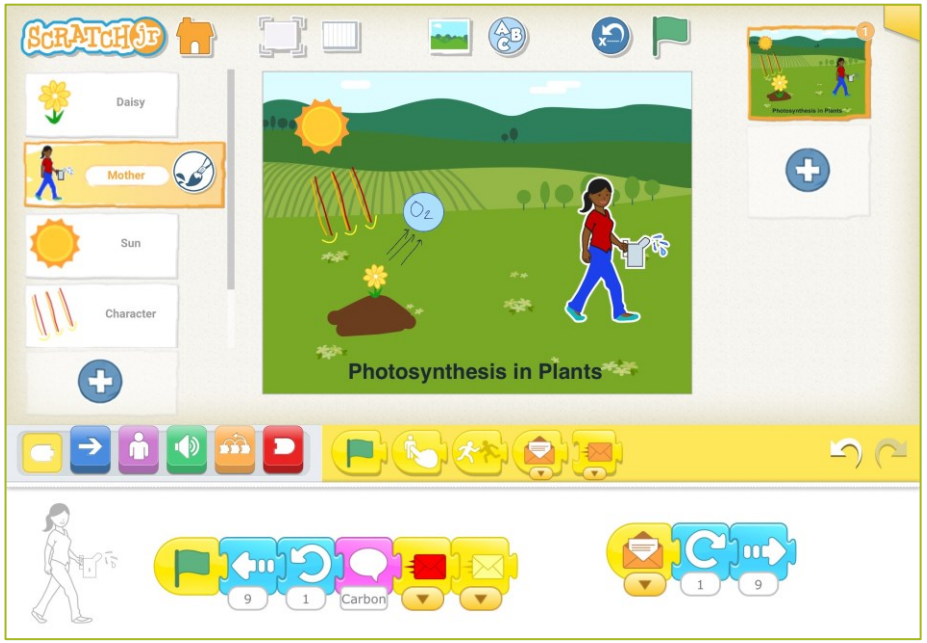
Sample Code


Daisy
Mother
Sun
Character
Photosynthesis in Plants
9
1
Carbon
1
9


Daisy
Mother
Sun
Character
Photosynthesis in Plants
4
2


Daisy
Mother
Sun
Character
Photosynthesis in Plants
12
12


Mother
Sun
Character
Character
Photosynthesis in Plants
5
1
1
5

Assessment as Learning

Working on it…	Learning Goal: We are creating a program in Scratch Jr. to demonstrate our understanding of photosynthesis	Got it…
	I included more than one character (sprite) in my program.	
	I created a program that includes concurrent events and repeat loops.	
	I tested, debugged, and refined my program to make sure it is my best work.	
	I created or edited a sprite and a background in my program.	
	I included all of the reactants and products of photosynthesis (carbon dioxide, water, light, sugar, and oxygen).	
	I demonstrated how photosynthesis helps a plant produce food and grow.	

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Other Look fors…

- Does the student program make sense and adhere to the topic?
- Is the student code efficient and concise? Does the student look for ways to make the program more efficient?
- Does the student test, debug, and refine their program to ensure it is their best work?
- Does the student persevere when obstacles are encountered?
- Does the student seek out and learn from peer examples?
- Does the student collaborate well with others?

RESOURCES

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Books about Photosynthesis

- Magic School Bus Gets Planted: A Book About Photosynthesis
- Plant the Tiny Seed by Christie Matheson
- Photosynthesis by Torrey Maloof (Epic Books)
- Plant Power Photosynthesis by Karen Latchana Kenney (Epic Books)
- The Cycle of Photosynthesis by Arnold Ringstad (Epic Books)
- Photosynthesis: Changing Sunlight into Food by Bobbie Kalman (Epic Books)

Videos and Links

- Magic School Bus Gets Planted
- Scratch Jr.
- Epic Books