Grade 2 Learning Experiences: Earth and Space Systems: Air and Water in the Environment

Experience 3: Coding a Raindrop through the Water Cycle

Long Range Plan - Grade 2 - Long Range Plan - Model 2

This series of learning experiences will introduce students to the concept that nature works in cycles (specifically the water cycle; with opportunities to connect to other science curriculum strands and learning from previous grades). Students will engage in a provocation to get them wondering about what happens to water as it evaporates, create their own water cycle in a bag experiment where they can observe the changes of state that water goes through as it moves through the water cycle, and create a model of those changes using coding. A variety of extensions and cross-curricular opportunities will allow teachers to customize these experiences to suit the needs and learning styles of their students while allowing for authentic assessment for, as, and of learning.

In the real world, scientists and engineers need to record their thinking and keep records of their scientific processes and engineering designs for a number of reasons. In these experiences, students will be using a science journal as a way of tracking their scientific thinking as they emulate scientists and engineers while engaging in the learning to make predictions, record processes, and observations, and draw conclusions about scientific phenomena. The journal will also be used during STEM investigations as a place for solving solutions to real-world problems (brainstorming, describing plans, and drawing designs for prototypes) and will be an evidence-based source of assessment information

Overview of learning experiences – why these activities	In this learning experience, students will code a model of the water cycle from the perspective of a drop of water travelling through the water cycle. The experience offers a tech-based option and an unplugged version. This experience will give students the opportunity to demonstrate all that they have learned about how water changes state as it moves through the stages of the water cycle. The lesson will also allow students to connect the importance of the water cycle to the needs of living things. These learning experiences link to the Grade 2 Long Range Plan Model 2, found in March/April.
Prior Knowledge / Prior Skill Set(s)	Teachers may wish to use or continue using the science journal for students to reflect on their experience with coding and to write their

	connections to the importance of the water cycle in the lives of living things. Teachers may wish to continue using a modelled or shared approach to completing the journal until the students are able to complete a journal activity on their own. The journal can be used as a form of assessment throughout the lesson series. Use a generic journal or use the Coding a Raindrop Through the Water Cycle Student Activity Guide (see Appendix A: Code a Raindrop Through the Water Cycle Journal). From the previous learning experiences, students should be familiar with the process of the water cycle and the terms evaporation, condensation, precipitation, and collection. Consider reviewing the vocabulary board or sheet prior to the investigation. Teachers and students should be familiar with the term algorithm as a sequence of events or set of steps that, when followed in the correct order, complete the desired task. In this instance, how a water drop would travel through the stages of the water cycle.
Strand A - STEM Investigation and Communication Skills	 **A1.5 Communication** - communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes  **A2.1 Coding and Emerging Technologies** - write and execute code in investigations and when modelling concepts, with a focus on decomposing problems into smaller steps  **A3.1 Applications, Connections and Contributions** - describe practical applications of science and technology concepts in their home and community, and how these applications address real-world problems
Overview / Big Ideas/Fundamental Concepts	The water cycle involves the continuous movement of water in different phases (evaporation, condensation, precipitation, and collection). In this investigation students model “where water goes” as it moves through the phases of the water cycle using an algorithm to show the path of a water drop as it goes from one stage and state to the next. Students will make the connection that the water cycle can never stop or the living things on Earth would not have access to the water that they need to survive.

Learning Goals / Success Criteria	By the end of this learning experience students will: ● Use a journal to record ideas, observations and to communicate ideas associated with inquiry and investigation ● Demonstrate their knowledge of the water cycle by writing an algorithm to show how a water drop would move through the water cycle ● Make connections between their own experiences and new learning ● Record their connections using science vocabulary Educators are encouraged to co-create success criteria with students and share "I Can Statements" based on the curricular expectations. Sharing options can include: ● I can write or draw my ideas to show my thinking. ● I can write an algorithm (sequence) to move my water drop through the water cycle. ● I can persevere and solve problems as I work. ● I can record the connections I make about the importance of the water cycle to living things using science vocabulary. **Ministry of Education Key Points:** ● STEM Skills & Connections ● Engineering Design Process ● Hands-On Experiential Learning ● Coding
Learning Experience(s)  **A2.1**	**Minds On (10 min.)** Show a picture of a magnified water drop (falling or splashing up). Have students imagine that they are that water drop. Have them move their bodies and make sounds to act out how the drop behaves as the sun shines on it. Teachers may wish to guide the activity by calling out the stages of the water cycle or allow students to explore on their own. **Action (30 min.)** **Coding a Raindrop Through the Water Cycle** **What the teacher does:** This activity can be completed using an unplugged version of the activity or using technology and can be modified depending on the technology available to you. Students may complete this activity in

	pairs or small groups depending on what works best with the students and the availability of materials. 1. Have students create large paper diagrams of a body of water, the sun, a white cloud, and a grey cloud. 2. In a large open area or on a large piece of mural paper, ask students to place their diagrams around the space. Ensure that they have placed them in a way that would allow them to travel the cycle in a cyclical way. 3. Using a Dash, Ozobot or other codable robots as a water droplet, and a block coding program, have students code the path that the water droplet would take to complete each stage of the water cycle. The code would be dependent on how far apart each diagram is and in which direction the water droplet is travelling through the cycle. Ask "Where should our water droplet start from?" If using a Dash or Ozobot students could also include in their code a sound or change of light colour to indicate a new stage of the cycle or change of state. Dash robots allow for students to record their voices and can therefore be coded to say the name of each stage of the water cycle. Students can also change the colours of their lights to show a change of state. 4. Encourage students to create the code, run the program, and problem solve or debug any errors until their robot makes it through the cycle one time. Ask "Does the water cycle stop after the water drop goes through it once? (Students should respond no). Ask "What can you do to your code to show that the water drop would keep going through each stage of the water cycle?" Students can add a repeat forever loop to their code to show that the cycle never ends (see Appendix B: Sample Code). For an unplugged version of this activity, you can substitute the robot for Scratch blocks printed on paper (see Appendix C: Paper Scratch Blocks) or create simple arrow blocks on cue cards (left, right, up, and down) and have students work in pairs to write the code using the blocks. Next, have one pair switch with another pair. The new pair follows the code, pretending that they are the water droplet. Allow students to report back to the coders if it was successful or not. Give them the opportunity to debug the code and then have the "water droplets" try to follow the code again.

A3.1	The unplugged version requires a fair amount of preparation prior to completing the activity. Once you create your paper coding blocks or arrows you can use them again for other coding projects. **What the students do:** **Initiating and planning** ● Students create paper diagrams of different parts of the water cycle and decide where they should be placed in the space or on the large paper ● Students should begin planning how their robot (water drop) will need to move through the diagrams **Performing and Recording** ● Write the code that will move the water drop through the cycle ● Execute the program ● Problem solve or make adjustments to the code if they determine it didn't produce the desired path **Analysing and Interpreting** ● Recognize the need for a loop on their code to demonstrate that the water cycle never ends ● Make connections between the importance of the water cycle to supporting the needs of all living things ● Make connections to other cycles in nature **Communicating** ● Use their science journal to share the connections they made during the activity ● Reflect on the coding process. How did they solve any problems that they encountered? ● Sharing their completed code **Consolidation** (**20 min.)** 1. Ask students to think about why the water cycle exists. What would happen if water didn't recycle itself? Why do all living things need water? 2. Ask students to brainstorm and record where they have observed other cycles in nature. (i.e., life cycle, seasonal cycles) Why are these cycles important?

	3. Have students record their reflections and connections in their journal or use the Coding a Raindrop Through the Water Cycle Student Activity Guide (see Appendix A: Coding a Raindrop Through the Water Cycle Journal)
Science and Technology Expectations	**Earth and Space Systems: Air and Water in the Environment** **Overall Expectations** **E2** demonstrate an understanding of the properties of air and water, including water in various states, and of ways in which living things depend on air and water for their survival **Specific Expectations** **E2.1** demonstrate an understanding of the key properties of air and water **E2.2** identify sources of water in the natural and built environments **E2.3** describe the stages of the water cycle, including evaporation, condensation, precipitation, and collection **E2.4** identify the three states of water in the environment, and describe how temperature changes affect the state of water within the water cycle **Matter and Energy: Properties of Liquids and Solids** **Overall Expectations** **C2**: demonstrate an understanding of the properties and physical changes of liquids and solids **Specific Expectations** **C2.2** describe the properties of liquids and solids **C2.3** describe properties of liquid water and solid water, and identify the conditions that cause changes from one state to the other
Science and Technology Vocabulary	**Code:** The language used by programmers to tell a computer what to do. **Algorithm:** A set of steps or a sequence of events written to complete the desired task. **Loop:** A term used in computer programming when a portion of the algorithm or set of instructions is repeated a specified number of times to complete the desired task. Loops save time when writing code. **Evaporation:** When heat energy from the sun causes water from bodies of water to rise into the air and turn into water vapour (gas). **Condensation:** When water vapour in the air cools down and turns back into liquid water.

	Precipitation: When water (in the form of rain, snow, hail or sleet) falls from clouds in the sky. **Collection:** This is when water that falls from the clouds as rain, snow, hail or sleet, collects in the oceans, rivers, lakes, streams. **Solid:** matter with a definite shape and volume. Particles are densely packed. **Liquid:** matter with a definite volume but takes the shape of the container it is in. Particles have more space between them allowing the matter to flow and pour. **Gas:** matter with no definite shape or volume. Particles are widely spaced so that they will fill any space that it is in. **Cycle**: a series of events that repeat in a pattern with regularity such as seasons, life cycles
Equipment and Materials	● Paper (consider good on one side paper) for water cycle diagrams ● Mural paper (if you choose) ● Pencils and colouring materials ● Scissors ● Codeable robots such as Dash or Ozobots (number dependent on availability) ● Block coding program ● Computers or IPads (number dependent on availability) ● Paper scratch blocks (see Appendix C: Paper Scratch Blocks) or arrows (if using the unplugged option) ● Journal or Coding a Raindrop through the Water Cycle Student Activity Guide (see Appendix A: Coding a Raindrop through the Water Cycle Journal)
Timeline and Preparation	**Lesson Preparation should take approximately 20 - 30 min.** ****allow extra time if using the unplugged version for printing, cutting, and laminating the blocks** Prior to the lesson, gather the materials required for the creation of the diagrams and secure the technology that will be used. If using the unplugged version of the activity, print a set of Scratch blocks for each group or create arrow cards for each group. Consider laminating the blocks for durability.

	Have the journal pages (if chosen) photocopied prior to the lesson. Pre-populate the vocabulary sheet or wall with the vocabulary for this lesson as it will be referred to again in the next learning experience. Consider preparing any chart paper anchor charts ahead of time. **Lesson Timeline:** **Minds On** 10 min. **Action** 30 min. **Consolidation** 20 min.
Safety Considerations	Students using scissors to cut out their water cycle diagrams should take care to use them safely and be mindful of the proper way to transport them from one space in the area to another. Refer to these safety resources: • Safety in Elementary Science and Technology (STAO) • Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE) • Ontario Curriculum Program Planning – Health and Safety
Opportunities For Assessment	The coding activity is designed to allow students to demonstrate their knowledge of water as it moves through the stages of the water cycle and draw conclusions about the natural world around them. **Assessment FOR Learning:** During discussions observe students' answers to the big idea questions. Observing how students place their diagrams in the space and the code they write to show their model of how water travels through the water cycle will allow the teacher to assess students' understanding of the concept of water moving through the water cycle in different states. Use the checklist (see Appendix D: Success Criteria Checklist) to record observations and evaluate what students

	already know and which direction the learning will take after this initial inquiry. **Assessment OF Learning**: The student's journal pages or Coding a Raindrop through the Water Cycle Student Activity Guide can be used as an example of student thinking and understanding. The completed written program can be an assessment of learning. Students should be able to complete a code that successfully shows what happens to water in nature; including demonstrating the concept that the water cycle repeats as a way of sustaining life and communicating that understanding and why it is important for living things. (see Appendix E: Coding a Raindrop through the Water Cycle Rubric)
Instructional Strategies and Adaptability	This learning experience makes use of a variety of instructional strategies. You may wish to adapt or change the strategy as indicated in the instructions section of this document. You may wish to scribe ideas or journal for students who require extra support. Some students may benefit from having the vocabulary and definitions on a handout sheet as well as being able to see and refer to them on a bulletin board.
Additional Supporting Resources	Scratch Blocks (English)
Cross-Curricular Opportunities	**Language** **Writing: Creative Writing - Life as a Raindrop** ● generate, gather, and organize ideas and information to write for an intended purpose and audience ● draft and revise their writing, using a variety of informational, literary, and graphic forms and stylistic elements appropriate for the purpose and audience ● use editing, proofreading, and publishing skills and strategies, and knowledge of language conventions, to correct errors, refine expression, and present their work effectively ● solve problems and create computational representations of mathematical situations using coding concepts and skills

Future Opportunities / Next Steps	Students can further investigate the concept of the importance of the water cycle by looking at how water pollution affects the quality of water. Students can participate in scientific research on water filtration and engage in the engineering design process to design and build a water filtration system. Students can also explore the concept of human impact on clean water and how access to clean water should be a right for all.

Appendix A: Code a Raindrop through the Water Cycle Journal Sheet

Code a Raindrop through the Water Cycle Journal Sheet

Name: Date:

Coding Reflection

How well did your code work?

What do you think you and your group did to make it work well?

What did you and your group find difficult?

How did you solve the problem?

I can make connections!

Your code had to repeat forever to show that the water cycle goes on forever. What would happen if the water cycle did not keep recycling the world's water?

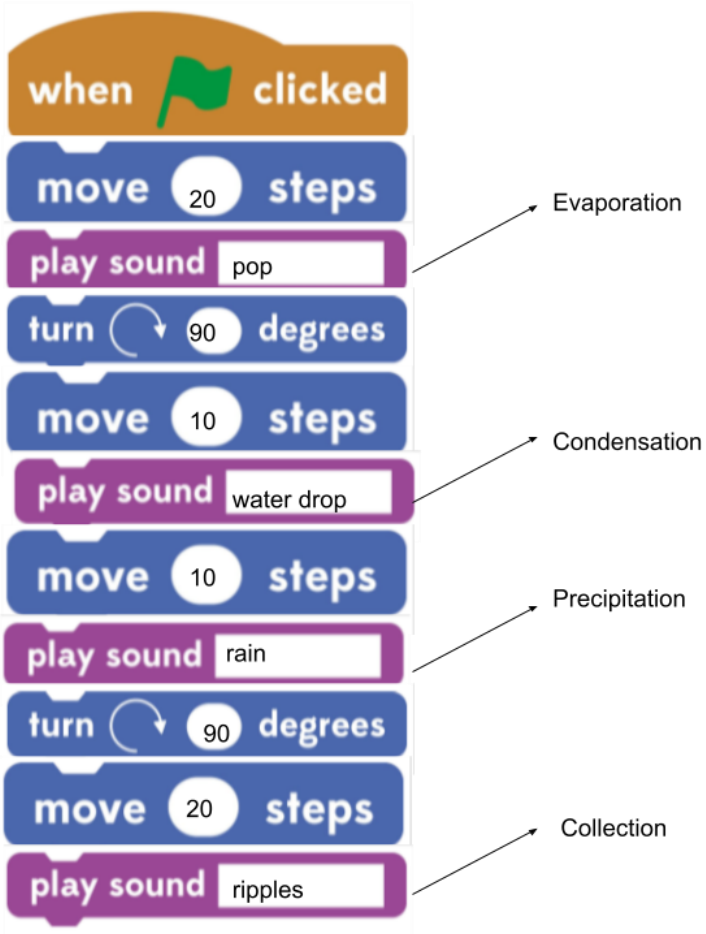
Are there more cycles that we can see in nature? Which ones can you think of?

Why do you think cycles important in nature?

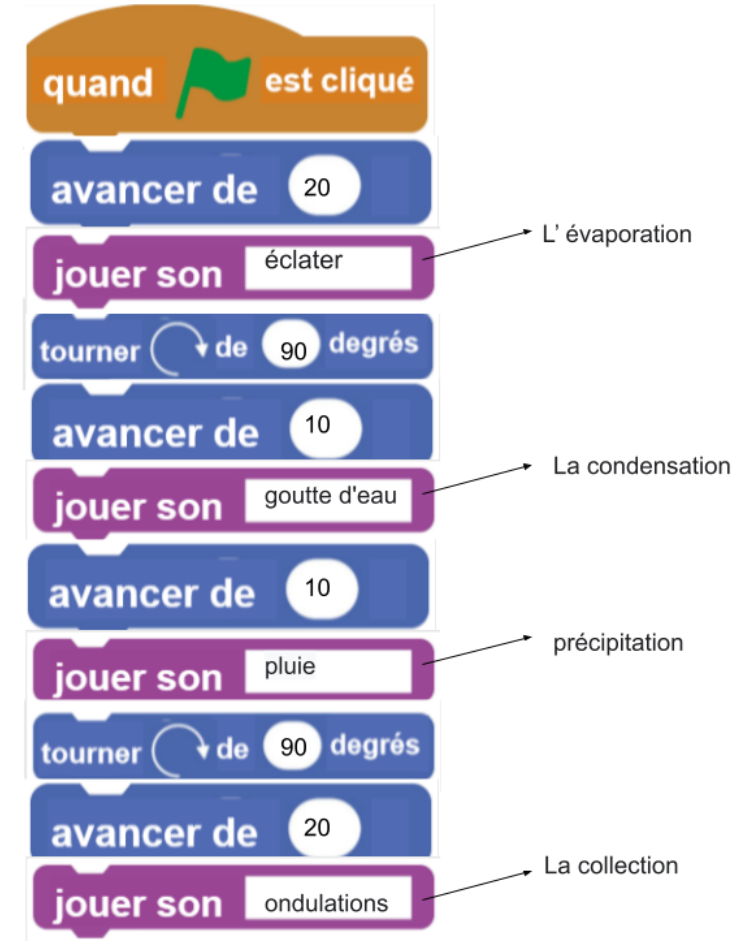
Appendix B: Sample Code

Sample Code

This is one example of what the code will look like. Student codes will vary. *Note a repeat forever block will need to be added to show the continuous nature of the water cycle.

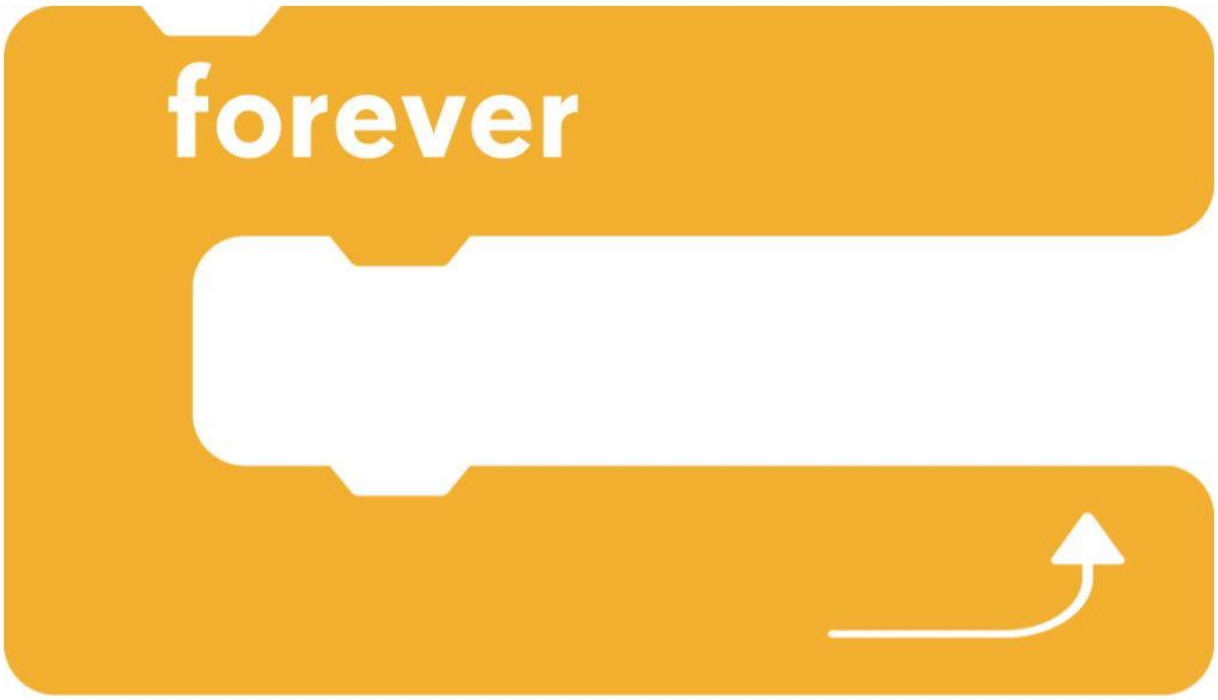


This block would go around the entire program.


quand est cliqué
avancer de 20
jouer son éclater
L' évaporation
tourner de 90 degrés
avancer de 10
jouer son goutte d'eau
La condensation
avancer de 10
jouer son pluie
précipitation
tourner de 90 degrés
avancer de 20
jouer son ondulations
La collection

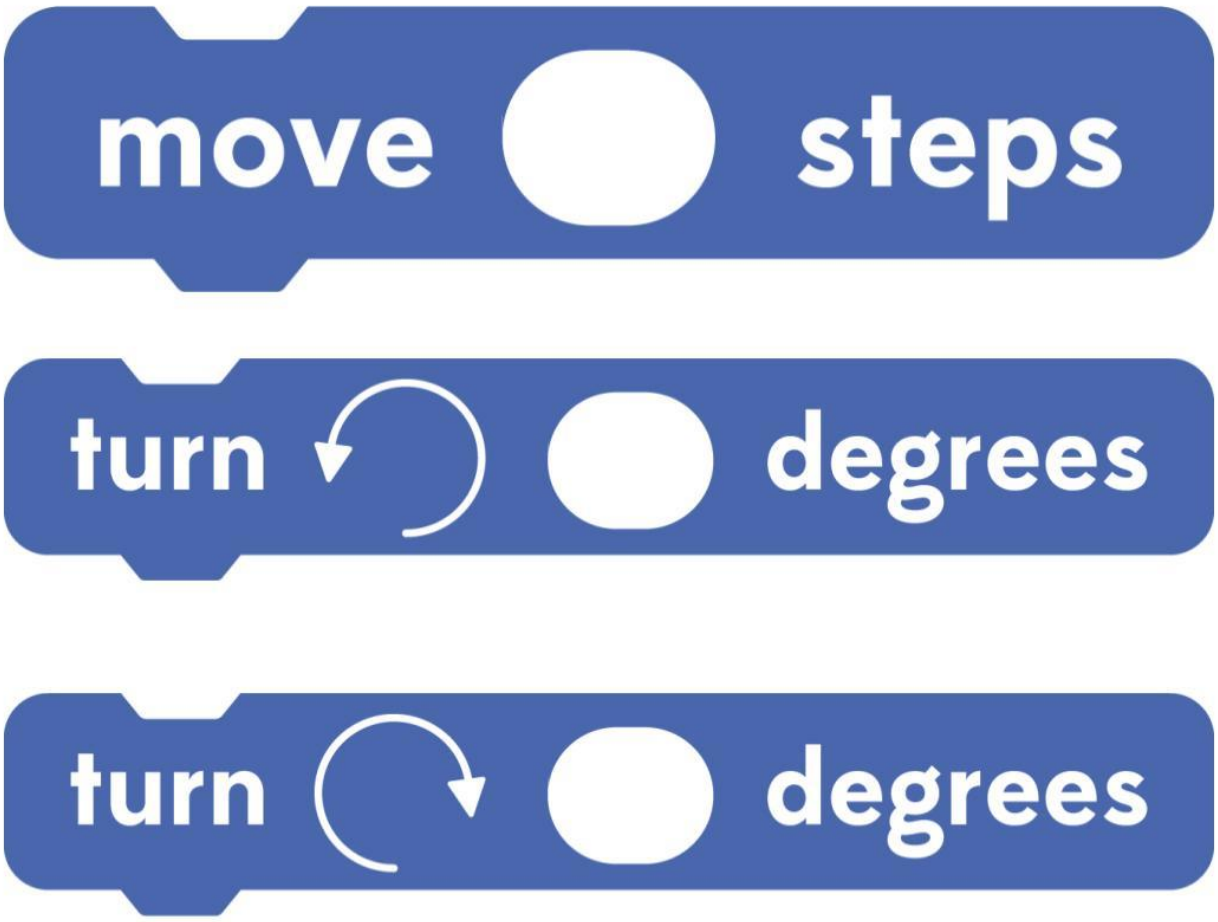

répéter indéfiniment

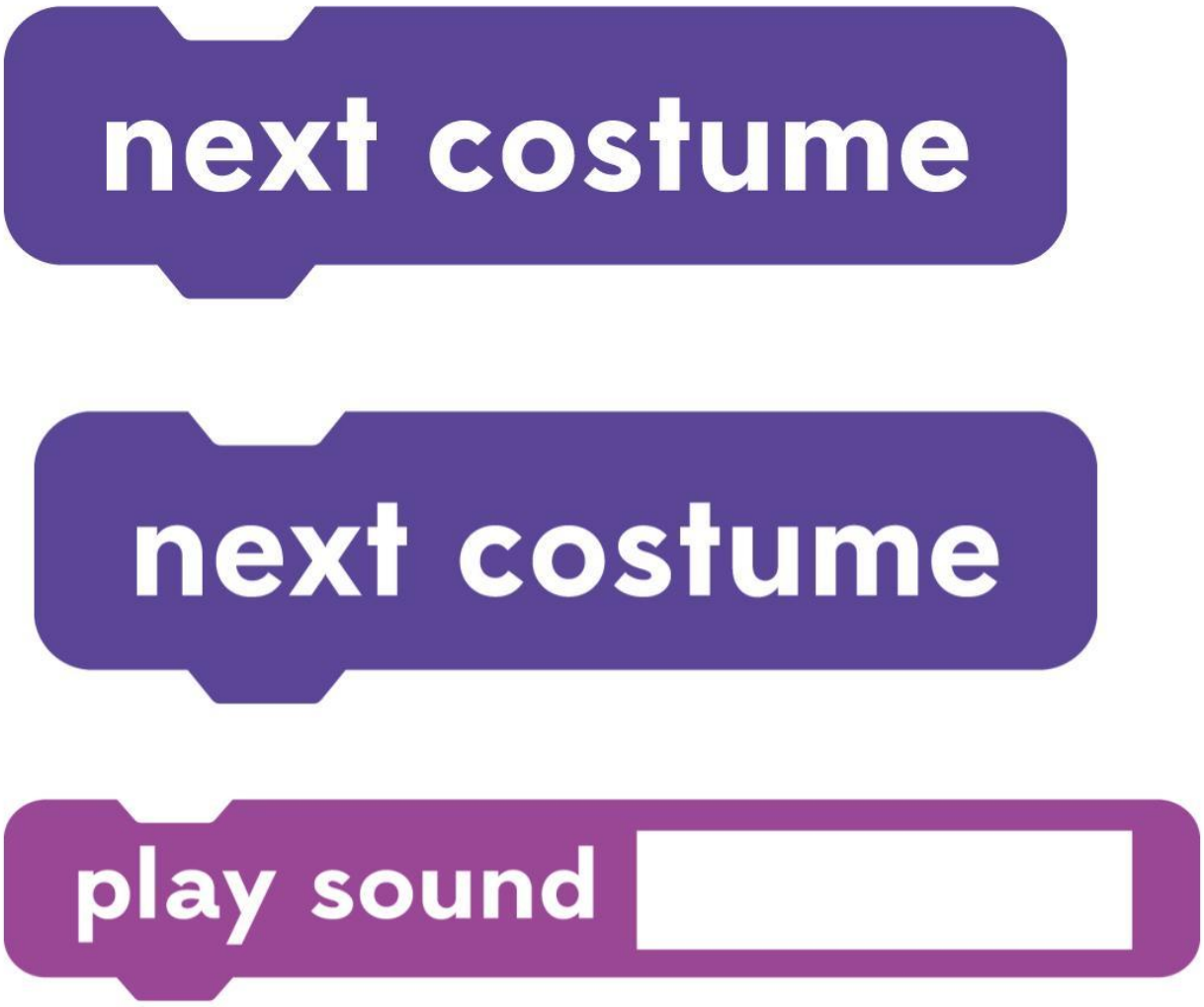
Appendix C: Paper Scratch Blocks


forever


when this sprite clicked


when clicked


move
steps
turn
degrees
turn
degrees


next costume
next costume
play sound

Appendix D: Success Criteria Checklist

Success Criteria Checklist

Name: Date:

I can	Met	Not Yet	Observations
I can write or draw my ideas to show my thinking.			
I can write an algorithm (sequence) to move my water drop through the water cycle.			
I can record the connections I make about the importance of the water cycle to living things using science vocabulary.			
I can persevere and solve problems as I work.			

Name: Date:

I can	Met	Not Yet	Observations
I can write or draw my ideas to show my thinking.			
I can write an algorithm (sequence) to move my water drop through the water cycle.			
I can record the connections I make about the importance of the water cycle to living things using science vocabulary.			
I can persevere and solve problems as I work.			

Appendix E: Coding a Raindrop through the Water Cycle Rubric

Coding a Raindrop through the Water Cycle Rubric

Expectations	Level 4	Level 3	Level 2	Level 1
A2.1 - write and execute code in investigations and when modelling concepts, with a focus on decomposing problems into smaller steps		-the learner wrote an algorithm that accurately moved a raindrop through the water cycle -the learner included a part of the code that indicated when the water drop was in a different stage of the water cycle -the learner worked through problems arising during the writing of the code		
A1.5 communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes		-the learner used unit vocabulary to communicate their findings		
A3.1 - describe practical applications of science and technology concepts in their home and community, and how these applications address real-world problems		-the learner made connections between the needs of living things and the role the water cycle plays in sustaining life. -the learner made connections between the water cycle and other cycles in nature.		
E2.4 identify the three states of water in the environment, and describe how temperature changes affect the state of water within the water cycle		-the learner used their code to demonstrate their understanding of the stages of the water cycle and the changes in state that water undergoes as it moves through the water cycle		

Comments: