



Modeling Natural Systems with Computers

2018 Hour of Code | Grades 2-8

Time | 45 - 60 minutes

Big Idea | You can use programming to simulate natural phenomena! In this example lesson, students will build an interactive model of the water cycle in Hopscotch.

Lesson Goals

- Students will identify all the essential components of the water cycle.
- Students will construct a visual model to illustrate the flow of water in the water cycle.
- Students will demonstrate an understanding of the changes of state of water by constructing an interactive model of the water cycle.
- (optional) Students will evaluate their own work as well as that of their peers in a positive and helpful manner.

Skill Focus

- Following a multi-step procedure to complete a task
- Using Hopscotch as a tool to express understanding of scientific concepts
- Manipulating inputs and outputs to create an animated, interactive model in a block-based programming language

Key Vocabulary

- **Water Cycle:** the continuous movement of water on the Earth
- **Event:** When something happens
- **Sequence:** A list of instructions, in order

Materials

- 1 iPad or iPhone per student, or 1 device per 2 students, for pair programming. Email educators@gethopscotch.com for bulk-created student accounts.
- Starter Project in Hopscotch: <https://c.gethopscotch.com/p/yfovtpb6i>
- Project examples available in Hopscotch:¹
 - <https://c.gethopscotch.com/p/xqrgdkl5u>
 - <https://c.gethopscotch.com/p/y0kr56ou9>
 - <https://c.gethopscotch.com/p/xvtc1lh8q>
 - <https://c.gethopscotch.com/p/xwtqyolh7>
- [Water Cycle Worksheet](#)

Teacher Brief

The role of water in the earth's surfaces processes is one of the disciplinary core ideas set forth by the Next Gen Science Standards. The water cycle is one of the important systems that students in middle grades must understand. There are many ways that students can construct visual and physical models of the water

¹ These project examples were made by Hopscotch users. Some are more complex than others. Please see note in section 0 below for suggestions on how to discuss them with students.

HOPSCOTCH

cycle; Hopscotch provides a unique opportunity for students to practice the skills of visualizing a complex system and using logic and problem solving to determine how to make an interactive model that is scientifically accurate. Creating a program to demonstrate understanding makes students' learning powerful, meaningful, and long lasting. Suggested modifications are included below and may prove helpful for students in need of more structure. This lesson assumes that students have little to no experience coding in Hopscotch, but are prepared to create a model of the water cycle.

Lesson

0. Whole Group Discussion (5 minutes)

- Introduce the project to students; explain that they will be using Hopscotch to create an interactive model of the water cycle.
- Review the components of the water cycle and have students brainstorm the elements for the project. With teacher guidance, these components could become the criteria for success.
- (Optional) Share example projects and/or the starter project with students. As a class, discuss if these projects capture the project criteria. *What is included? What is missing? What do these examples do well and how could you make them more effective?* This is also a great opportunity to introduce the practice of reflecting and giving feedback on a project using helpful and constructive language.

1. Getting to Hopscotch (5 min)

1.1 Find the Hopscotch app on your iPad

1.2 Sign in to your account (students may need to create accounts)

1.3 Making a new project: Tap on the highlighted + on the bottom of the screen

2. Getting Familiar with Hopscotch (10min)

2.1 Exploring the Workspace & Blocks

- Students new to Hopscotch must go through the introductory tutorials to get a sense of how to add objects to the workspace and code these objects. This step enables students to create new projects from scratch.
- Share the [water cycle](#) worksheet with students; this worksheet shows code that might be helpful in making an interactive model of the water cycle.

2.2 Check In & Share Out

- Ask students to share helpful things they noticed.
- Answer common questions, if necessary.

3. Create the Model (20 min)

HOPSCOTCH

3.1 Work Time: Building the Model (10 min)

- First, students will need to plan their model. Students will add objects to the workspace so that the visual model of the water cycle comes together. Then, they will need time to plan and design how the different parts of the model will interact with each other.
- (Optional) If students are not already working in partners or small groups, encourage students to use *thought partners* who will help each other during the design process.

3.2 Work Time: Making it Interactive (10min)

- Now comes the fun part. The water cycle is full of motion; encourage students to express how water changes state at each phase of the cycle using the motion and looks and sound blocks in Hopscotch. For example, objects may appear, disappear, or make a sound as the model unfolds.

4. Reflection (5 min)

4.1 Whole Group Reflection

- Choose a few student projects to share and discuss as a class
- Suggested questions for student presenters:
 - What part(s) of your project are the most proud of?
 - What challenges did you experience?
 - What choices did you make while designing your project?
- For students commenting on projects, it may be helpful to recommend a format for feedback such as red/yellow/green, plus/delta, etc.
- Suggested questions for students giving feedback:
 - What do you think the creator did well?
 - What do you think could be improved?
 - What questions do you have about the choices the creator made?

5. (Optional) Sharing Projects with the Hopscotch Community (15min)

5.1 Publishing a Project

- When students finish, they can publish projects to the Hopscotch community. This is a great opportunity for students to share their work with a digital audience. Students can "like" another student's project and remix it to see how it was made.

5.2 Evaluating a Classmates' Project

- Show students how to search for projects in the Hopscotch community.
 - Encourage students to remix their classmates' projects in order to see how they created their project.
 - Students may use the project rubric or pre-determined criteria for success to evaluate each other's work and give helpful feedback.
-

HOPSCOTCH

Modifications

- Pair programming: this is a great opportunity for students to work together to create strong projects that they are proud of
- Students can remix the [Project Starter](#) in Hopscotch
- Create a visual model on paper that students can recreate in Hopscotch
- Printed copies of the [Water Cycle worksheet](#)

Curriculum Extensions

- Make it a game: Encourage students to gamify their project. For example, a project might require that the player tap on the phases of the water cycle in the correct order.
- Extend the learning: How could the project capture environmental challenges?
- Self-assessment: Using this rubric as a model², encourage students to assess their work, evaluate its effectiveness, and iterate to improve the project.

Next Gen Science Standards

ESS2.C: The Roles of Water in Earth's Surface Processes: Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ESS-2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Common Core State Standards

- CCSS.MATH.PRACTICE.MP4 Model with mathematics.
- NGSS Practice 1 Defining problems
- NGSS Practice 2 Developing and using models

² Rubric: <https://drive.google.com/file/d/0BwKFT8tX5oZVbzkwWHN0OFBOM3c/view>