Overview

This lesson requires 2 periods over a course of 1 week (7 days). In the first session, students are introduced to the element of a system for tracking relatively slow change (plants germinating and growing) and in setting up the system, including 'planting' seeds in damp cotton wool and paper. In the second session, approx 7 days later (depending on conditions) students will examine their recording of the change and use the photographs obtained to make a presentation for their classmates.

During this lesson, students will gain understanding of how change occurs in plant life over time. Students will integrate and exhibit learning by identifying and recording changes over time.

Key Information

Level 2: (Ages 9-10) US Grades 3 or 4

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7.5 minutes
Challenge 1	7.5 minutes
Challenge 1 - Debug	5 minutes
Challenge 2	50 minutes (over 2 sessions)
Tidy Up / Exit Ticket	5 minutes

Lesson Topics

● **Science**
  ○ Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe
  ○ Plants acquire their material for growth chiefly from air and water
● **Scientific Thinking**
  ○ Asking relevant questions and using different types of scientific enquiries to answer them setting up simple practical enquiries
  ○ Trial and error combined with calibration and adjustment
● **Math**
  ○ Duration of events and measurement of time (months, days hours, minutes, seconds)
● **Computing**
  ○ Inputs, outputs, modifiers, debugging
  ○ Create, edit, manipulate and present digital content
● **Design and Technology**
  ○ Generate, develop, model and communicate ideas through talking, drawing and mock-ups
● **English Language Arts**
  ○ Use information gained from the illustrations and words in a print or digital text
  ○ Oral presentation

Learning Objectives

● *As a result of this lesson, students will be able to*
  ○ Explain and demonstrate that plants grow if they have light and water

   ○ Explain that change, if not observable, is recordable
   ○ Build, debug and make the system to record the growth of a plant

Materials

- **Per group**
  ○ 1 glass water
  ○ ½ tsp sugar
  ○ 1 yoghurt pot
  ○ handful cotton wool
  ○ 2 sheets kitchen roll
  ○ pepper grass or cress seeds
- SAM Labs Kit
- SAM Labs Student Workbook

Warm Up – Scientific Discussion   5 minutes
Can we observe all change as it takes place?

Objective: Understand that change takes place at different rates in different settings

Procedures: Teachers asks the students to look at the pictures. *Can you see that all of the things have changed over time: How long do they estimate this change takes or has taken? What evidence do they have to support their viewpoints?*

Sample photo ideas: ice cream, rock, jeans

Link Forward: The teachers prepares students to design and build a system to record change using a series of photographs

Mini-lesson   10 minutes
Exploring the speed of change.

Objective: Students learn that some change happens very quickly and some more slowly.

Procedures: Teacher elicits or explains that some change we can see (like an ice cream melting or a sandcastle disappearing in the ocean waves on the beach), and some we cannot. We certainly cannot see the change in a rock being eroded (8 minutes).

At the end of the mini-lesson, students match or define keywords in their workbooks. (2 minutes)

Key Words
- Change
- Speed
- Grow
- Melt
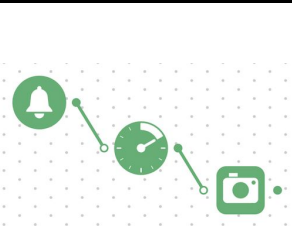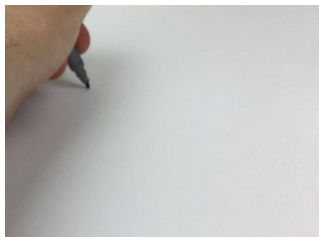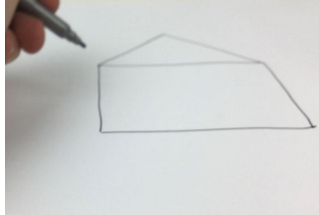
- Imperceptible
- Erosion
- Dissolve
- Perceptible

Let's discuss: *Does all change happen at the same speed? In your workbooks or with a partner, record, discuss, or share a definition of change and examples of fast (visible) change and slow (imperceptible) change.*

Link forward: The teacher prepares students to design a system to track the growth of a plant.

Worked Example   7.5 minutes
Make a working system that tracks change over a short time.

Instructions	Workspace	Notes for Teachers
Step 1. Drag the Time Trigger block, Interval Block and Camera block onto the Workspace.		*Time Trigger blocks are a form of delayed output. Like an alarm clock but more flexible - they can make anything do anything at a certain time*
Step 2. Set the Time Trigger block to a few minutes from now and the Interval block at 10 second intervals.		*Take the opportunity to revise the 24 hour clock*
Step 3. Connect the output of the Interval block to the input of the Camera block.		*The camera block is a SAM feature allowing you to take photos using your device's built-in camera* ● *On iOS the photos are found in the Photo app* ● *On Windows the photos are found in Windows -> Pictures folder* ● *On Mac OSX they are found in homedirectory/Pictures/SAMSpace*
Step 4. Point the camera at the desk. They should have a piece of paper ready.		*Students are going to take a series of photos of themselves drawing or writing*
Step 5. Ask the students to start the system and to begin to draw or write.		*Make sure that the camera can see your hand before you start*

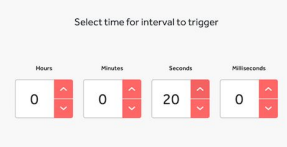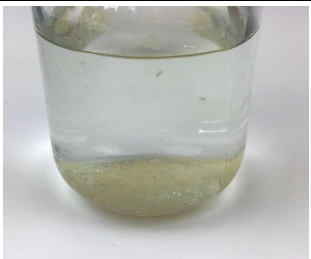|		
Step 6. After one minute ask them to stop and to check the photos in the device.		*You will see, in a series of photos, how the paper on which you drew gradually changed. Although this change is quite quick and visible, we have a record of all it.*

Checks for understanding: *Do they understand how we have created a record of the changes they made upon the paper?*

Challenge 1   7.5 minutes
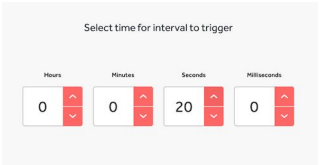*Make a working system that records slow change.*

Instructions	Workspace	Notes for Teachers
Step 1. Use the system as before.		*The system is the same but we are going to repurpose it for a slower changing situation*
Step 2. Place a glass with some water in front of the camera.		*The glass should be transparent.* *If the computer has a detachable webcam, this is simpler. A tablet device will need a support*
Step 3. Set the Interval block to trigger every 20 seconds.		*3 minutes is approximately the time it takes for a few grains of sugar to dissolve at room temperature, but the exact time will depend on the conditions in your class*
Step 4. Put a small amount of sugar in the water and start the system.		*Not too much. A few grains (as long as they are visible to the camera) are better than a spoonful*
Step 5. After 3 minutes look at the pictures.		*The photos show how the sugar gradually dissolves in the sugar. You should keep a note of the time it take for the Debug*

Checks for understanding: *Why do we not see the sugar dissolving with our eyes, but we can appreciate it when we look at the pictures?*

Challenge 1 - Debug it: 5 minutes

Are the Intervals are too long or too short to capture the sugar dissolving?
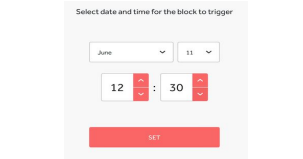
Instructions	Workspace	Notes for Teachers
Step 1. Edit the Settings of the Interval bock so that they capture the sugar dissolving.	Select time for interval to trigger Hours Minutes Seconds Milliseconds 0 0 20 0	*This will depend on:* ● *the type of sugar* ● *the temperature if the water* ● *the amount of sugar* *Use your notes from the previous step to approximate a time to capture the entire process*

Checks for understanding: *If we wanted to capture a record of slower change, what would we have to do?*

Challenge 2:   10 + 40 minutes

Make a working system that records a slower change. This time, instead of dissolving or erosion, we look at growth.

Instructions	Workspace	Notes for Teachers
Pre-Task		
Step 1. In groups, pupils make an environment for cress seeds to grow. All have a yoghurt pot. Put wet kitchen roll in the bottom and damp cotton wool on top. Place cress seeds on top and put near a window to grow within 7 days.	Yoghurt Pot Kitchen roll Cotton Wool Cress seeds	*Cress or pepper grass is chosen as it is the most rapidly-growing common seed we can easily find* *Note that this preparation is done at the beginning of the experiment - probably in the first period*
Step 2. Ensure all have completed *Step 1* and have a yoghurt pot with cress seeds in it, ready to grow.	Yoghurt Pot Kitchen roll Cotton Wool Cress seeds	*Have a couple of sets ready for the students who do not or cannot perform the pre-task.*
Step 3. Add 7 Time Trigger blocks to the workspace		*We are going to record growth each day, so instead of measuring in second or minutes we are using days, as the change is slower. We are choosing the correct unit for the periods we want to measure.*
Step 4. Edit the settings of all the Time Trigger blocks to the same time but a different day on each.	Select date and time for the block to trigger June 11 12 : 30 SET	*Edit the settings of all the time trigger blocks to the same time but a different day on each.*

Step 5. Connect the outputs of the Time Trigger blocks to the input of a Camera block.		*It is a good idea to set the Triggers to a time when everyone is in class.*
Step 6. Leave the system for 7 days.		*Do not move the system over this time.*
Approximately 1 week (7 days) are needed between the preceding and following steps		
Step 7. After 7 days you'll see the cress has grown.		*The series of picture will show, all at once, how the seeds sprout and grow.*
Step 8. Make a slideshow of your photos and show them to the rest of the class.		*Plants like cress acquire their material for growth chiefly from air and water. They need little else. Is this true of all plants?* *We highly recommend that this step be completed so students can appreciate the benefits of mechanisms for recording change and learning from this for planning for the future.*

Extension Ideas:
- **Science**
  - Ask students if they have any idea how long they would need to record other plants in their yard or home
  - Other changes, eg: their desk over the course of a day
  - Another slower-growing plant. perhaps get one for the class and assign different students to care for it every day
- **ICT**
  - Time lapse video using Movie Maker (PC) or iMovie (Mac)
- **Scientific Thinking**
  - in what ways could keeping a record of a slow change help up to prepare for the future?
  - Recording pedestrian traffic or vehicle flow in cities to plan crossings and roads
  - Recording eating patterns at lunch time

Tidy Up / Exit Ticket   5 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.