

Investigating Two SENSES



Lesson Overview

Students investigate Cubelets with two SENSE Cubelets.

Today students will investigate what happens when they use more than one SENSE Cubelet in their robot construction. There are two important lessons to learn about robot constructions that use multiple SENSE Cubelets. First, students will discover ACT Cubelets *average* the values they receive from multiple SENSE Cubelets - and the further away a SENSE Cubelet is from an ACT Cubelet, the lower the signal it sends. We call this a "Weighted Average". Second, students will discover that SENSE Cubelets do not send information *through* them. Therefore, if two SENSE Cubelets are right next to each other, it is as if there is a blocker between them - ACT Cubelets on either side will not receive an *average* value.



Lesson Tags

Grade Level
Grades 7+

Difficulty
Apprentice

Duration
55 minutes

Prerequisite Knowledge

ACT Cubelets
SENSE Cubelets
How SENSE Cubelets control ACT Cubelets



Supplies

Cubelets (for each group)

2 Distance SENSE
1 Brightness SENSE
1 Rotate ACT
1 Drive ACT
1 Flashlight ACT
1 Battery
1 Bar Graph ACT per group (if possible)
Have all other Cubelets available in central location for students who need them.

Other Supplies

Flashlight (one per group)
[Claim-Evidence-Reasoning worksheet](#)



Description

Outline

1. Review vocabulary and Group Norms
2. Students investigate Cubelets constructions using multiple SENSE Cubelets
3. Students discuss findings from the investigation

Objectives

Students will investigate the effect of using two SENSE Cubelets in a robot construction.

Assessment

Teachers look for students using computational thinking by carefully testing each SENSE Cubelet individually, then together. Teachers look for collaborative language and perseverance through this challenge.



Standards

ISTE

- 1.d. With guidance from an educator, students explore a variety of technologies that will help them in their learning and begin to demonstrate an understanding of how knowledge can be transferred between tools.
- 4.a. With guidance from an educator, students ask questions, suggest solutions, test ideas to solve problems, and share their learning.
- 4.d. Students demonstrate perseverance when working to complete a challenging task.
- 5.b. With guidance from an educator, students analyze age-appropriate data and look for similarities in order to identify patterns and find solutions.

K12CS

Algorithms: People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

Modularity: Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. These modules can be procedures within a program; combinations of data and procedures; or independent, but interrelated, programs. Modules allow for better management of complex tasks.

NGSS

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.



Vocabulary

Weighted Average
Collaborate
Cubelets
Robot
Sense
Think
Act

Battery
Distance
Brightness
Drive
Flashlight
Rotate



Resources

Attachments

[Claim-Evidence-Reasoning Worksheet](#)

Tips & Tricks

- **Keep the lights dim or off during this lesson**

Pacing

5 minutes: Review Cubelets vocabulary and group-work norms
 15 minutes: Students use guided inquiry worksheet to develop their thoughts about robots with more than one SENSE Cubelet
 15 minutes: Whole class discussion of findings from investigation
 Introduce vocabulary: **weighted average**
 5 minutes: Ticket Out

Instructional Steps



Step 1 - Pre-class setup

Time: 10 minutes

Cubelets Needed

- ☐ Separate Cubelets into groups, each containing:



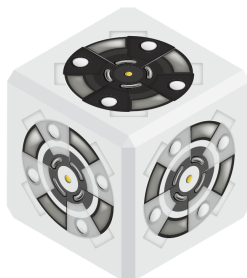
- ☐ Distance SENSE



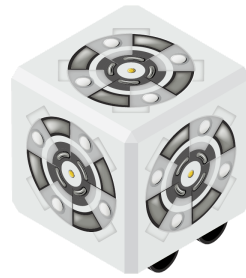
- ☐ Distance SENSE



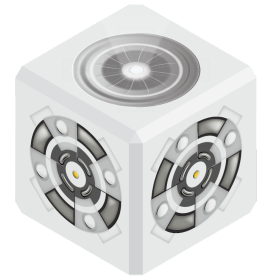
- ☐ 1 Brightness SENSE



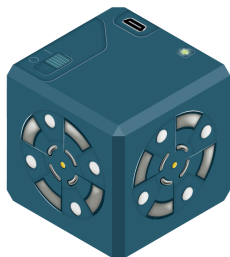
- ☐ 1 Rotate ACT



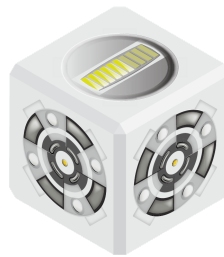
- ☐ 1 Drive ACT



- ☐ 1 Flashlight ACT



- ☐ 1 Battery



- ☐ 1 Bar Graph ACT (if possible)



- ☐ 1 real flashlight

Classroom Management

- ☐ Plan 6 student groups (groups should be no more than 4 students, and are best with 2-3).
- ☐ Dim or turn off lights so students can more easily tell the difference between the Distance SENSE and Brightness SENSE



Step 2 - Cultivate Wonder

Time: 5 minutes

Introduce Task

"Yesterday we investigated Cubelets through the context of complexity, emergence, and modularity. Now you have a strong understanding of how each individual Cubelet contributes to the system, but today we're going to investigate a couple underlying "rules" of Cubelets - especially SENSE Cubelets.



Step 3 - Experience Before Expertise

Time: 20 minutes

Investigate (20 minutes)

"Today your group is in charge of investigating what happens when we have two SENSE Cubelets instead of only one SENSE Cubelet. There are a couple different rules you'll need to discover about how SENSE Cubelets do and don't work together. (Hint: it has to do with where they are in the robot construction relative to each other). Once you've figured out at least two of the "rules" governing how SENSE Cubelets work together (or don't), then your group may explore the various robot designs you can create with multiple SENSE Cubelets.

- Groups investigate robot constructions with multiple SENSE Cubelets.

Notes

- ★ SENSE Cubelets have some unique properties (but do not tell them during class today)::
 - Two SENSE Cubelets on one robot construction will cause *all* connected ACT Cubelets to act according to a **weighted average** of the SENSES based on how far away each SENSE Cubelet is from the ACT Cubelet.
 - SENSE Cubelets do not communicate *through* each other, so if two SENSE Cubelets are touching, then they will not average out.
- ★ If a robot is not doing anything, check:
 - Is the Battery attached?
 - Try wiggling the Cubelets against each other to reseal the magnets together.
 - Try attaching the Cubelets using different sides (occasionally one side of a Cubelet will become a "dud" while the other sides still work)



Step 4 - Co-Construct Meaning

Time: 25 minutes

Guided Inquiry (10 minutes)

"Now that you think you know all there is to know about robots with two SENSE Cubelets, I'd like to you capture your thinking on these pages. The front is designed to help you double-check your claims about robot constructions with multiple SENSE Cubelets, the back will help you write a Claim-Evidence-Reasoning statement about robot constructions with multiple SENSE Cubelets. After you finish, we'll share our CERs and revise our thinking as needed

- Students draft [Claim-Evidence-Reasoning statement](#)

cubelets		Name: _____
Claim-Evidence-Reasoning about SENSE Cubelets		
C Claim	When using two SENSE Cubelets in one robot construction, it is important to remember the SENSE Cubelets also by their rules:	
	I proved my claim when I compared these two robot constructions:	
E Evidence	1st robot construction	2nd robot construction
	When I compared the two robot constructions above, this is how they behaved differently from each other:	
R Reasoning	This makes sense because:	

Discuss (15 minutes)

"What did you discover about using two SENSE Cubelets during your investigation today?"

- [[Robot moves slower with two instead of one]
- [Can control the robot with either SENSE, but somehow they still are working together]
- [Robot **averages** the two SENSES: it is "halfway" between the SENSES]
- [It matters how *close* an ACT Cubelet is to a SENSE Cubelet]
- [SENSE Cubelets do not send commands *through* each other]

"How might this new understanding help you design future robots?"

Notes

- ★ You may include the term **weighted average** to include how far away the Cubelets are from each other. The further apart, the lower the "weight" of that SENSE into the average.
- ★ Based on how your class discussion goes, you may choose to give your students time to revise their CER statements before submitting them as their Check for Understanding.



Step 5 - Check for Understanding

Time: 5 minutes

Collect CERs

Materials Managers put away Cubelets.

- Depending on your students' experience writing Claim-Evidence-Reasoning statements, you may choose to assess solely based on Cubelets content understanding or you may choose to give students feedback about the structure of their CER.



Differentiation - Intervention & Extension

Time: NA

Intervention

If students are struggling to explain what happens when they add a second SENSE Cubelet, have them take a break by exploring with two ACT Cubelets for a few minutes. Then redirect them to choose an ACT Cubelet that is their favorite (Rotates and Flashlights are especially good for this). Have them make a 3-block robot construction with this ACT Cubelet and ask them to explain how the robot works. Then add the second SENSE Cubelet and have them explain what happens now. Is it the same? Is the light as bright? Does the rotate spin as fast? What if they shine the flashlight on and off the Brightness SENSE Cubelet?

Extension

Challenge students to investigate which THINK Cubelets mimic having multiple SENSE Cubelets in a robot construction.