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# 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
Intermediate (4-6)

### Difficulty
Artisan

### Duration
45 minutes

### Prerequisite Knowledge
ACT Cubelets
SENSE Cubelets
How SENSE Cubelets control ACT Cubelets

## Supplies

### Cubelets (6 groups of)
1 Distance SENSE
1 Brightness SENSE
1 Rotate ACT
1 Drive ACT
1 Flashlight ACT
1 Battery

### Other Supplies
Flashlight (at least 6)
One Investigating SENSES worksheet per student

## 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 algorithmic thinking by carefully testing each SENSE Cubelets individually, then together. Teachers look for collaborative language and perseverance through this challenge.

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## 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.

**Common Core**

**Grade 6 -** CCSS.MATH.CONTENT.6.SP.B.5.C. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

**K12CS**

Hardware and Software - Hardware and software work together as a system to accomplish tasks, such as sending, receiving, processing, and storing units of information as bits. Bits serve as the basic unit of data in computing systems and can represent a variety of information.

Modularity - Programs can be broken down into smaller parts to facilitate their design, implementation, and review. Programs can also be created by incorporating smaller portions of programs that have already been created.

**NGSS**

Planning and Carrying Out Investigations - Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Using Mathematics and Computational Thinking - In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

## Vocabulary

| | | | | |
|---|---|---|---|---|
| Weighted Average | Collaborate | Robot | Think | Distance |
| | Cubelets | Sense | Act | Brightness |

## Resources

**Attachments**

Investigating SENSE Cubelets Worksheet

**Tips & Tricks**

- **Keep the lights dim or off during this lesson**
- Before class, have your groups planned - think also of what collaboration structures make the most sense for your class or your school.

**Pacing**

5 minutes: Review Cubelets vocabulary and group-work norms
10 minutes: Students investigate Cubelets using two SENSES
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



*How did this lesson work for you? Let us know!* goo.gl/8DPzLX
Check out **our newest resources** at *www.modrobotics.com/thehub*

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# Instructional Steps

## Step 1 - Pre-class setup

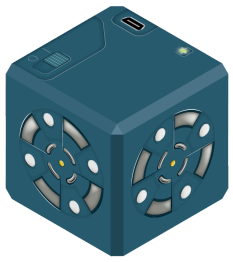
Time: 10 minutes

### Cubelets Needed

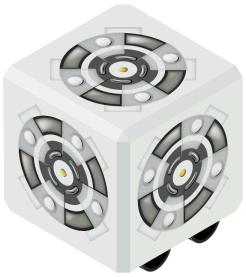
- ❑ Separate Cubelets into 6 groups, each containing:

- ❑ 1 Distance SENSE

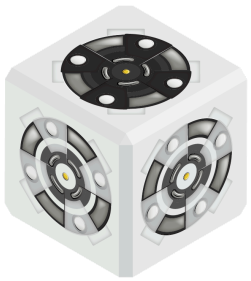
- ❑ 1 Brightness SENSE



- ❑ 1 Battery

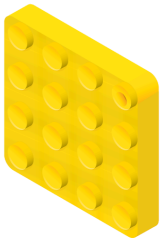


- ❑ 1 Drive ACT



- ❑ 1 Rotate ACT

- ❑ 1 Flashlight ACT



- ❑ Brick Adapters

- ❑ Construction bricks

- ❑ 1 real flashlight

### Classroom Management

- ❑ Plan 6 student groups (groups should be no more than 4 students, and are best with 2-3).
- ❑ Decide on collaboration roles that fit your classroom culture. Some ideas could include:
  - Materials Gatherer - the only team member that can leave the group. Gathers materials and puts materials away correctly.
  - Facilitator - responsible for making sure the group stays on task and follows directions.
  - Encourager - responsible for encouraging group members and making sure everyone has a chance to share their ideas
  - Time Keeper - monitors time to help team stay on track

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## Step 2 - Cultivate Wonder

Time: 5 minutes

### Introduce Task

*"We've played with a lot of Cubelets during this unit, right? And so far, how many SENSE Cubelets do we normally use when we build?"*

- [one]

*"Yes, so far we've only been building with one SENSE Cubelet. But today, we're going to move from Cubelets Artisans to Cubelets Masters - we're going to investigate what happens when we use two SENSE Cubelets on one robot construction! Does anyone have any ideas about what might happen when we use both the Distance AND the Brightness Cubelets on a robot construction?*

- [Students share predictions]

### Review Group Norms

*"First, let's remember the Group Norms we made on the first day of this Cubelets unit.*

- Review ideas on Group Norm anchor chart.

*"Today, you will be in groups of [2, 3, or 4] students. Each person will have a very specific job. [Review the jobs you decided on during your preparation for class]."*

- Wrap up conversation by reviewing the group norms, separating students into their groups, and assigning group roles.
- Once students are in their groups, have them share with the other group members what their role in the group is.

## Step 3 - Experience Before Expertise

Time: 25 minutes

### Investigate (10 minutes)

*"Today your group is in charge of investigating what happens when we have two SENSE Cubelets instead of only one Cubelet. After you have figured out what happens when we use two SENSE Cubelets, you are welcome to begin building robot constructions that have both two SENSE Cubelets and two ACT Cubelets. Be careful, though, using two SENSE Cubelets can make a big change to your robot! Spend some time figuring out how to explain it with your words."*

- Groups get to work investigating SENSE Cubelets one at a time.

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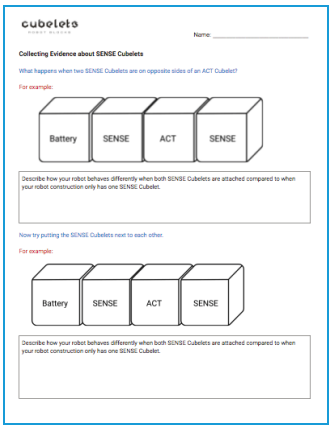
### Guided Inquiry (15 minutes)

*"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 continue investigation with Investigating SENSE Cubelets Worksheet

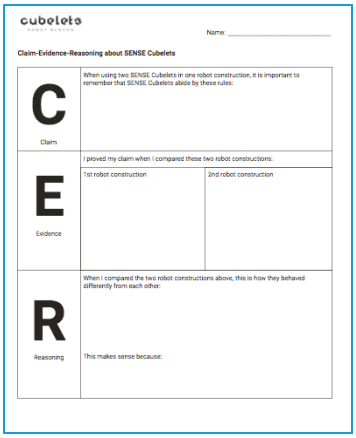

cubelets
ROBOT BLOCKS
Name: _____
Collecting Evidence about SENSE Cubelets
What happens when two SENSE Cubelets are on opposite sides of an ACT Cubelet?
For example:
Battery SENSE ACT SENSE
Describe how your robot behaves differently when both SENSE Cubelets are attached compared to when your robot construction only has one SENSE Cubelet.
Now try putting the SENSE Cubelets next to each other.
For example:
Battery SENSE ACT SENSE
Describe how your robot behaves differently when both SENSE Cubelets are attached compared to when your robot construction only has one SENSE Cubelet.

## Step 4 - Co-Construct Meaning

Time: 15 minutes

### Discuss

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


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

- [[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]

### Notes

★ It's appropriate to say average is in the middle of the two SENSE Cubelets. You may also 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: 0 minutes

### Collect CERs

- Since this is the second opportunity for students to create Claim-Evidence-Reasoning statements and there is time for substantial class discourse before revision and submission, it is appropriate to use this Claim-Evidence-Reasoning as a baseline data point for your students.

Materials Managers put away Cubelets.

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## 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 on 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 explains 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

It is unlikely students at this age will quickly grasp this concept, but for students who very quickly figure it out, ask them to use Legos and brick adapters to make their robots “come to life” with what they think it could do or be.