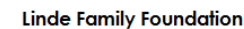


ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

Educator Training – Day 1
Welcome!



Agenda



- » Welcome
- » ZR Background/Intro
- » The SPHERES
- » Math Terms
- » ZR IDE, Part 1
- » Lunch/Snack Break
- » Q and A
- » Intro to the 2015 Game
- » ZR IDE, Part 2
- » Explore Teacher Guide

WHO'S IN THE ROOM???





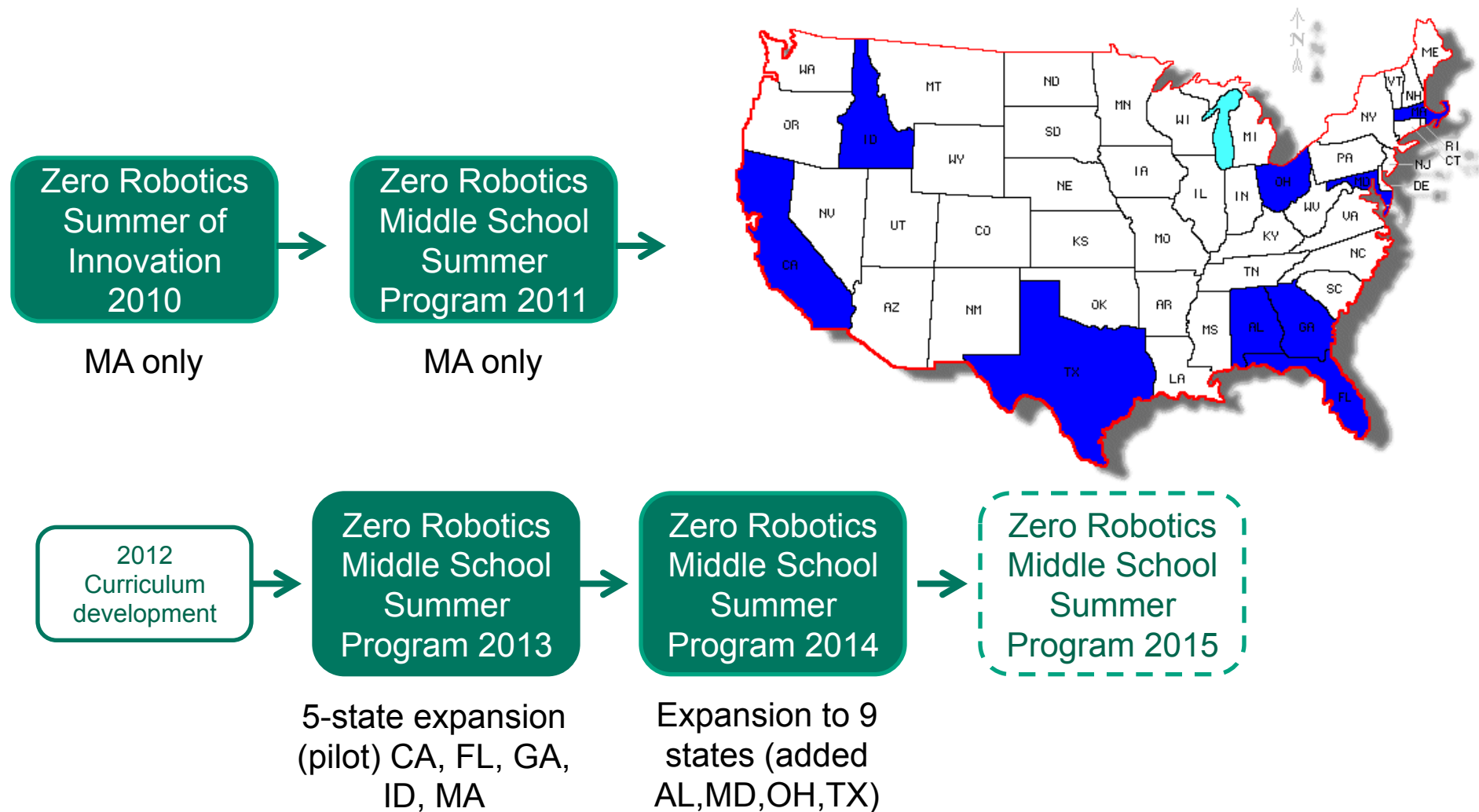
“I don’ t know, but we’ ll find out!”

This training is supported in part by:

Linde Family Foundation

Mott Philanthropic





Program Overview

- Supports a variety of programming schedules
- Mixture of math and science instruction, coding, problem-solving, games, and youth development activities
- 15 hours per week (75 hours total)
 - 5 days per week with 3 hours ZR per day - OR -
 - 3 days per week with 5 hours ZR per day - OR -
 - 4 days per week is also successful since it avoids problems with student absences on Fridays





Schedule	Competition Elements	Curriculum Units
Week 1	Introduction	Introduction to Physics and Math
Week 2	Field Day	Intro to Computer Science, SPHERES & the ZR Game
Week 3	Intramurals/Practice Regional Competition	Time to Play! - Programming and Support
Week 4	Regional Competition	Strategies and Testing
Week 5	ISS Collaboration	Finals Prep and My Future in Science & Engineering
Mid- Aug	ISS Finals!	

Note: Due to ISS availability, the ISS Finals date is not fixed until ~3 weeks before event.

Middle School Program Schedule



- May: Educator training part 1
- June: Educator training part 2 (3 hour webinar)
- July 6 – August 7: 5 week summer program
- August: One day event: ISS Finals, live from ISS



Synchronized
Position
Hold
Engage
Reorient
Experimental
Satellites



- SPHERES are the size of a bowling ball
- The SPHERES first reached the ISS in 2006
- There are currently three SPHERES aboard the ISS
- Each satellite is self-contained with power, propulsion, computers and navigation equipment
- The three satellites float freely in the ISS and perform flight formations



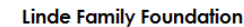
SPHERES

GLOBAL COORDINATES ACTIVITY

ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

Math or Code?



VOCABULARY

Variables

Integers

Floats

Arrays

Coordinates

Vectors

VARIABLES

Math: an alphabetic character representing a number

$$2 + x = 5 : x = 3$$

ZR and coding: A “container” for single piece of data. The computer *must be told* what type of information will be going in the container.

INTEGERS AND FLOATS

INTEGERS AND FLOATS

We know from math that **integers** are **WHOLE NUMBERS**:

INTEGERS AND FLOATS

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1, 73, -5

INTEGERS AND FLOATS

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1, 73, -5

In coding, **FLOATS** represent **decimals**:

INTEGERS AND FLOATS

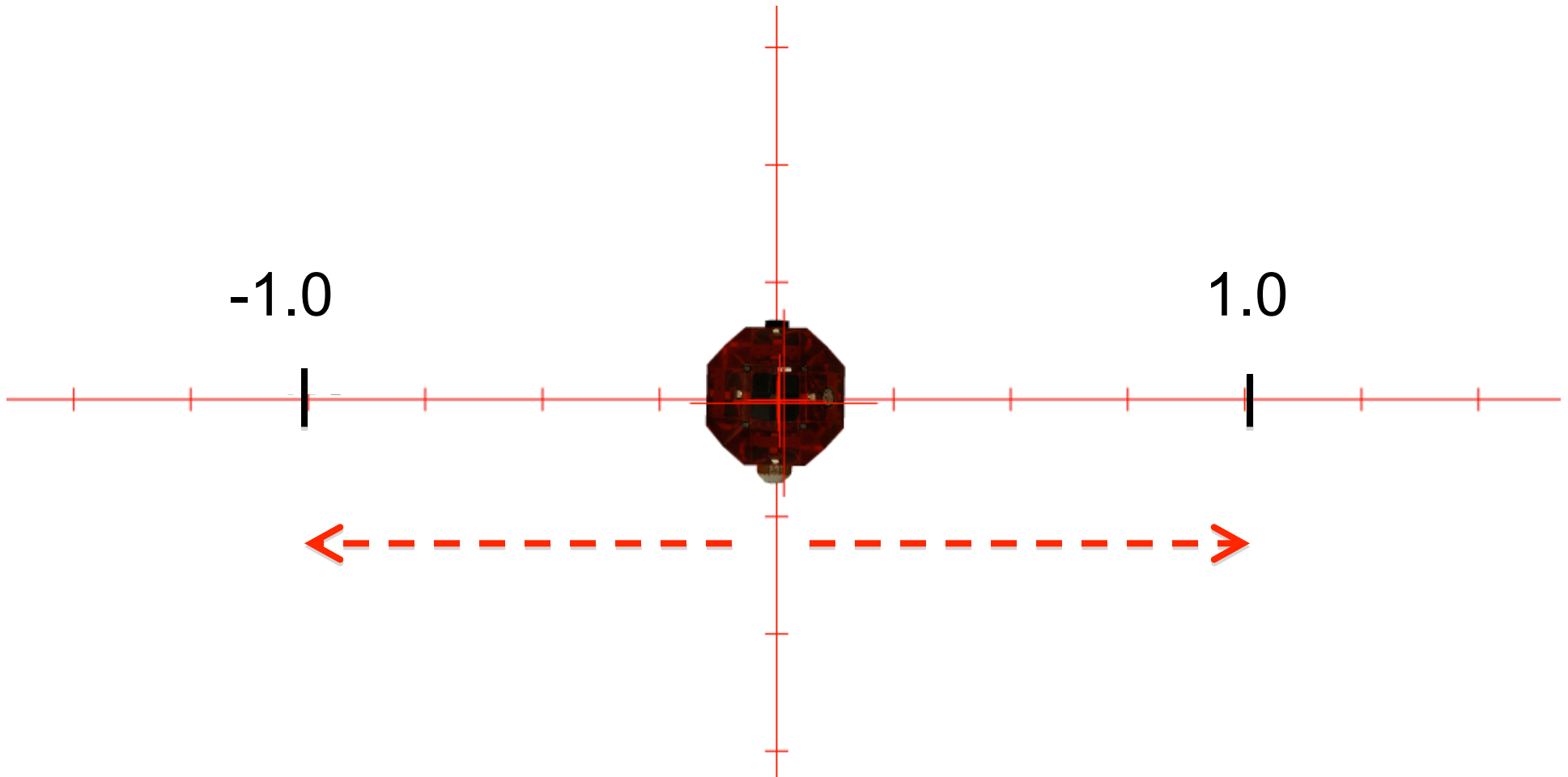
We know from math that **integers** are **WHOLE NUMBERS**:

1, 73, -5

In coding, **FLOATS** represent **decimals**:

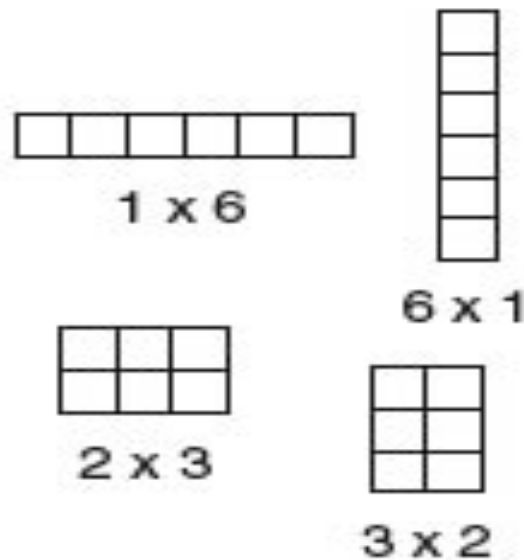
1.3, 73.2, -5.98

Active Region of Number Line



ARRAYS

Math: an arrangement of a set of numbers or objects in rows or columns



ARRAYS

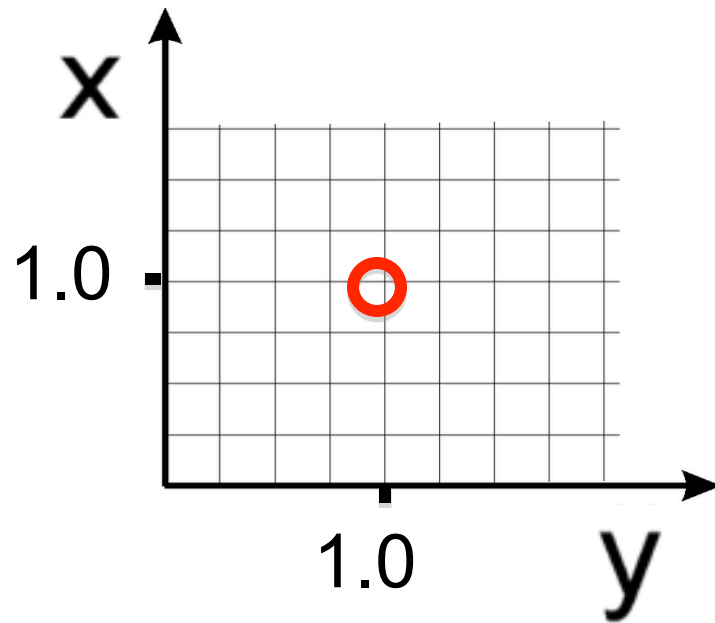
ZR and coding: a data type that stores multiple pieces of data in one place...essentially a list of data types

$\{x,y,z\}$

$\{0,1,2\}$

$\{1.2,3.0,-2.5\}$

COORDINATES -2D



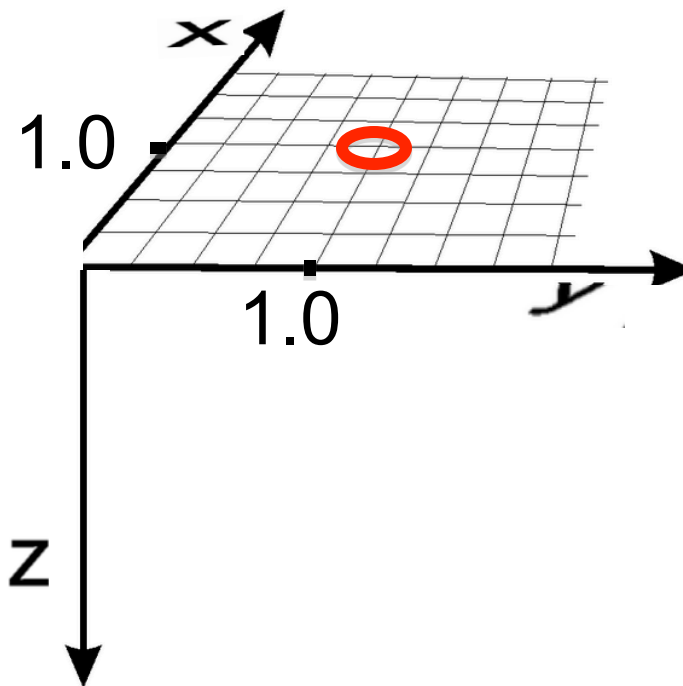
$\{x, y\}$

$x = 1.0$

$y = 1.0$

$\{1.0, 1.0\}$

COORDINATES -3D



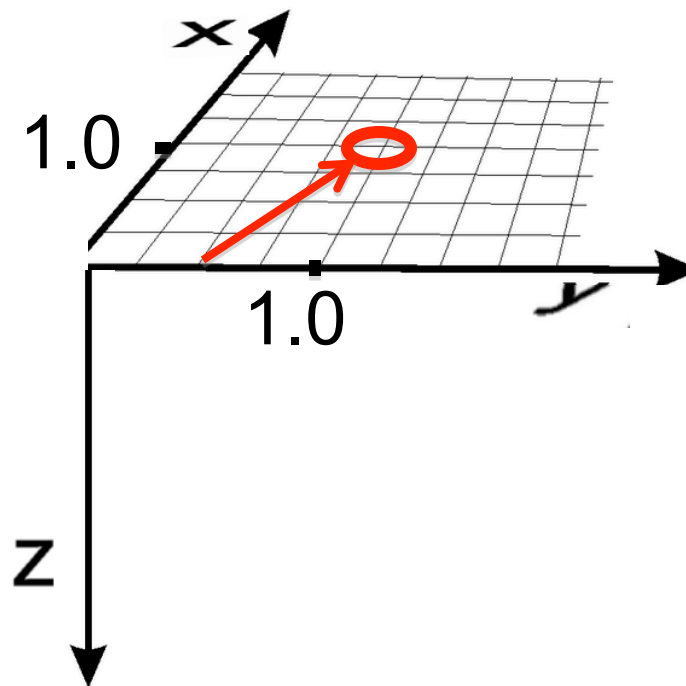
$\{x, y, z\}$

$\{1.0, 1.0, 0.0\}$

$z = 0$



VECTORS AND POSITION COORDINATES

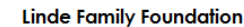


$\{1.0, 1.0, 0.0\}$

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ISS PROGRAMING CHALLENGE

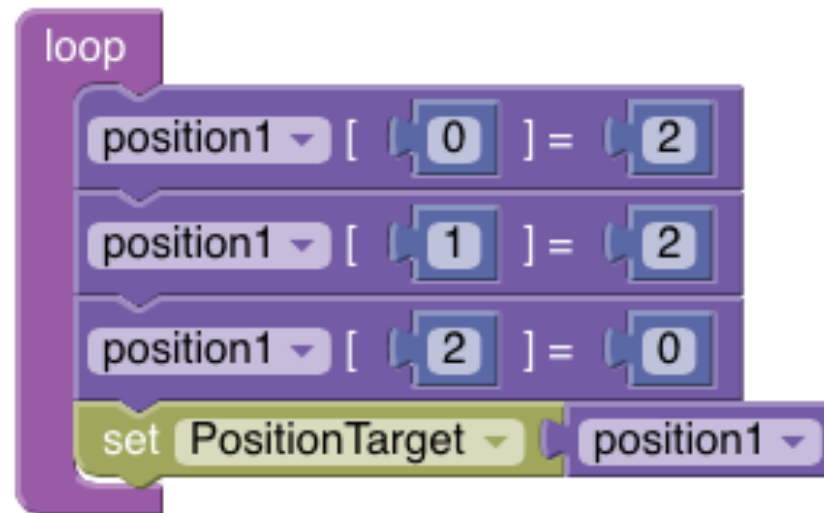
Introduction to the IDE *(Integrated Development Environment)*



```
1- void loop() {  
2   position1[0] = 2;  
3   position1[1] = 2;  
4   position1[2] = 0;  
5   api.setPositionTarget(position1);  
6 }
```

```
1 void loop() {  
2   position1[0] = 2;  
3   position1[1] = 2;  
4   position1[2] = 0;  
5   api.setPositionTarget(position1);  
6 }
```

x = 2 y = 2 z = 0



SetPositionTarget

Send your SPHERES to a point within the ISS

SetPositionTarget

Send your SPHERES to a point within the ISS

Arrays

A list of data of the same type



move forward

turn left ↺

turn right ↻

when run

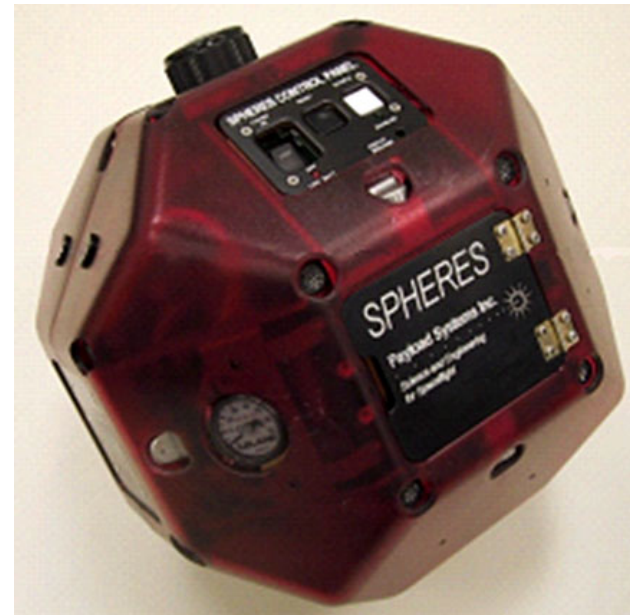
move forward

Drag a "move" block and snap it below the other block

Hour of Code



Zero Robotics





To the IDE!

SetAttitudeTarget

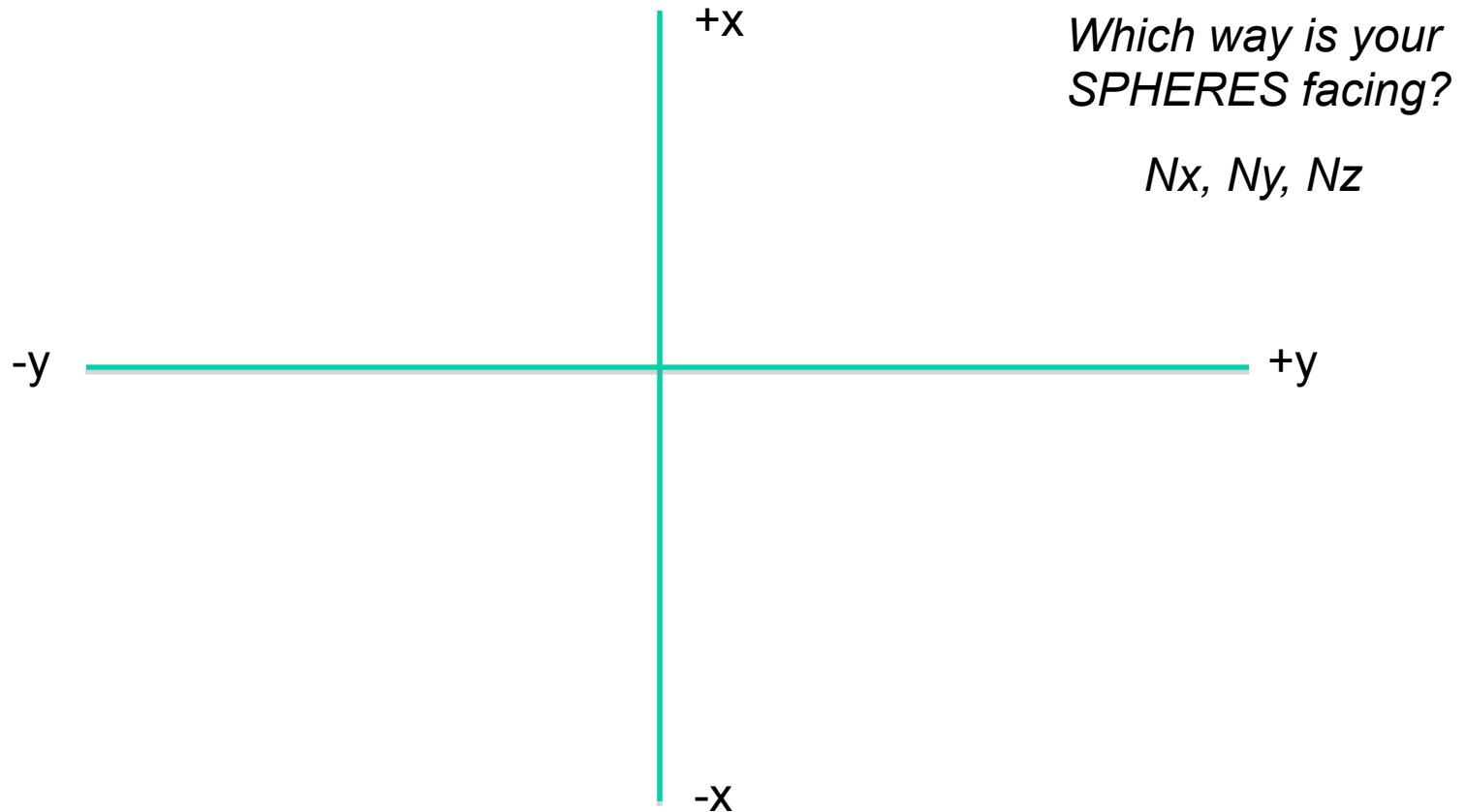
Rotate your SPHERES to face a direction

SetPositionTarget: [x, y, z]

setAttitudeTarget: [Nx, Ny, Nz]



ATTITUDE



ATTITUDE

Which way is your SPHERES facing?

DIRECTION	Nx, Ny, Nz
Positive X	1, 0, 0
Positive Y	0, 1, 0
Negative X	-1, 0, 0
Negative Y	0, -1, 0

SetPositionTarget: [x, y, z]

setAttitudeTarget: [Nx, Ny, Nz]

To the IDE!

Lunch/Snack Break!

Q and A

ZERO ROBOTICS ISS PROGRAMING CHALLENGE

CORONASPHERES *The 2015 Game*



Linde Family Foundation





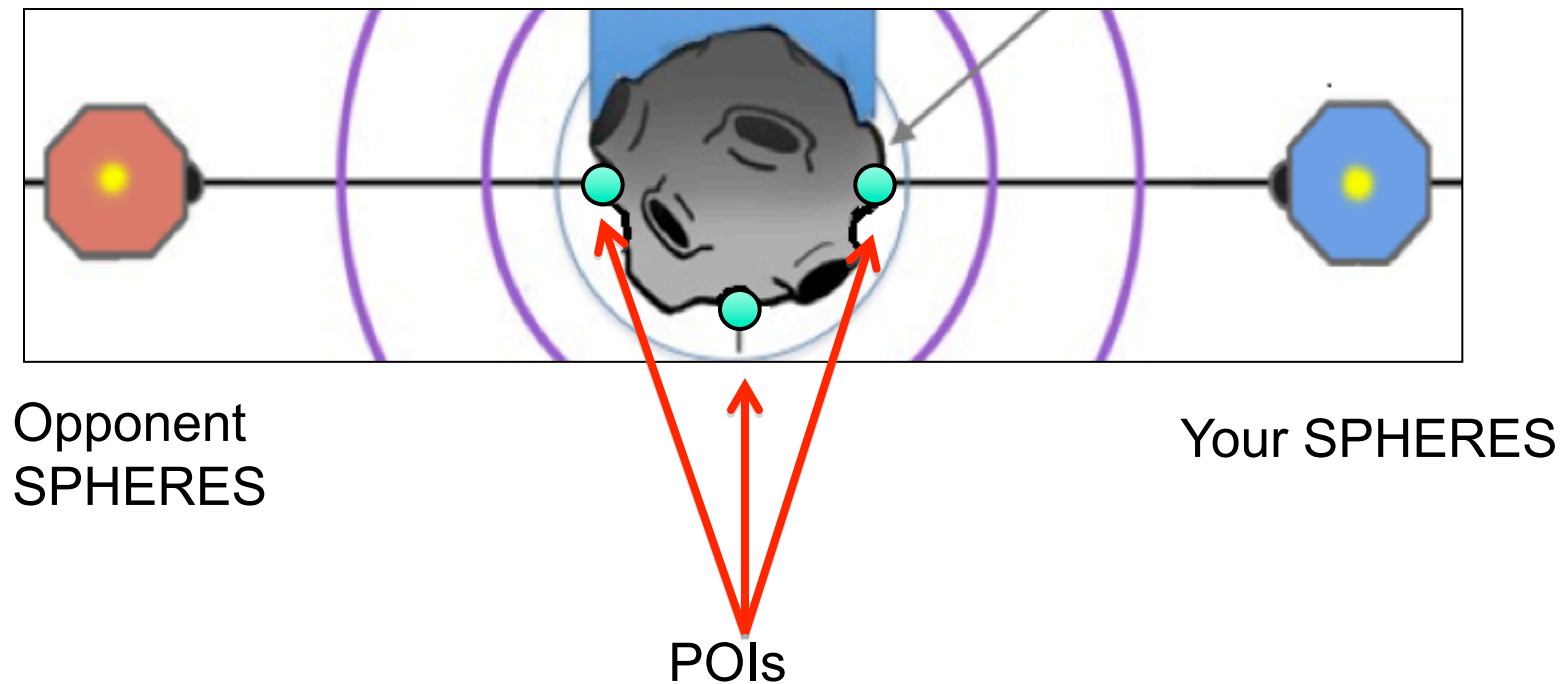
- **Conducting Optical Research on Nearby Asteroids (Corona)**
 - Your Mission: Use a robotic satellite to take pictures of “points of interest” on an asteroid
 - Your Goal: Collect and upload as many new pictures as possible while avoiding effects of solar flares



Your Tasks



- Command your robotic SPHERES to take pictures of Points of Interest (POIs) on an asteroid



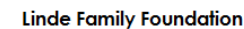
Intro to the Game

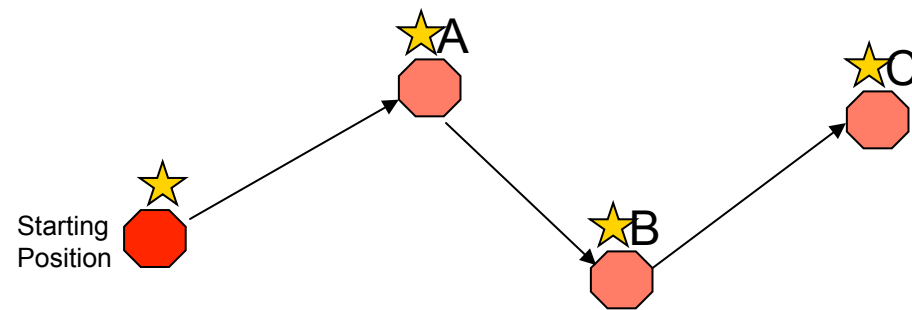
ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

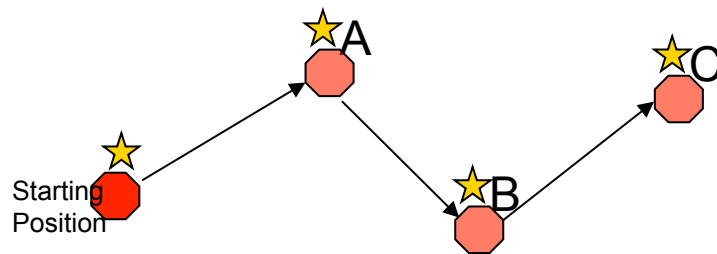
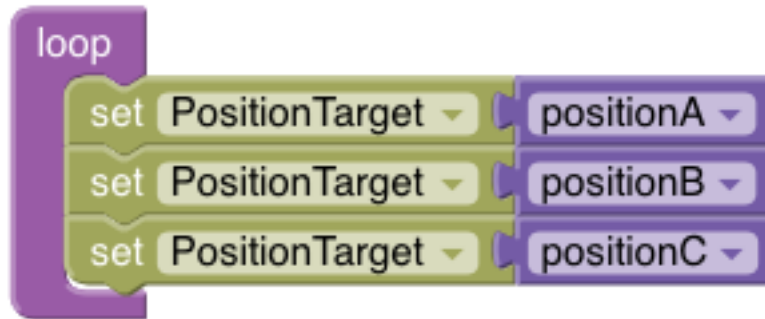
Introduction to the IDE

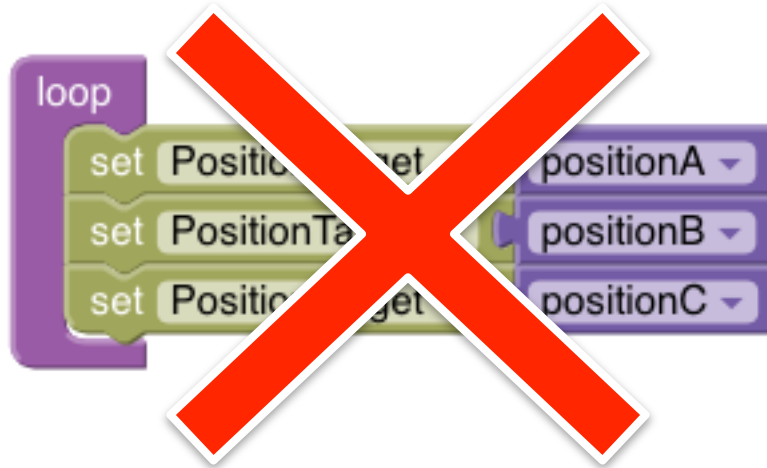
Part 2











CONDITIONALS

If this, then do that: the basics of logic statements



Hey, SPHERES!

Go to PositionA.

*Then, when 20 seconds have
gone by in the game, go to PositionB.*



VARIABLES

A container for single pieces of data

VARIABLES

A container for single pieces of data

COUNTER

A way to count how much time passed in the game

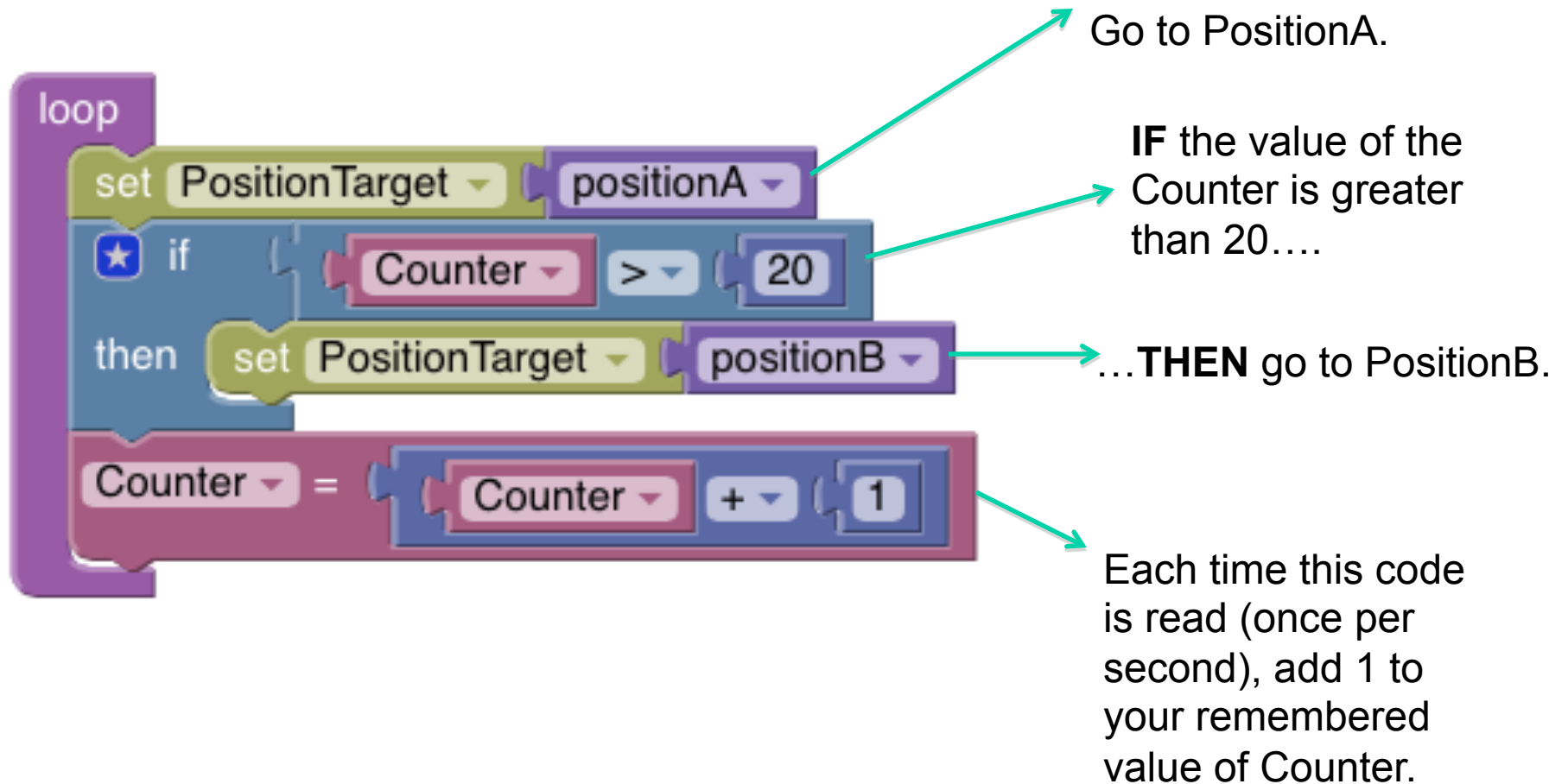
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Go to PositionA.

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To the IDE!

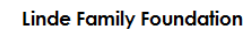




ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

Exploring the Educator Guide



How to Access the Educator Guide

zerorobotics.mit.edu

→ Resources

→ Middle School Curriculum

OR:

<http://static.zerorobotics.mit.edu/docs/ms/EducatorGuide.pdf>

- Designed to be used electronically – hyperlinks will take you to tutorials, videos, etc.
- You can save it to your computer, and hyperlinks will still be usable when you're connected to the internet
- **If you're a hard-copy kind of person:**
 - Print so you have it – but ALSO have the electronic version available!
 - Note: page numbers in the printed document are slightly different than how a PDF reader indicates page #

Educator Outcomes - page 7 (page 11 in PDF)

- Improved technology skills, especially around computer science and programming
- Strengthened instructional practice
- An understanding of the value of integrating technology into teaching

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**HOW TECHNOLOGY INFLUENCES OUR STUDENTS, &
HOW THEY CAN INFLUENCE TECHNOLOGY**

Color-Coded Activities

- Exploration
- Instruction
- Active Activity
- Computer Programming Tutorial
- Game
- Assessment & Reflection

Color-Coded Activities

- Exploration
- Instruction ★
- Active Activity
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- Game
- Assessment & Reflection

Pages 5-6 (9-10 in PDF): Getting Started – What to do first!

Before You Teach



- Make arrangements for field trips or speakers.
 - The following required field trips will be organized in conjunction with your regional State After-School Network (SAN):
 - Field Day: This field trip occurs at the beginning of V 2 and includes a tour of a college campus, NASA/space institution, local planetarium or science museum.
 - ISS Finals Event: Details will be provided separately.
 - For a list of optional field trips that you can choose to organize yourself, see **Possible Field Trips and Speakers** page 135.

Page 6 (10 in PDF): Links to All Tutorials

- Run through each of the other tutorials:
 - Week 1
 - [Getting to Know the ZR IDE](#)
 - [Introduction to Arrays and the setPositionTarget Function](#)
 - [More Simple Arrays and the setAttitudeTarget Function](#)
 - [More Simple Arrays — Another Way to Initialize Variables](#)
 - Week 2
 - [The Conditionals: The Basic of “If-Then”](#)
 - [Conditionals: More Fun with “If-Then” and Logic Operators](#)
 - [Conditionals with Advanced Logic Operators](#)
 - [Conditionals Continued: “If-Then-Else”](#)
 - [Introduction to Game Mode](#)
 - Week 3

Pages 9-10 (13-14 in PDF): Schedule of Learning Outcomes

Schedule

	Week 1	Week 2	Week 3	Week 4	Week 5
Science and Mathematics Concepts	• Cartesian coordinates • Forces • Grids and graphing	• Cartesian coordinates • Dimensions • Forces • Grids and graphing • Motion • Newton's Laws • Order of operations • Vectors	• Kinematics • Mass vs. Weight • Speed vs. Velocity		• Dynamics • Degrees of Freedom
Science and Mathematics Activities	• Bottle Rockets, Part 1 • Mystery Coordinate Grid • <i>Optional:</i>	• Seeing in 3-D—How to Visualize Space! • Vector Hunt • Thruster Balloons	• Mapping with Speed • Kinematics Scenario		• STEM programs a careers • Smooth Mo • How Many

Exploration Activity

- Break into 3-4 groups
- Each group has a task/challenge re: the Educator Guide
- Complete your challenge & make your poster
- Prepare to present your findings to the group (*be creative & colorful!!*)

ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

Scheduling Your ZR Summer



Linde Family Foundation



Break

Mock ZR Schedules

- Pick one person in your group whose program you will create a schedule for
- Working in the constraints of their program – hours, numbers of kids, space, etc. – dive into Week 1's many activities
- Select the activities you will do and create a schedule

Reflection Activity

Thank You!
Good Work!
Now Go Have Fun!

Educator Post Survey