ZERO ROBOTICS
SPHERES ISS CHALLENGE

Acting Out LIFE-SPHERES
Instructor's Guide
v 1.1

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Overview

Students will work in teams to create a strategy for the LIFE SPHERES (LIFE_SPHERES MS 2D) game and then act it out. Two teams will compete to see which team's strategy captures the most points in the time allowed.

This instructor's guide assumes some familiarity with the LIFE-SPHERES game (details about the LIFE-SPHERES game are available in the game overview powerpoint and the game manual).

Notes:
- This activity works well with 5-10 students on a team. Consider combining smaller teams or splitting a larger team.
- Team members will take roles, acting out the parts of: SPHERES, SPHERES Pilot, 100% Zone Keeper, Geyser referee, Base Station Engineer, Drill/Sample Technician, Increment Counter, and Score Keeper as described later.
- Teammates on the sideline will help give directions to their teammates on the grid based on their pre-planned strategy.
- Game duration: Approximately one hour. Each test takes approximately 15 minutes

Student's Mission

Drill into the icy surface of Enceladus and collect samples containing microorganisms. Drop collected samples at a shared Base Station.

Preparation in advance

- Review Part 1 of the LIFE-SPHERES Game Overview PowerPoint with students prior to introducing this activity
- Read through this guide
- Gather Materials (Materials checklist, page 4)
- Print multiple copies of pages 8-11 double sided
- Set up the Game Grid (instructions below)

Game Format

Game is played on a 4 yd x 8 yd grid sectioned into 1.5'x1.5' squares (making an 8x16 square grid) See Game Grid on page 9 for reference. This can be created using tape or chalk on the ground,floor or a tarp. Label the edges of the Grid as shown on page 9 with sticky notes.

Materials

1. **Tape for Grid**
   a. Use blue tape (2 rolls) to create grid
   b. Use another color tape to differentiate axes from gridlines, and to outline the Base Station
   c. *Optional:* large tarp to place tape gridlines on for reuse
2. **Post-It notes**
   a. During the game the concentrations of each sample will be recorded (written on the post-it note
   b. Also use post-it notes to label the grid squares as shown on the Grid (page 9.)
3. **Pens/Pencils/Markers**
   a. Used by Score Keeper, Increment Keeper, Drill/ Sample Technician, Geyser Referee
4. **2 Buckets/containers for each team**
   a. Set a bucket/container at the SPHERES starting location.
   b. Set a bucket at the Base Station for the Base Station Engineer
5. **Sunglasses--**
   a. Place at Analyzer starting position
   b. These are picked up and worn when the Analyzer is picked up
6. **Deck of Cards for 100% Zone Keeper**
   a. Used to select x and y coordinates for the 100% Concentration Zone
   b. Use red cards for negative numbers and black card for positive numbers
      i. Red and black cards 1-4 to select x coordinates for 100% Concentration Zone
      ii. Red and black cards 1-7 to select y coordinate for 100% Concentration Zone
      iii. Alternately have students pick a number between -4 and +4 to select x coordinates and between -7 and +7 to select y coordinate
7. **Dice for Geyser Referee**
   a. One dice (or labeled cube) for determining the probability of a geyser. (Roll the dice into the bucket)
8. **Calculator for Score Keeper**
9. **Documents**
   a. Print multiple copies of pages 8-11 (double-sided) (at the end of the document)

Activity Explanation

This activity involves a strategy planning phase and a game phase.

Before beginning, each team will have 10 minutes to plan an overall strategy and decide the roles of each player. **Teams cannot change their strategy once the game has started**.

After reading through this manual, you will find "strategy sheets" located at the end of the document. These are formatted to prompt students to think about what they want to accomplish and how they will

implement each action (i.e. what information is needed, how many steps they will take, what direction they will travel, etc).

Once you have run out of tasks on your strategy sheet, the SPHERES will remain idle. No commands can be added during the game.

Increments

Since time is important in the game, the pace of the SPHERES movement on both teams must be coordinated. To do this, each game is broken into 10 increments with 5 actions allowed in each increment. Teams must wait for both SPHERES to complete their 5 actions before moving to the next increment.

Number of Increments	Actions allowed per increment
10	5

Possible Actions

Each of the following count as actions since they represent tasks that use time in the real game.

Counts as One Action	Not counted as Actions (Free)
- Move one square (in any direction) - Pick up Analyzer - Rotate 90° - Drop Sample(s) at the Base Station (Multiple samples can be dropped at the same time) - Being hit by a Geyser is equal to 5 actions	- Ask Geyser Referee- - How many drills in this square? - Ask 100% Zone Keeper- - What is concentration of this square ? (SPHERES must have Analyzer and be standing on the square)

The following example represents 5 actions: Ex: Move forward 3 squares, Pick up Analyzer, Turn 90 degrees.

Scoring/Penalties

- Points are earned for drilling, dropping samples at the Base Station, and for picking up the 100% sample.
- Penalties deducted for Drilling in Base Station = -10 pts.
- See scoring sheet for details and point values. (page 10)

Student Roles

Before beginning assign the following roles to students on your team. Since you will be playing with two SPHERES, you will need two of every role defined here. If you do not have enough students present to fill all of the roles, some of them can be combined so that all of the roles are filled. For example, the increment counter and the score keeper can be combined and the role of the Base Station technicians can be filled by placing buckets in the Base Station (one for each team).The Student roles are defined below.

SPHERES   (Needs container for samples)
1. You are the SPHERES!
   a. Make sure to follow your teammates' directions as closely as possible.
   b. Collect "samples" in your bucket or container
   c. Count your number of actions
   d. Rotating is an action, so don't turn or step unless told to!

SPHERES Pilot (Needs clipboard with strategy sheet)
(The Team on the sidelines can also help with this role)

1. Your job is to tell give the SPHERES instructions from your strategy sheet and help count actions.
   a. Give directions about where to step in order to move along the path that was marked on their strategy sheet. For example, to tell your SPHERES to move to a certain square, you might say, "Take two steps forward and then one step to the right."
   b. The SPHERES should maintain whichever direction they're facing and not rotate unless you tell them to.
   c. SPHERES can move in any direction without needing to face the direction of movement.
   d. When a SPHERES moves, it moves from within one square to within another. The position of the SPHERES is considered to be the square they're standing in, not their position within the square.
2. Don't change what's on the strategy sheet! If something starts to go wrong, that's okay. Try to follow the strategy sheet as exactly as possible, even if your SPHERES is going way off course. Your team can fix it in the next planning phase.

Drill/Sample Technician (Needs post-it notes and a pen)
1. Give "samples" with correct concentration to the SPHERES each time they complete a drill motion
   a. Ask the 100 % Zone Keeper the concentration of the sample square and write the concentration on the post-it and hand it to the SPHERES
   b. Make sure that SPHERES collects no more than 5 samples at a time.
2. Help report to the Score Keeper each time the SPHERES drills.

Geyser Referee (needs one dice, paper grid, pen, Guidelines handout)
1. Determine whether drilling has caused a geyser.
   a. Rolls dice to determine if the drilling causes a geyser. See Geyser Referee guidelines on handout)
   b. If a geyser occurs
      i. Takes 1 "sample" away from the SPHERES.
      ii. Makes sure the SPHERES does nothing other than step back one square for the next 5 actions.
2. Keep track of the number of geysers that has occurred in each location
   a. Mark sample square with the number of drills-using a blue post-it or make a note on your paper grid.
   b. Tell a team how many drills in a certain square, if asked.

Base Station Engineer (needs bucket)
1. Collects "samples" at the Base Station for their SPHERES
   a. Confirms SPHERES is in the Base Station and has called "Drop Sample".
   b. Reports samples received to the score keeper at the end of the game.

100% Zone Keeper (Needs Game grid handout, Guidelines handout, colored markers, clipboard)
1. Determines the location of the 100% zone at the start of the game.**Keep this information secret!** (See 100% Zone Keeper Guidelines on handout)
   a. Tells the SPHERES the concentration of the sample square they are standing in--but only if asked.
   b. Tells the Drill/Sample Technician the concentration of each sample picked up

Increment Counter (Needs pen, clip board or white board, (see bottom of score sheet)
1. Keep track of the increments
   a. Coordinate when SPHERES are allowed to begin their next increment.
2. Keep track of how many actions SPHERES have taken in a single increment, and make sure no one makes more than 5 per increment!

Score Keeper (Need score sheet, pen, calculator)
1. Tallies points and penalties on the score sheet and calculates score at the end.
   a. During the game:
      i. Tally drills, 100% bonus points and penalties
   b. After the game ends
      i. Tally samples dropped at the base station
      ii. Calculate total score

Brainstorm a Strategy

Before you play, you'll want to plan out your strategy. Write down a list of tasks you'd like to complete, in order, with the questions you'll need to ask to know how to complete those tasks.
Here are some questions to think about as you plan out your strategy:

1. What do you plan to do first: start drilling or pick up an Analyzer and scan for high concentrations?
    a. Where do you want to drill first?
    b. What path will you follow to scan?
2. How many samples will you collect before going to the Base Station?
3. How much risk do you want to take when drilling? (How many times will you drill in a sample square?)
4. What will you do if you are hit by a geyser?

Once you've thought about your overall strategy, it's time to define that strategy so that the SPHERES can follow it. Write down the goal of each step you plan to take and the actions required to take that step.

Here's an example strategy with just a few steps to give you an idea of what information the SPHERES needs:

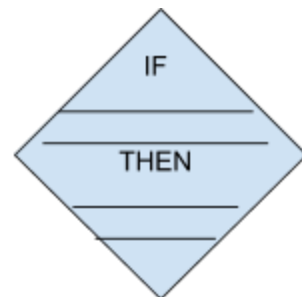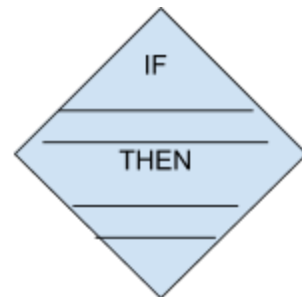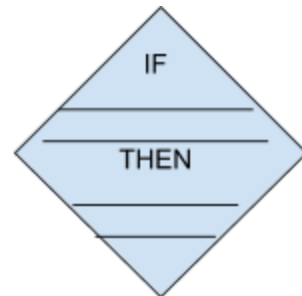| Goal	Goal	Actions Required	If statements
1	Go to first location to drill (marked on grid) Drill 1 time /pick up 1 sample	Steps Rotate 90 degrees	If samples are full go to Base Station If hit by Geyser, go xxxx
2			
3			
etc			

Now you're ready to write out your own strategy!

Strategy Sheet

- **Assign roles:** SPHERES, SPHERES Pilot, 100% Zone Guide; Drill/Sample Technician; Geyser Referee; Base Station Engineer; Increment Counter, Score Keeper
- **Make a Plan:** Mark your SPHERES path on the grid on the back of this page. Write out your plan below. Indicate any if statements you plan to use.

Goal #	Goal	Actions Required
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

IF statements you plan
to use during the game

IF
THEN

IF
THEN

IF
THEN

GAME GRID

Counts as One Action	Not counted as Actions (Free)

• Move one square (in any direction)
• Pick up Analyzer
• Rotate 90°
• Drop Sample(s) at the Base Station (Multiple samples can be dropped at the same time)
• Being hit by a Geyser is equal to 5 actions
	• Ask Geyser Referee-
	  ○ How many drills in this square?
	• Ask 100% Zone Keeper-
	  ○ What is concentration of this square ? (SPHERES must have Analyzer and be standing on the square)

Scoring Sheet

	One Tally per Point type	*Point value*	*Total Points*
During the game: Tally Drill and Bonus points			
Drill first time in a square		1	
Drill 2nd time in a square		2	
Drill 3rd time in a square		3	
100% sample bonus points		2.5	
At the end of the game: Tally samples dropped at the Base Station (Do not count samples held by the SPHERES)			
10% samples dropped at Base Station		2.5	
30% samples dropped at Base Station		3.5	
100% samples dropped at Base Station		7	
		Sub total	
Penalties (subtract penalties)			
Drilling in Base Station		(-10)	
		Sub total	
		Total (points - penalties)	

At the end of the game multiply the tally marks by the point value

Increment Counter: Track Increments Here

(remember 5 actions per increment)

1	2	3	4	5	6	7	8	9	10

Geyser Referee Guidelines

GEYSER GUIDE			
1 drill	**2 drills**	**3 drills**	**4 drills**
0= geyser (there is a chance but it is very low so we assume no geysers for AOTG)	Roll dice 6= geyser	Roll dice 1,3,6 = geyser	Geyser occurs. Lose a sample

100% Zone Keeper Guidelines

Before the game begins, you and someone from your opponent's team determine the location of the 100% zone. **Keep this information secret!**

100% zone keeper from blue team picks the x value: Choose a card/number between -4 and +4
100% zone keeper from red team picks the y value: Choose a card/number between -7 and +7

Check to be sure that you did not pick any points shown in the pink zone on the Game Grid. If so repeat steps above.

Make sure to mark down the 100% zone on a game grid corresponding to the correct column letter and row number. The mark in the opposite 100% zone which should be mirrored diagonally across the grid.

EXAMPLES