

ZERO 
R  B  TICS

SPHERES ISS CHALLENGE

*Acting Out Space SPHERE-S
Instructor's Guide*

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Overview

Students will work in teams to create a strategy for the Space SPHERES (SPACE-S 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.

Student's Mission

Find the assembly zone location and collect the most points by moving items into the correct zone and keeping them there the longest.

Preparation in advance

- Review Part 1 of the SPACE-S Game Overview PowerPoint with students prior to introducing this activity
- Read through this guide
- Gather Materials (Materials checklist, page 3)
- Print off Strategy, Assembly Zone and Score Keeper sheets (pages 11, 12, 13, 14)
- Set up the Game Grid (instructions below)

Game Format

Game layout at start of the game is a 4 yd x 8 yd grid sectioned into 1.5'x1.5' squares (making an 8x16 square grid)

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

Notes:

- This activity works well with 10-12 students on a team. Consider combining smaller teams or splitting a larger team.
- Team members will take roles, acting out the parts of: SPHERE-S, scorekeepers, field referees, increment counter, assembly zone keepers, and docking referees as described later.
- Teammates on the sideline will help give directions to their teammates on the grid based on their preplanned strategy.
- Game duration: Approximately one hour. Each test takes approximately 15 minutes

Materials

- 1. Grid**
 - a. Tape, preferably 2 colors to differentiate axes from gridlines
 - b. *Optional:* large tarp to place tape gridlines on for reuse
- 2. Satellite Positioning System (SPS) pieces**
 - a. Flat pieces, such as sponges. After placement these pieces are basically "out-of-the-way" during gameplay
- 3. Items**
 - a. You'll need two sets of small, medium and large items. You can use boxes, baskets, etc. (Ex: two small blue boxes, two medium red boxes, and two green/yellow large boxes)
 - b. It's preferable that these pieces are roughly rectangular so that they have four sides.
 - c. Mark the docking face using a piece of tape to mark one side of each piece.
- 4. Assembly Zones**

- a. One for each Zone. Flat piece of cardboard cut into a circular shape. Large enough to place the various items on top of it on the grid.
- 5. Bucket**
 - a. Set these at the SPHERES starting location with the SPS pieces inside.
- 6. Dice**
 - a. Two dice for determining the “unknown” location of the Assembly Zone
- 7. SPHERES IDs**
 - a. Can be anything used to differentiate students playing SPHERE-S (i.e. different colored lanyards, pieces of paper on shirt, etc)
- 8. Documents**
 - a. Print out 2 scorekeeping sheets and 2 strategy sheets (Both are located at the end of the document)

Game Explanation

Activity Description and Guidelines

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

Each team will be required to develop a strategy for the game before starting. 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).

Increments

Since time is important in the game, the pace of the SPHERE-S movement on both teams must be coordinated. To do this, each game is broken into 15 increments with 5 actions allowed in each increment. Teams must wait for both SPHERE-S to complete their 5 actions before moving to the next increment. The scorekeeper records score and keeps track of penalties at the end of every increment.

Number of Increments	Actions allowed per increment
15	5

Student Role Summary

Before beginning assign the following roles to students on your team. Since you will be playing with two SPHERE-S, 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, one

person can easily be both the Referee and Increment Keeper. These roles are also defined in detail in the Game Explanation section of this document, but here is a brief overview of each position:

1. SPHERE-S
 - a. One student will portray the SPHERE-S for each team.
2. SPHERE-S Guide
 - a. One student holds the strategy sheet and gives the SPHERE-S exact instructions for how to move for each team.
3. Field Referee
 - a. One student will play as referees for each team.
 - b. The referees can report information requested by the students.
4. Assembly Zone guide
 - a. One student from each team keeps track of how long the pieces are in the assembly zone.
5. Increment Keeper
 - a. One student from each team will keep the two teams synced in the correct increment and make sure each takes the correct number of steps.
6. Docking referee
 - a. One student from each team will ensure that SPHERE-S dock properly (in the correct orientation and at the correct distance).

Game Guidelines

Actions Overview

In each increment, each SPHERE-S may take 5 total actions.

Possible Actions

Each of the following represents 1 action:

- *Move one square*
- *Rotate up to 180°*
- *Drop an Item*
- *Dock to an Item*
- *(Placing an SPS - can be done while moving so does not count as an "action")*

Ex: Move forward 3 squares, turn 90 degrees to the right, and attempt to dock= 5 actions

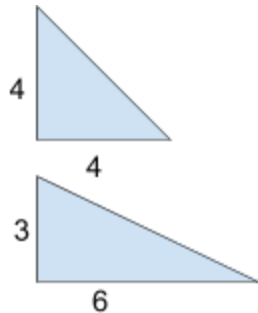
SPHERE-S can also place SPS and ask questions without using up an action from their increment. Once you have run out of tasks on your strategy sheet, the SPHERE-S will remain idle. No commands can be added during the game.

You'll need gather information from the Field Referee on the locations of objects. This will not count as an action, but make sure to get your information before you start your series of actions. Look at the list of commands you can use on the game guidelines.

Important notes on Actions

Dropping the SPS

- The SPSs must be dropped in a triangle of area no less than 8 square units. For this acting out the game activity teams must choose from one of the following two right triangles which meet this requirement $A = (\text{base} * \text{height}) \div 2$.



- When placing the final SPS, the referee will notify the team as to whether or not their triangle is valid.
- Once the final SPS is placed, the Assembly Zone Keeper will reveal the location of the team's assembly zone.
- SPSs can be placed by simply declaring that an SPS is going to be dropped. Since the SPHERES does not have to stop to place SPSs, it can move while dropping the SPS pieces. **Therefore, dropping an SPS does not count as one of the 5 steps in an increment.**

Docking

- Docking Guidelines:
 - To dock with any of the items, the SPHERE-S must be
 - In the square adjacent to the item's correct face
 - facing the item.
- Furthermore, students should understand that SPHERE-S should be stationary when docking. By making docking its own action within the increment, it is apparent that the SPHERE-S can't move when docking.
- Once an item is picked up, it is not available for pick up until it has been dropped.
- If both SPHERES arrive in the same square on the grid at the same time to pick up an item:
 - Neither team can collect the item**
 - Both SPHERE-S are bumped one square to their right**
 - Both SPHERE-S incur a collision penalty.**

This is to mimic the effect of collision avoidance.

Item Location

- Items can be picked up and dropped in new locations. As long as an item is not currently being held by another SPHERE-S, it can be picked up again as many times as wanted.
- Once an item has moved from its initial location, SPHERE-S have to ask where it is in order to move to it or they will not be allowed to move.

Scoring

Items accrue a certain number of points for each time increment they spend in a SPHERE-S assembly zone. The number of points depends on the size of the item placed in the assembly zone:

- Small items: 0.1 points / increment
- Medium items: 0.15 points / increment
- Large items: 0.2 points / increment

Penalties:

- Both SPHERE-S enter the same square
 - -0.5 points
 - Both are bumped to the squares to adjacent to them on the right
- SPHERE-S enters an opponent's assembly zone (after an entire increment has been completed)
 - -0.4 points/ action
 - Each action (including rotation, steps, picking up item, etc. will continually add until SPHERE-S leaves opponent's assembly zone)
- SPHERE-S enters same space as small, medium, or large item
 - -0.3points/ increment for each object in SPHERE-S' square
- SPHERE-S enters the same square as an SPS item
 - No penalty

Student Role Guidelines

SPHERE-S

1. You are the SPHERE-S! Hold on to everything the SPHERE-S is carrying and make sure to follow your teammates' directions as closely as possible.
 - a. Rotating is an action, so don't turn or step unless told to!

SPHERE-S Guide

1. Your job is to tell their SPHERE-S what direction to step in order to move along the path that was marked on their strategy sheet. For example, to tell your SPHERE-S to move to a certain square, you might say, "Take two steps forward and then one step to the right."
 - a. The SPHERE-S should maintain whichever direction they're facing and not rotate unless you tell them to.

- b. SPHERE-S can move to either direction, forward, or backward without needing to face the direction of movement.
 - c. When a SPHERE-S moves, it moves from within one square to within another. The position of the SPHERE-S is considered to be the square they're standing in, not their position within the square.
2. It is also your job to tell the SPHERE-S when your strategy says to take other actions.
3. 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 SPHERE-S is going way off course. Your team can fix it in the next planning phase.

Docking Referee

1. Make sure that the docking face of each item is clearly marked.
2. Whenever a team tries to dock, make sure that they are:
 - a. Adjacent to the correct side of the item
 - b. Facing the item
 - c. The correct distance away:
 - In the square adjacent to the item

If the SPHERE-S hasn't met these conditions, don't let them dock!

Field Referee

1. Give information to the SPHERE-S upon request about locations and statuses of objects.
2. Keep track of penalties!
3. If an item has moved from its initial position, make sure that the SPHERE-S asks where it has moved to, or they will not be allowed to move.

Assembly Zone Keeper and Scorer

1. Before the game begins, meet with the other SPHERE-S Assembly Zone Keeper and roll two dice to determine the location of both teams' assembly zones. **Keep this information secret!** The rest of each team won't know this until they've deployed their SPS.
 - a. Assembly Zone Keeper from both teams identify zone locations together at start of game because the location will be mirrored for each team. Follow the chart on the Assembly Zone Keeper's Guide to place zones correctly.
 - b. Check that the right size triangle is created.
2. Place the Assembly Zone on the grid once the SPHERES has successfully dropped all three SPS items. (Make sure the area is correct and place assembly zone in correct location)
3. Keep track of points earned by items in the Assembly Zone
 - a. More guidelines are located on the next page

Increment Keeper

1. Call out when SPHERE-S 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!
3. Make sure that the score keepers have recorded any scores before moving on to the next increment. Points are earned per increment not per action.

The Team

1. Give directions to the SPHERES, ask questions, and follow the strategy you planned out!

- a. Make sure not to stray from your predetermined strategy - if it starts going horribly wrong, you can always fix it in the next game.

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. Where are you going to place your SPSs?
 - a. Will you start by dropping an SPS or move first?
 - b. Where do you want to be when you drop your last SPS?
2. How do you plan on accumulating the most points?
 - a. Which items will you try to dock with first?
 - b. Will you try to take items from your opponent's assembly zone?
3. How will you avoid penalties?
 - a. Can you make sure you dock correctly?
 - b. Can you avoid collisions?
 - c. How can you stay out of your opponents assembly zone unless taking an item?
4. Where are the items you want to pick up?

Once you've thought about your overall strategy, it's time to define that strategy so that the SPHERE-S 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 SPHERE-S needs:

Goal	Goal	Actions Required
1	Go to a small item in order to dock with it	Ask some questions: <ul style="list-style-type: none"> ● Where is the small item? ● What square should I be in to dock? ● Which way should I be facing? Move depending on the answers to the questions.
2	Dock with item	Try to dock.
3	Go to Assembly Zone	<ul style="list-style-type: none"> ● Where is my assembly zone? ● Are there any objects in my way? Move to the assembly zone.
etc		

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

Pages to Print

Print Double sided

- “Scoring Sheet” and “Assembly Zone Keeper Guidelines”
 - 2 copies per team
- “Strategy Sheet” (2 pages)
 - Several copies per team so multiple groups can plan strategies

Scoring Sheet

	<i>One Tally per Increment in Zone</i>	<i>Points/Increment</i>	<i>Total Points</i>
<i>Points (add points)</i>			
Small Items		x0.1	
Medium Items		x0.15	
Large Items		x0.2	
Sub total			
<i>Penalties (subtract penalties)</i>			
In Opponent's Assembly Zone?		x-0.4	
Item Collision?		x-0.2	
SPHERES Collision?		x-0.5	
Sub total			
Total (points - penalties)			

Scorekeeper

- At the end of every Increment (after every 5th action), add a tally mark for the items in your team's assembly zone.
- Make sure you mark down any penalties reported to you.
- Total score at the end.

Penalties:

- Collision with Item-
 - -0.2 points
- Collision with SPHERES
 - -0.5 points
 - Both are bumped to the squares to adjacent to them on the right.
- SPHERES has stayed in its opponent's assembly zone long enough that an increment has ended
 - -0.4 points

*SPHERES are not penalized for running into SPSs

Assembly Zone Keeper Guidelines

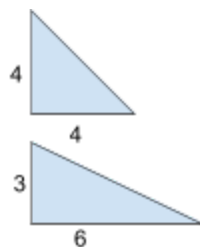
The Assembly Zone Keeper has major roles.

1. Before the game begins, roll two dice to determine the location of your team’s assembly zone.
Keep this information secret! Your team won’t know this until they’ve deployed their SPS.
2. Keep track of points earned in the assembly zone

Mark a square in the grid according to the dice rolls. The first die determines the row number. The second die determines the column letter (1=A, 2=B, etc). Make sure to mark down an assembly zone in both the blue and the red zones corresponding to the correct column letter and row number. The two assembly zones should be mirrored diagonally across the grid. (Note that some rows, columns are omitted to allow use of a 6 sided die)

	-	A	B	C	D	E	F	-	-	F	E	D	C	B	A	-	
-																	-
1																	6
2																	5
3																	4
4																	3
5																	2
6																	1
-																	-

Once the SPHERES has placed all three of its SPSs, make sure that the team’s correctly used one of the triangles below.



Once you’ve confirmed that, place the assembly zone item in the correct grid square!

Strategy Sheet

- 1) **Assign roles:** SPHERE-S; Field Referee; Assembly Zone guide; Increment Keeper; Docking Referee
- 2) Fill in SPS Triangulation Guide with SPS locations
- 3) Plan your actions

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

