Guided Exploration in Scratch of Zyphon's Game

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The following tasks provide a guided exploration of Zyphon's Game described in:

> Muller, E., Buteau, C., Monaghan, M., & Rocci, E. (year). The citee gamers. *Ontario Mathematics Gazette, 58*(2), 34–38.

A reader not familiar with Scratch programming may wish to start with the Scratch activities in this *Gazette*'s article "Bhanu and the Chocolate Cupcake."

Task One

Zyphon displays two fuel containers, but only puts fuel into one of them. He needs to pick a container, into which to put the fuel. He finds two moon rocks and labels them "1" and "2," then puts them into a space helmet. If he picks number "1," he will put the fuel into the first container, and if he picks number"2," he will put the fuel into the second container.

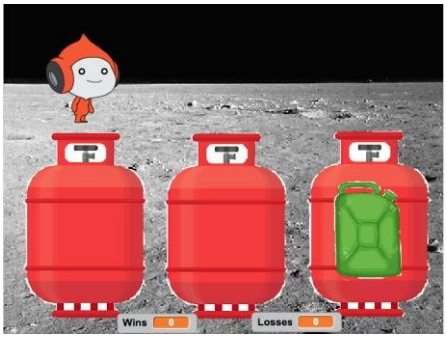
The pilot gets to the fuel station and sees that there are two containers. Zyphon tells him to choose carefully because only one container has the fuel. The pilot is unsure which container to pick, so he also finds two moon rocks and follows the same procedure as Zyphon.

If the pilot goes to the station a 100 days in a row, how many times do you expect he gets the fuel? Explain your answer.

Click on Zyphon Task One to open the simulator. Now run the simulator a few times to test your answer by clicking on .

Task Two

Now, suppose there were three containers, but only one contains the fuel. Does the pilot have a lower or greater chance of getting fuel than in the first task?



Modify the Zyphon Task One program to simulate this new situation:

- Click on Pico 

at the bottom left to see the code (displayed to the right).

- Complete the code in 

by dragging the code pieces found to its right. As a start-up, you may want to look at the code above in 

from Task One.

- Click on Fuel 

at the bottom left to see the code for Zyphon's choice of hiding the fuel, and complete the code in 

by dragging the code pieces found to its right. Again, as a start-up, you may want to look at the code above in 

.

If a pilot goes to the station 100 days in a row, how many times do you expect the pilot would now get the fuel? Explain your answer.

Now run the simulator a few times to test your answer. This time, you need to press the 'a' key to start this simulator[1].

Task Three

Zyphon got bored of this game, so he wants to make it more interesting. There are still three containers, but after the pilot chooses one, Zyphon reveals an empty container of the remaining two and gives the pilot the option to stay with his first choice or switch to the other unopened container. The pilot always stays with his original choice. He doesn't like changes! Does the pilot have a lower, equal, or greater chance of getting fuel than in the second task? If a pilot goes to the station 100 days in a row, how many times do you expect the pilot would now get the fuel? Explain your answer.

Click on Zyphon Task Three to open the simulator. Now run the simulator a few times to test your answer.

Now, the pilot isn't convinced this was a good strategy, and decides to always change his choice. Does the pilot have a lower, equal, or greater chance of getting fuel than when always staying with his original choice? If a pilot goes to the station 100 days in a row, how many times do you expect the pilot would now get the fuel? Explain your answer. Modify the program in Zyphon Task Three to simulate this new situation, and run it a few times by clicking on "a" key to test your answer:

- Click on the green fuel container to the bottom left to see the code (displayed to the right).

[1] Check again the code for Pico to see why this time it is the 'a' key rather than the green flag.

- Complete the code in 

by dragging the code pieces found underneath it.

- To help you, look at the code under 

.

So, what advice would you give the pilot? Make sure he understands why (maybe you would want to simulate it, just one game at a time, and see what is happening each time)!

Task Four

What if the pilot wants to change his choice sometimes? He does this by flipping a coin. If he lands on heads, he changes his choice, but if he lands on tails, he stays. What is the probability that he switches if he flips a coin? Do you think this will give him a better chance of choosing the fuel container? Why or why not?

Click on Zyphon Task Four to open the simulator. Now run the simulator a few times by clicking on  to test your answer.

The pilot wants to test this further. He rolls a die to see if he will stay with his original choice or switch and test different probabilities of switching.

1) If he rolls a 1, he will switch (1/6 chance of switching).
2) If he rolls a 1 or 2, he will switch (1/3 chance of switching).
3) If he rolls a 1, 2, or 3, he will switch (1/2 chance of switching).

Etc.

Modify the simulation to test the different probabilities. *Programming challenge: Modify the simulation to show 6 bars in the graph that relate to a chance to switch of 0/6, 1/6,…, 1. What provides the greatest probability of choosing the fuel?*

After testing all these probabilities, what advice will you now give the pilot?