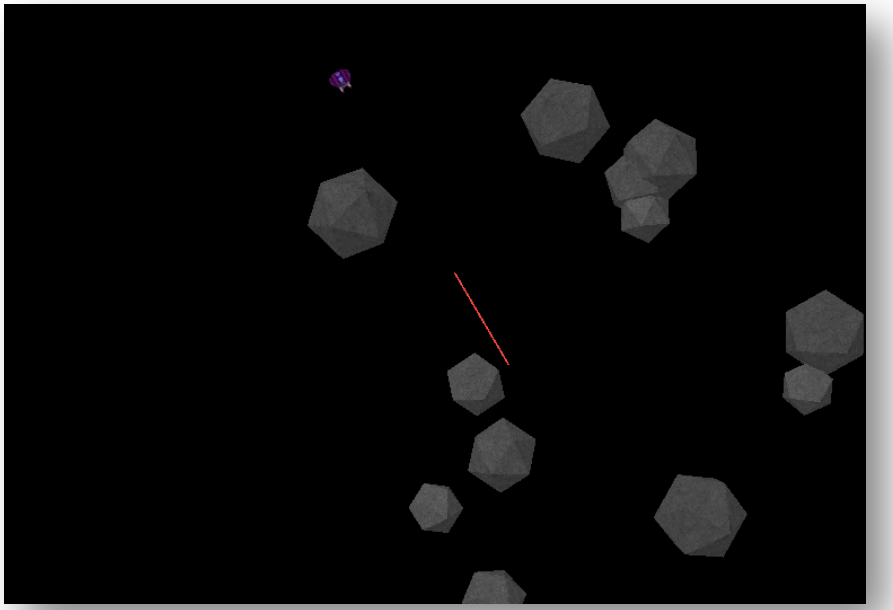
Asteroids!



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What Does The Game Do?

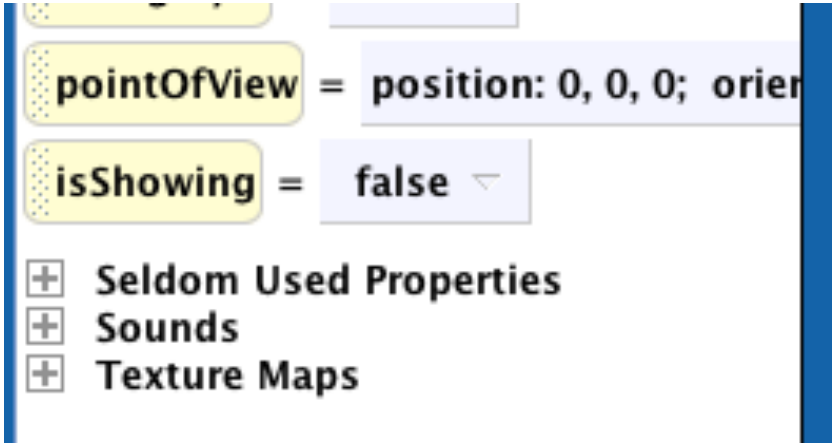
- We're going to re-create the 1979 Atari classic video game "Asteroids" in Alice.
- In the game, you pilot a ship around in any direction and use the spacebar to shoot a laser at incoming asteroids.
- The incoming asteroids vary in size and speed and fly in from off the screen.
- If you hit all of the asteroids, you win! If you crash into one, you lose.

Topics Covered

- Building a game like this covers many topics in both Alice and computer science in general
- Main Topics:
  - Collision Detection
  - Game Loops
  - Conditional “If/Else” Statements
- Other Topics:
  - Texture Mapping
  - Random Numbers
  - Lists

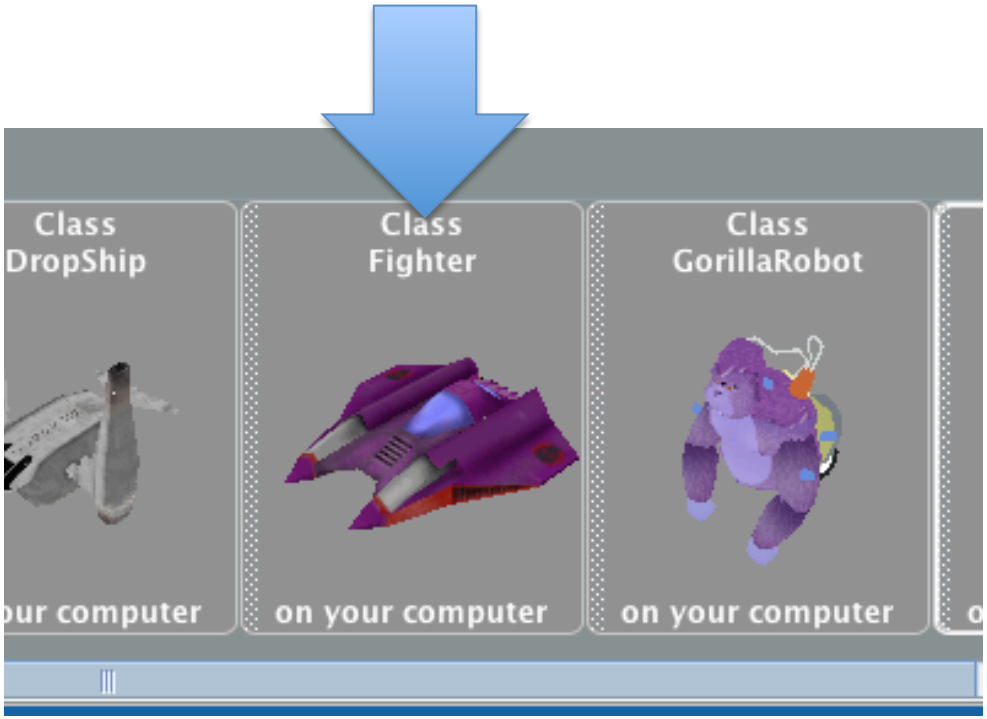
First Steps

- Open Alice and select the “space” default.
- The first thing we want to do is remove the ground. Go to “**ground**” in the object tree and click on it. Navigate to ‘**properties**’ in the lower left corner of the screen and set ‘**isShowing**’ to ‘**false**’.



First Steps

- Now we want to add the fighter that we'll fly around in space. Click on the "**add objects**" button.
- Scroll over to "**SciFi**" and add a "**fighter**" to the world.

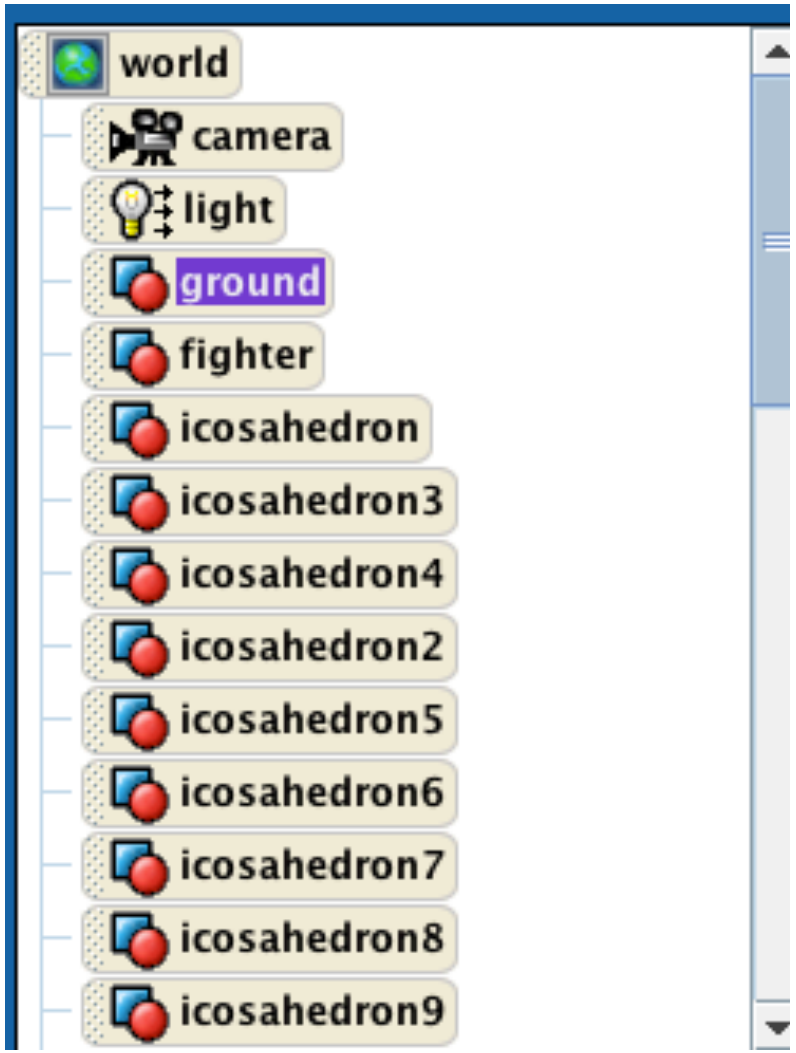


First Steps

- Use the camera controls to get an overhead view of the fighter.
- Go to world→properties and make a new boolean variable called “currentlyPlaying”. Set it to “false”.

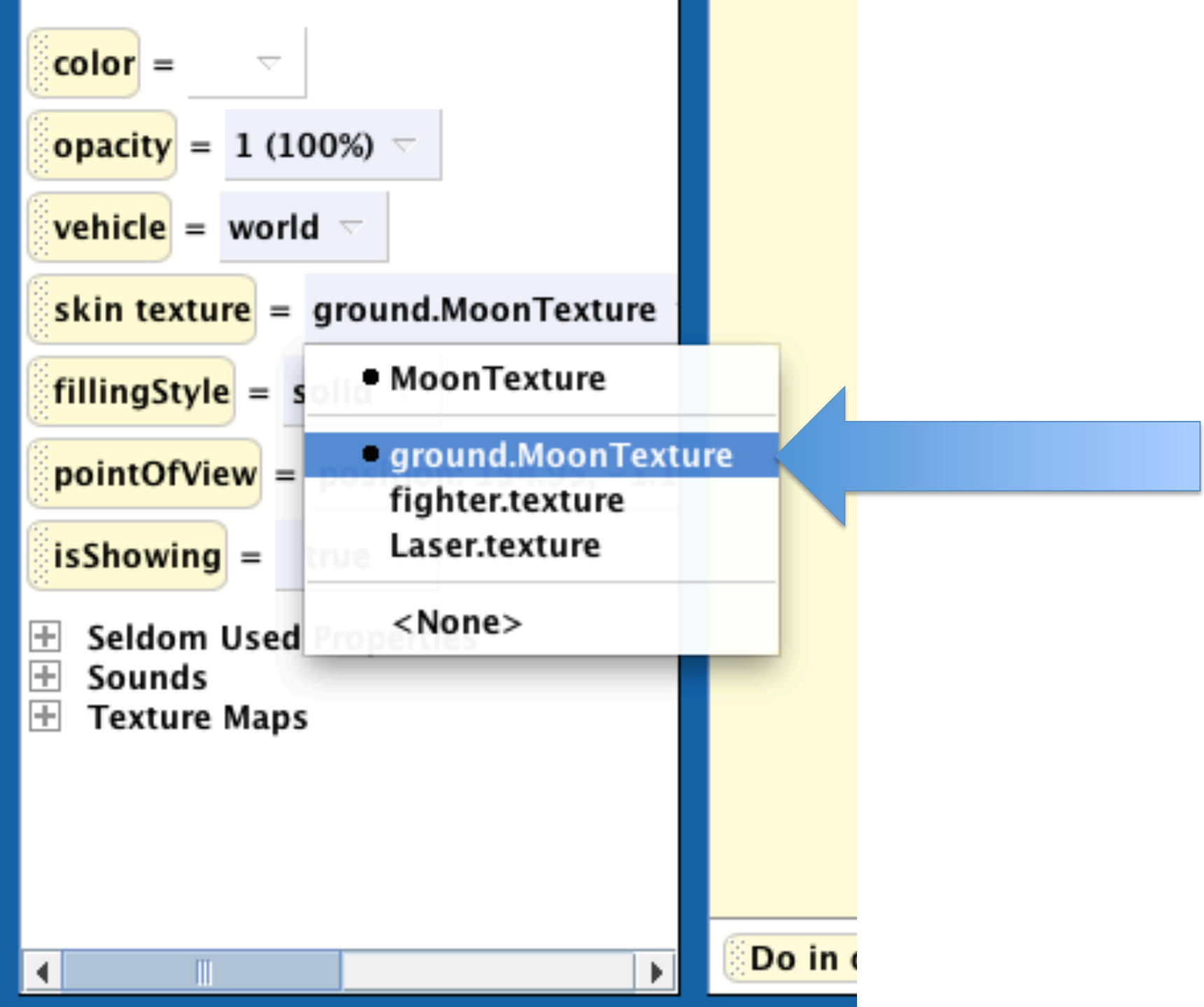
Making the Asteroids

- Now we want to make the asteroids that we'll have to shoot in the game.
- For this demonstration, we're going to use thirty asteroids. However, you can use as many as you like to make the game harder or easier.
- Click on "**add objects**" and go to "**shapes**". Add thirty "**icosahedron**" objects to the world.



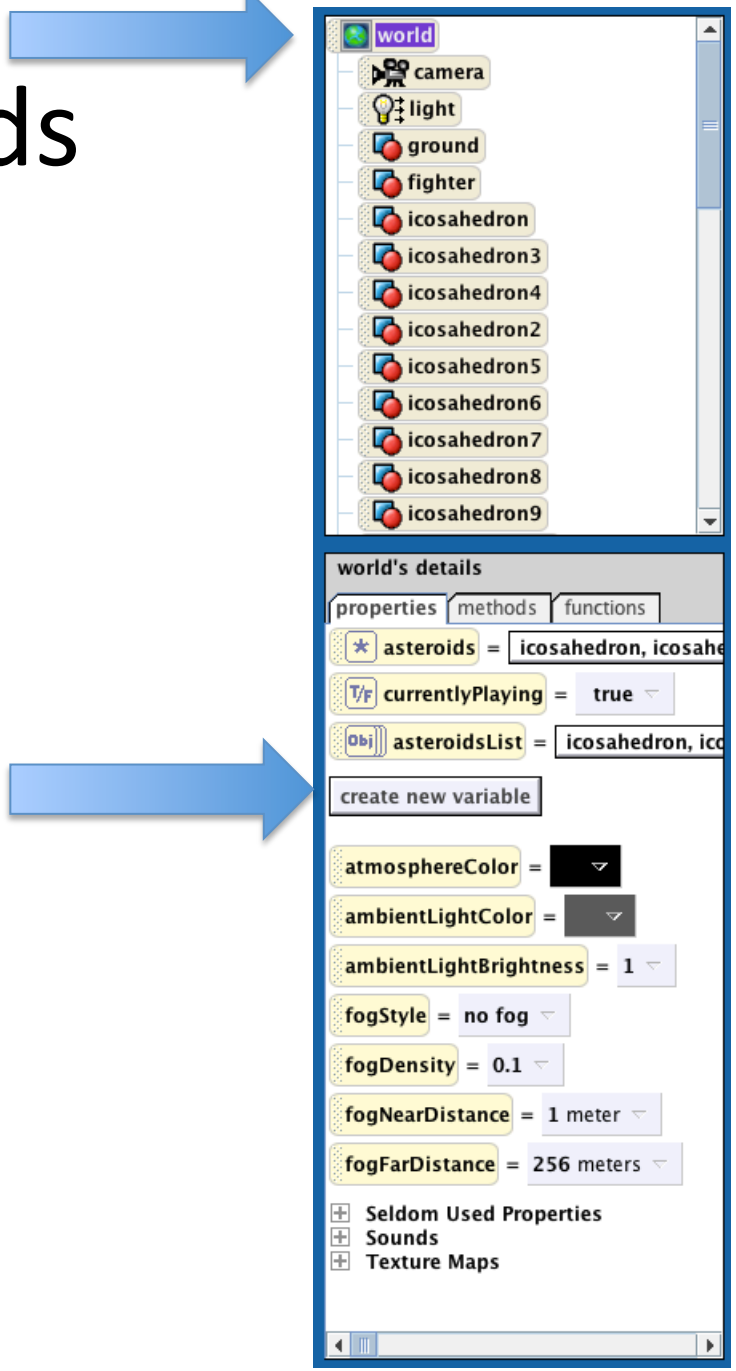
Texturing the Asteroids

- We want to make the asteroids look like real asteroids. To do this, we're going to steal the moon texture from the ground and apply it to each asteroid.
- For each icosahedron, click on it in the object tree. Click on the "properties" tab.
- Change "skin texture" to "ground.moonTexture".

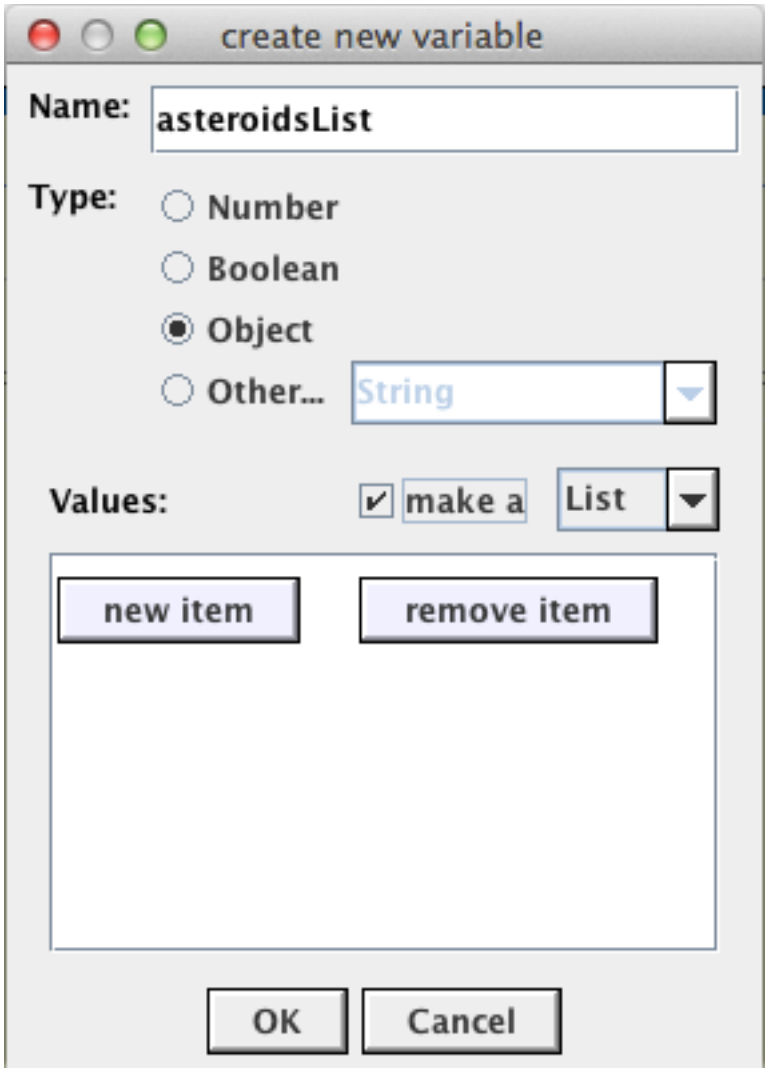

color =
opacity = 1 (100%)
vehicle = world
skin texture = ground.MoonTexture
fillingStyle =
pointOfView =
isShowing =
Seldom Used
Sounds
Texture Maps
MoonTexture
ground.MoonTexture
fighter.texture
Laser.texture
<None>
Do in

Managing the Asteroids

- We'll want to put the asteroids in a list so that we can manage them later.
- Go to "world" in the object tree and click on "properties". Click "create new variable".
- A box should pop up.



Managing the Asteroids



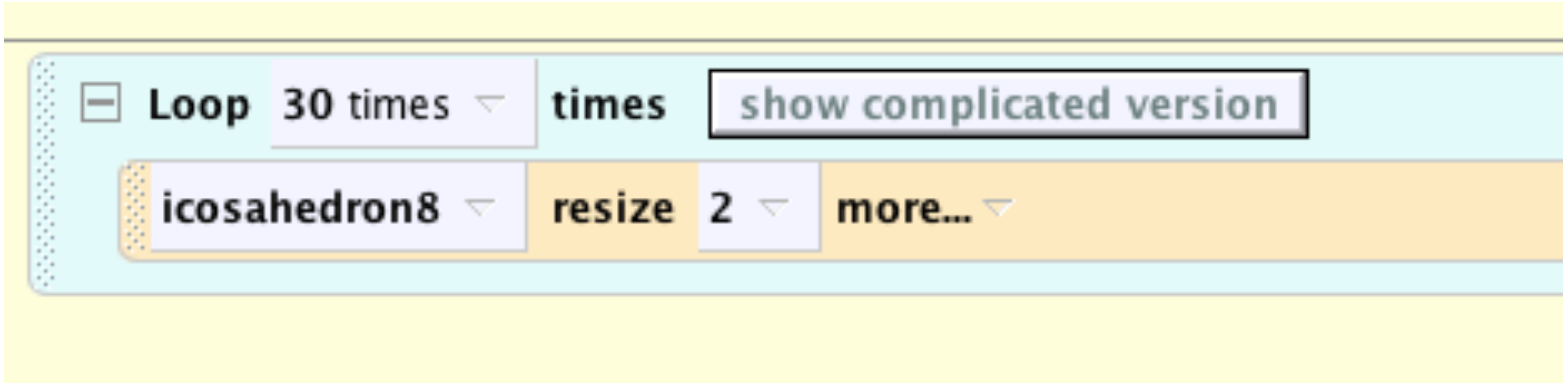
- Name the variable “asteroidsList”.
- Click on “object” under **type**.
- Make sure to check the box in the bottom-right corner that says “make a List”.
- For each asteroid, click “newItem” and set each new item to its respective icosahedron object.

Resizing the Asteroids

- Move all of the asteroids off-screen out of the camera view.
- Now we want to make the asteroids bigger or smaller and make them all different sizes.
- The good news is that because we made our list, the tedious step is over.
- If we want to do something to all the asteroids, we can now tell the list to modify all of its objects.

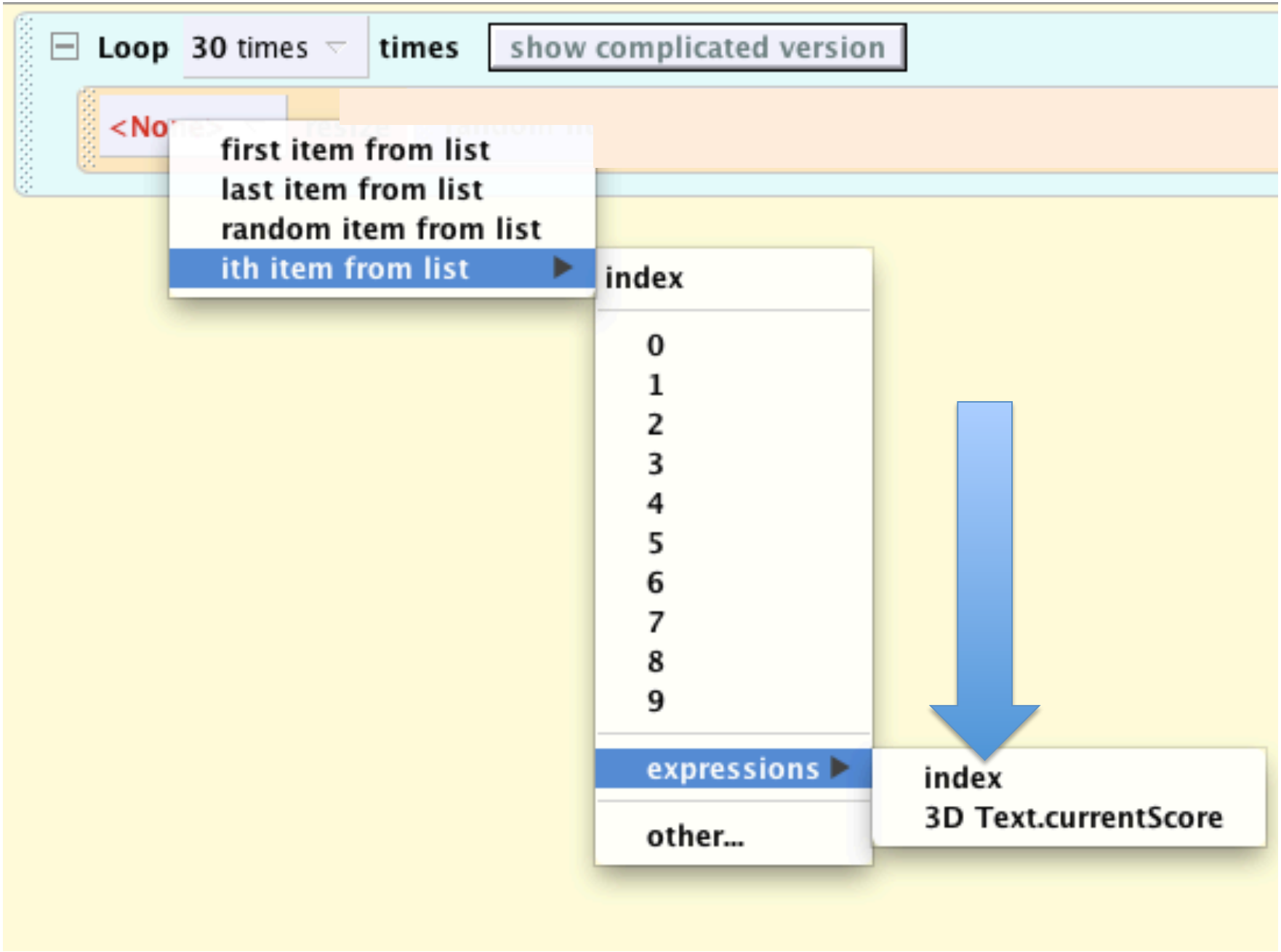
Resizing the Asteroids

- Click on “world” in the object tree and create a new method called “resizeAsteroids”.
- Drag in a loop and have it run thirty times (or as many asteroids as you have in your world)
- Pick any icosahedron and drag its resize method into the loop. Set the duration to 0.



Resizing the Asteroids

- Go to world → properties and drag the list of asteroids on to the icosahedron in the method.
- Click “ith item from array” and then expressions → index.

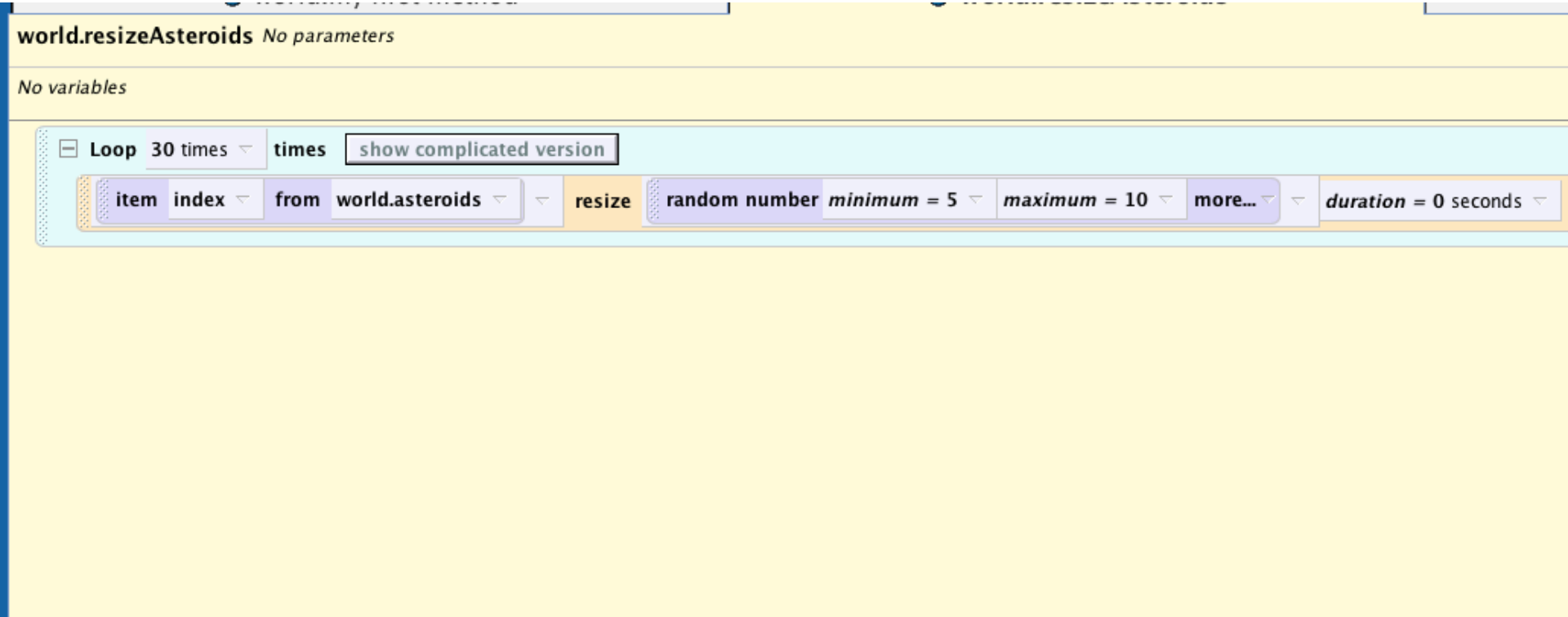

Loop
30 times
times
show complicated version
first item from list
last item from list
random item from list
ith item from list
index
0
1
2
3
4
5
6
7
8
9
expressions
other...
index
3D Text.currentScore

Resizing the Asteroids

- We don't want every asteroid to be the same size, though. We want some to be smaller and some bigger.
- We're going to use the random number function to do this.
- Go to world →functions and drag in "random number" to the number in your resize method.

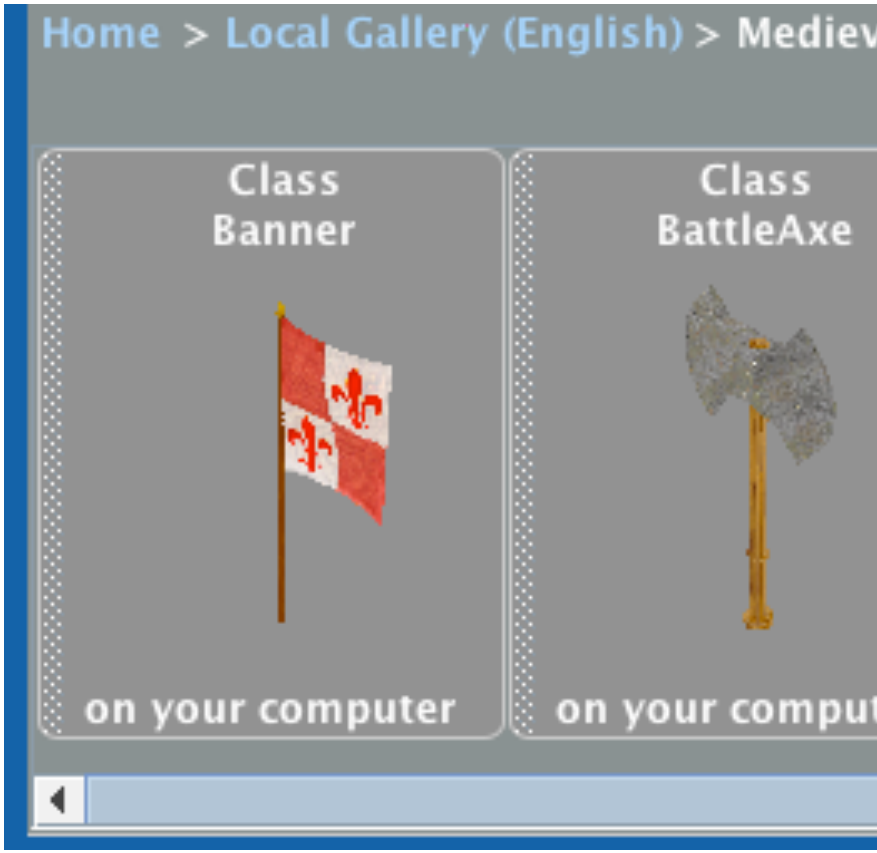
Resizing the Asteroids

- Choose “5” as the minimum and “10” as the maximum. Set the duration to 0.
- Your code should now look like this:



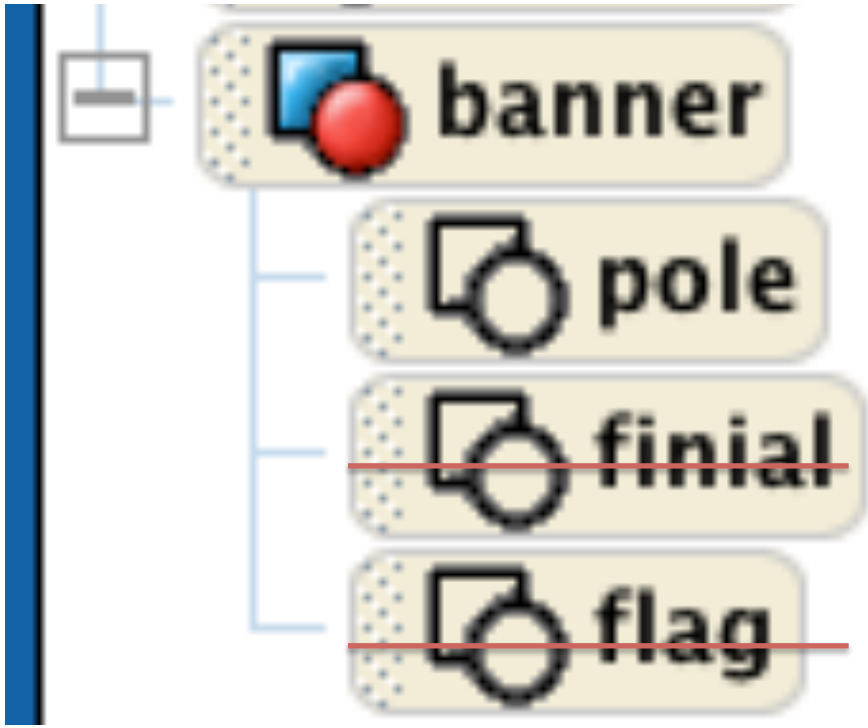
Creating the Laser

- We're now going to make the laser that we shoot at the asteroids.
- To do this, we're going to modify a flag object to use just the pole.
- Go to "add objects" and click on the "Medieval" folder. Add a "banner" to the world.



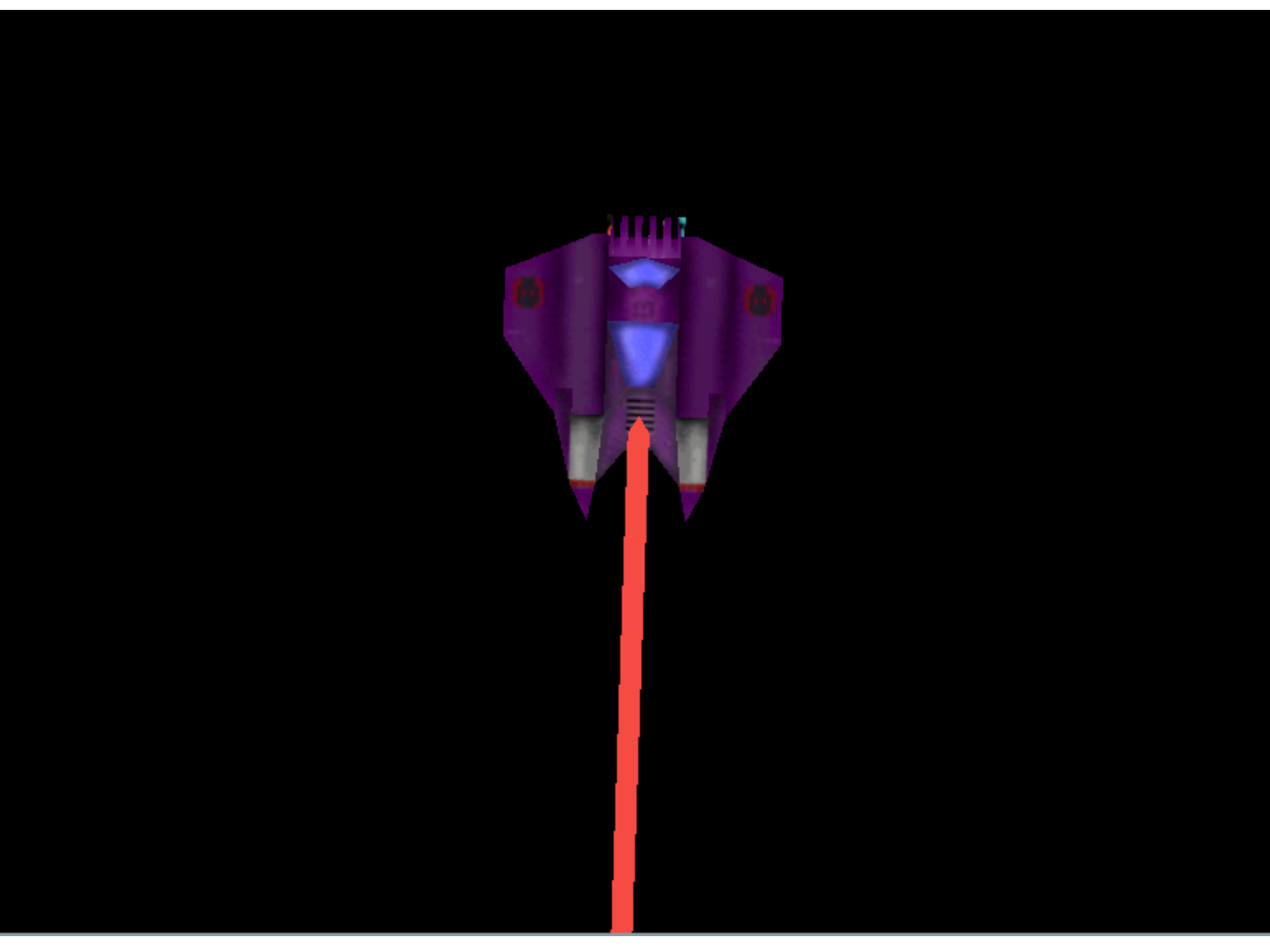
Creating the Laser

- Find the banner in the object tree.
- Click on the plus next to “banner”. Right-click on “flag” and “finial” and delete them both.
- Only “pole” should be remaining.
- Rename the “banner” to “Laser” by right-clicking on “banner” and hitting “rename”.



Creating the Laser

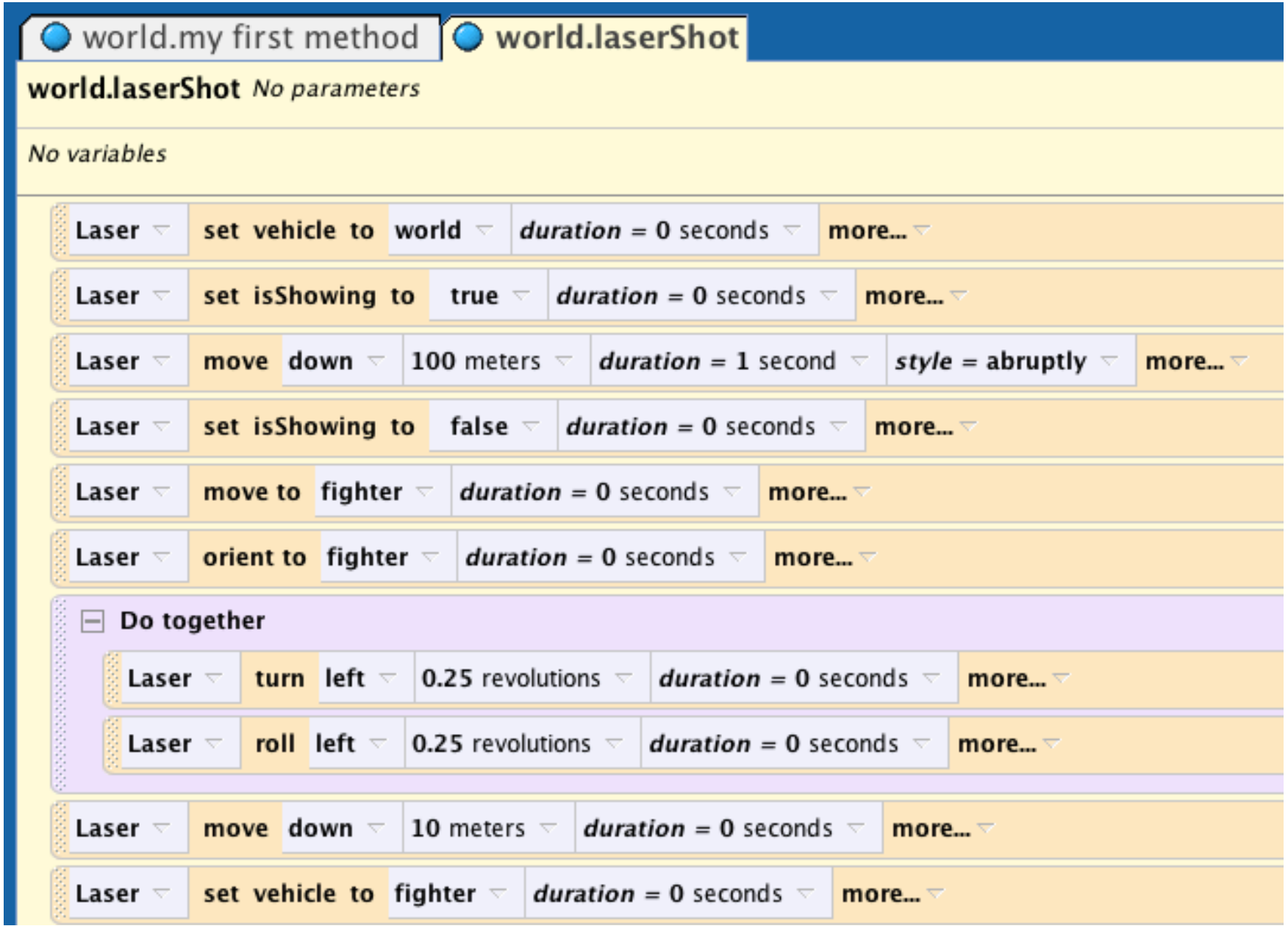
- Position the laser so it's right underneath the fighter. You may have to resize it, turn it, or roll it. This step requires some tinkering.
- In our example, we used the following in-place methods:
  - Move to Fighter
  - Orient to Fighter
  - Quarter Revolution Left
  - Quarter Revolution Backward
- Set the laser's vehicle to "fighter" and set isShowing to false.



Shooting the Laser

- Create a new world method and call it “laserShot”.
- The basic idea is to…
  - Detach the laser from the ship
  - Make it visible
  - Move it one hundred meters
  - Make it invisible
  - Move it back to the fighter and orient it to the fighter
  - Reattach the laser to the ship.

Your Method Should Look Like This



Starting the Game

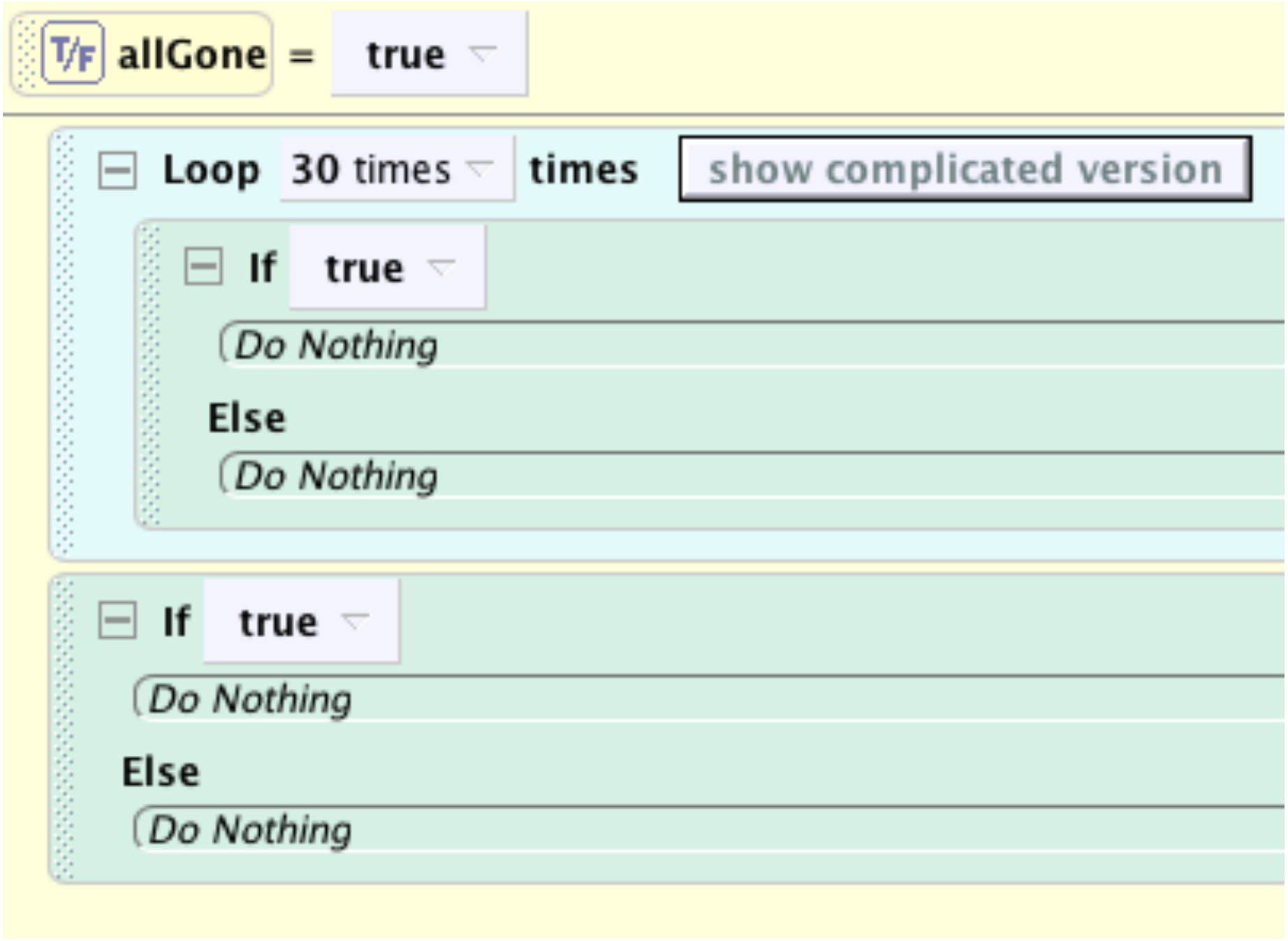
- Remember the variable we made called “currentlyPlaying? We can set “currentlyPlaying” to “true” whenever we want the game to be going on, and we can set it to “false” whenever we want the game to stop. More on this later.
- Now we’re going to write two simple methods that will occur when the game is won or lost.

Game Won

- We're going to make a method called "GameWon" that checks to see if all the asteroids have been shot (are invisible).
- To do this, we're going to make a true or false "switch". We'll first set the switch to "true", meaning that all the asteroids are gone.
- Then we'll loop through the list of asteroids. If at any time an asteroid is visible, we flip the switch to "false".
- At the end of the loop we can check to see what position the switch is in and then react accordingly.

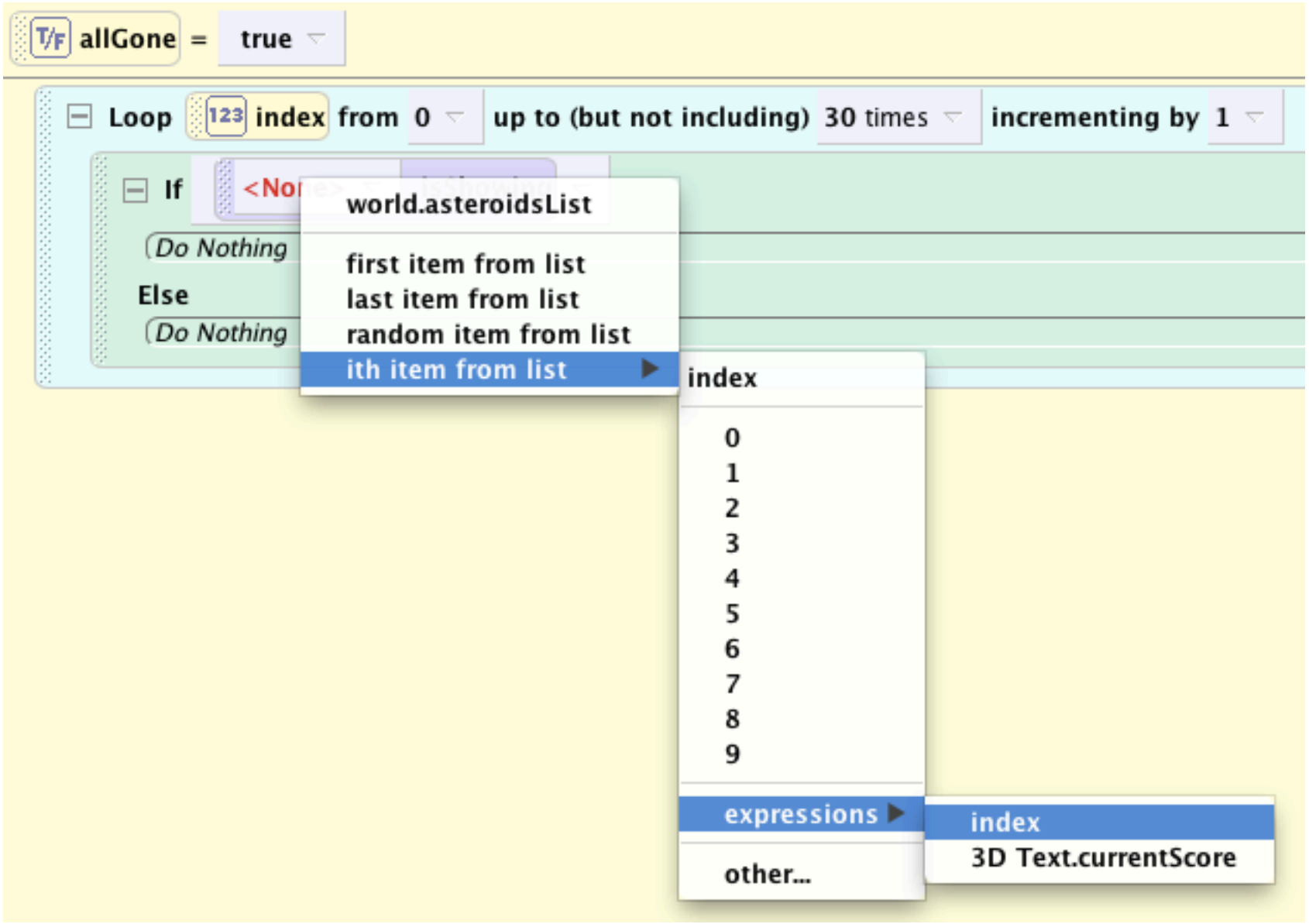
Game Won

- Go to world→methods and create a new method named “GameWon”.
- Drag in a “loop” and set the loop to loop thirty times.
- Drag in an “if/else” into the loop, and another “if/else” below the loop.
- Click “create new variable”. Make it a boolean called allGone. Set the value to “true”.


T/F
allGone = true
Loop 30 times times
show complicated version
If true
Do Nothing
Else
Do Nothing
If true
Do Nothing
Else
Do Nothing

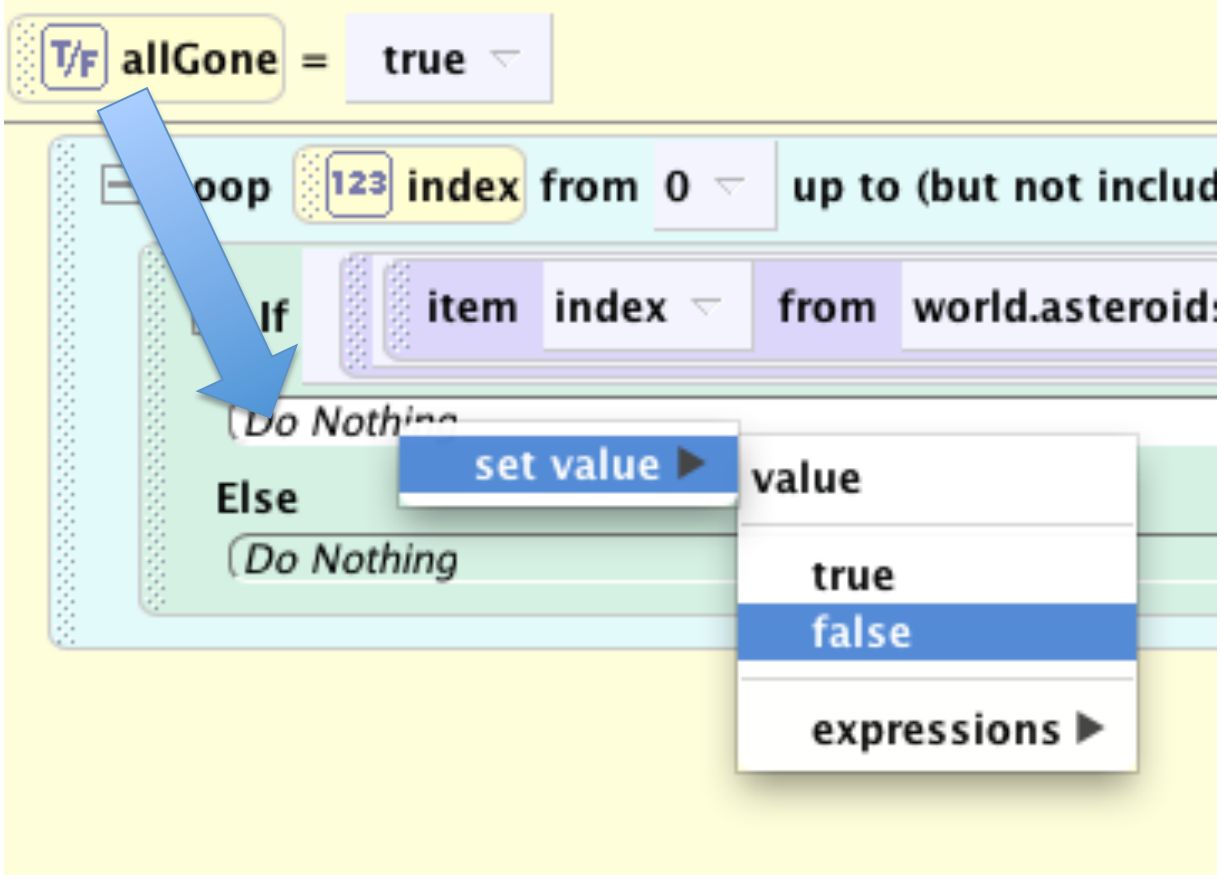
Game Won

- Pick a random icosahedron and go to its properties. Drag “isShowing” into the if/else within the loop.
- Go to world→properties and click on “asteroidsList”. Drag it in to the name of the icosahedron.
- Pick “ith item from list”, “expressions” and “index”.


T/F allGone = true
Loop 123 index from 0 up to (but not including) 30 times incrementing by 1
If
Do Nothing
Else
Do Nothing
world.asteroidsList
first item from list
last item from list
random item from list
ith item from list
index
0
1
2
3
4
5
6
7
8
9
expressions
other...
index
3D Text.currentScore

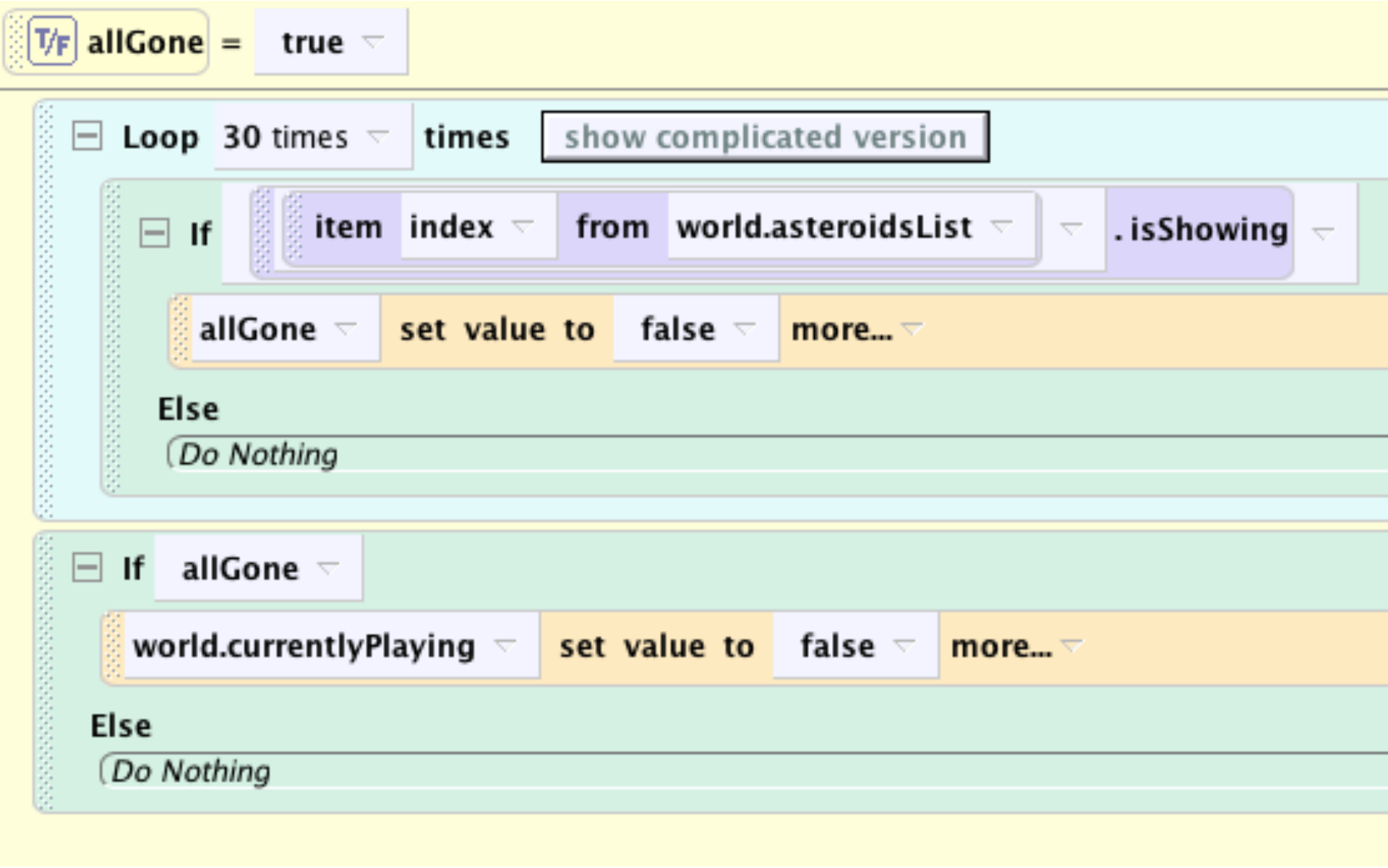
GameWon

- Drag in “allGone” into the first “if/else” statement.
- Set its value to “false”.



GameWon

- Drag in “gameWon” onto the “true” in the second “if/else” statement.
- Go to world→properties and drag in the “currentlyPlaying” variable into the second “if/else”.
- Set it to “false”.

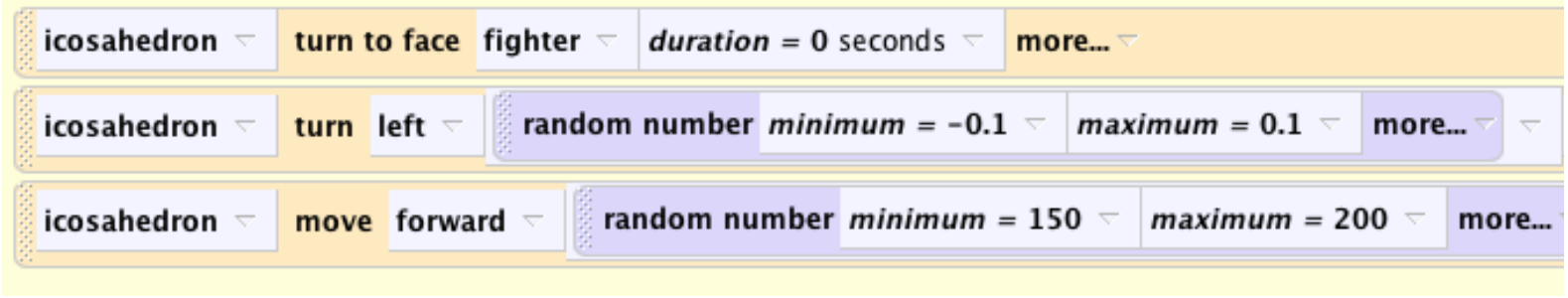

T/F
allGone = true
Loop 30 times times
show complicated version
If item index from world.asteroidsList . isShowing
allGone set value to false more...
Else
Do Nothing
If allGone
world.currentlyPlaying set value to false more...
Else
Do Nothing

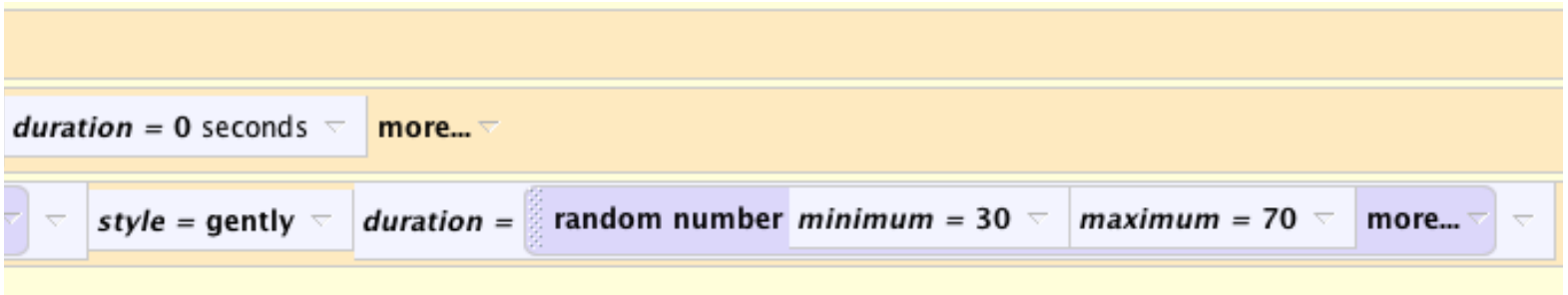
Asteroid Movement

- Now we're going to make a method that moves our asteroids.
- The basic idea is to have them all turn to face the fighter and then rotate a slightly additional amount to the left or right.
- Then, they fire at a random speed and distance until they stop, where they turn to face the fighter again and the process restarts.

Asteroid Movement

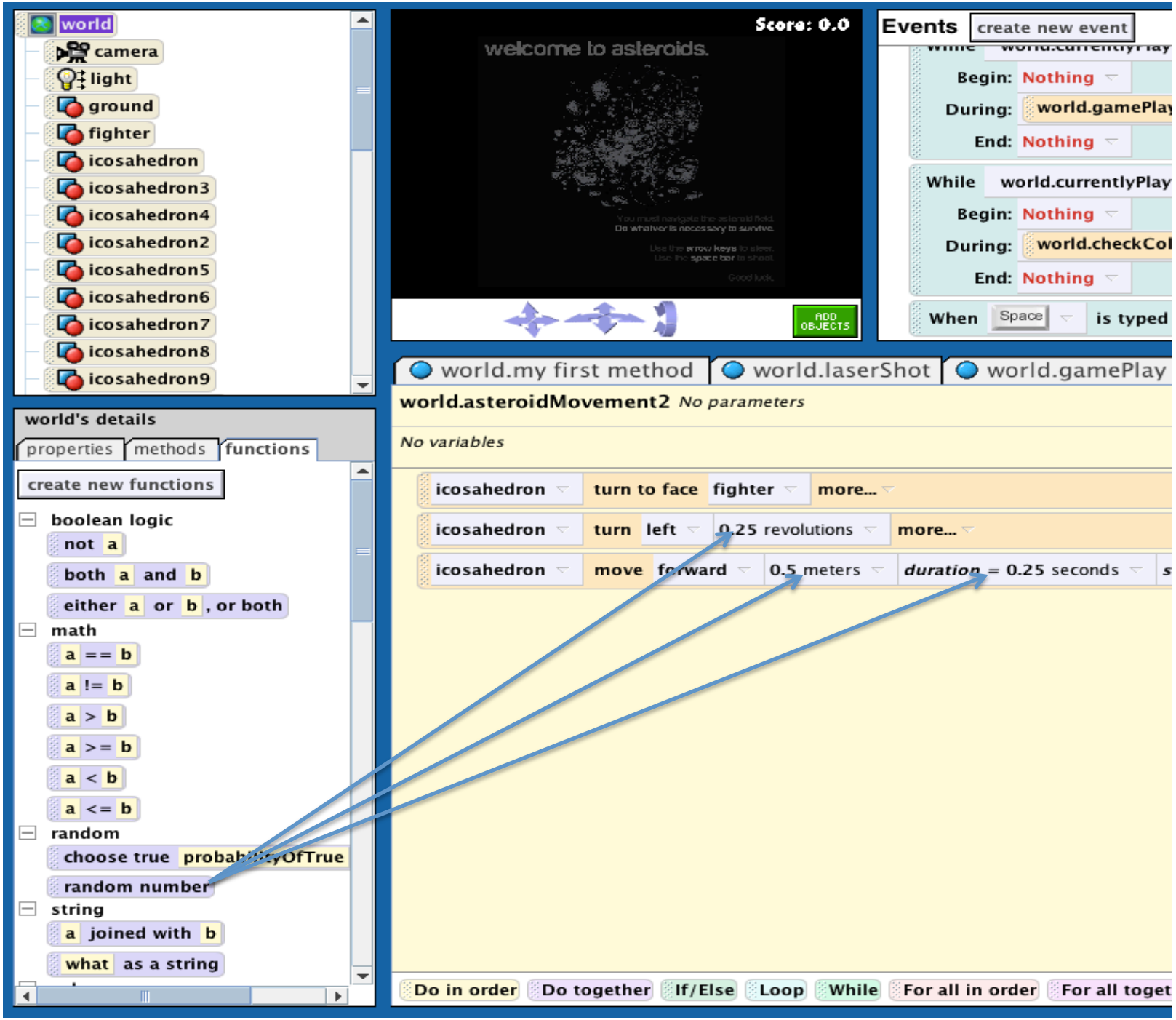
- Pick any random icosahedron and drag in three methods:
  - A “turn to face” the fighter. Set duration to 0.
  - A “turn left” with any distance. Set duration to 0.
  - A “move forward” with any distance and any duration. Set style to abruptly.





Randomizing Asteroid Movement

- Go to world→functions.
- Drag a “random number” onto both distances for the “turn left” and “move forward”. Also drag one on to the duration of “move forward”.


world
camera
light
ground
fighter
icosahedron
icosahedron3
icosahedron4
icosahedron2
icosahedron5
icosahedron6
icosahedron7
icosahedron8
icosahedron9
Score: 0.0
welcome to asteroids.
ADD OBJECTS
Events
create new event
Begin: Nothing
During: world.gamePlay
End: Nothing
While world.currentlyPlay
Begin: Nothing
During: world.checkCol
End: Nothing
When Space is typed
world.my first method
world.laserShot
world.gamePlay
world.asteroidMovement2 No parameters
No variables
icosahedron turn to face fighter more...
icosahedron turn left 0.25 revolutions more...
icosahedron move forward 0.5 meters duration = 0.25 seconds
world's details
properties
methods
functions
create new functions
boolean logic
not a
both a and b
either a or b, or both
math
a == b
a != b
a > b
a >= b
a < b
a <= b
random
choose true probabilityOfTrue
random number
string
a joined with b
what as a string
Do in order
Do together
If/Else
Loop
While
For all in order

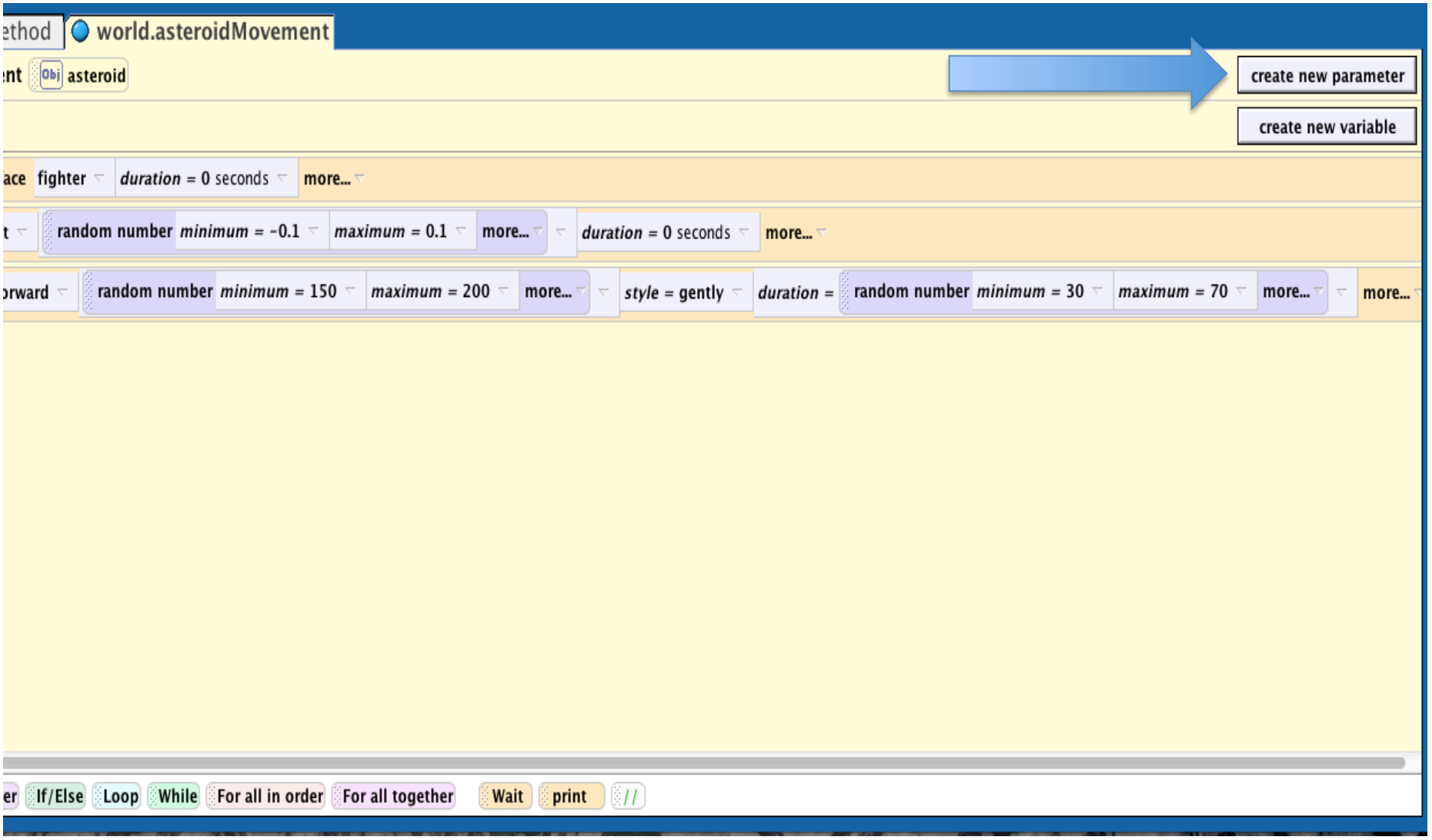
Randomizing Asteroid Movement

- Set the random number's maximums and minimums by clicking on the purple arrow to the right of "random number".
- Set the values to the following:

Method	Maximum	Minimum
Turn Left Distance	-0.1	0.1
Move Forward Distance	150	200
Move Forward Duration	30	70

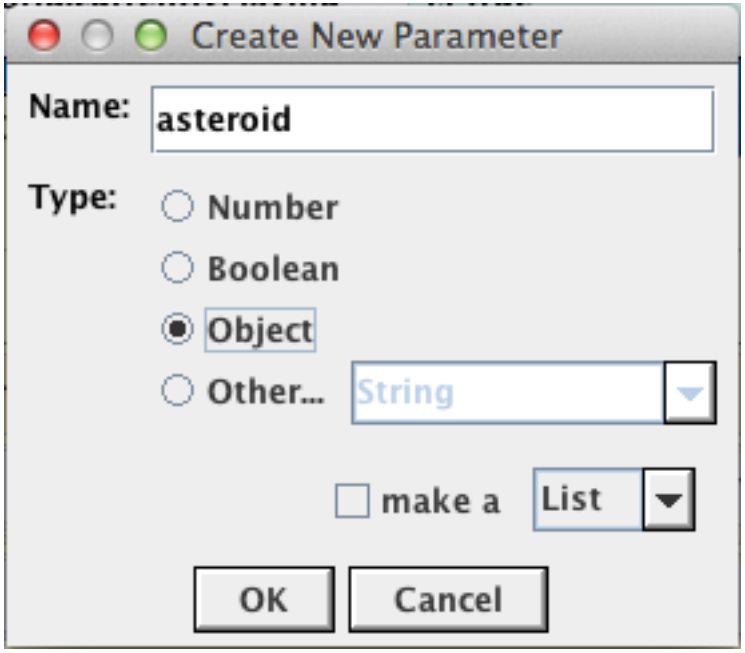
Parameterizing Asteroid Movement

- We want to make this method more flexible – not just for one asteroid, but for *all* asteroids.
- We're going to use a parameter so we can tell this method to work on any asteroid.
- Make sure you have "asteroidMovement" pulled up in your code editor and click on "create new parameter" in the top-right corner.


ethod
world.asteroidMovement
nt
Obj asteroid
create new parameter
create new variable
ace fighter duration = 0 seconds more...
t random number minimum = -0.1 maximum = 0.1 more... duration = 0 seconds more...
orward random number minimum = 150 maximum = 200 more... style = gently duration = random number minimum = 30 maximum = 70 more... more...
er If/Else Loop While For all in order For all together Wait print //

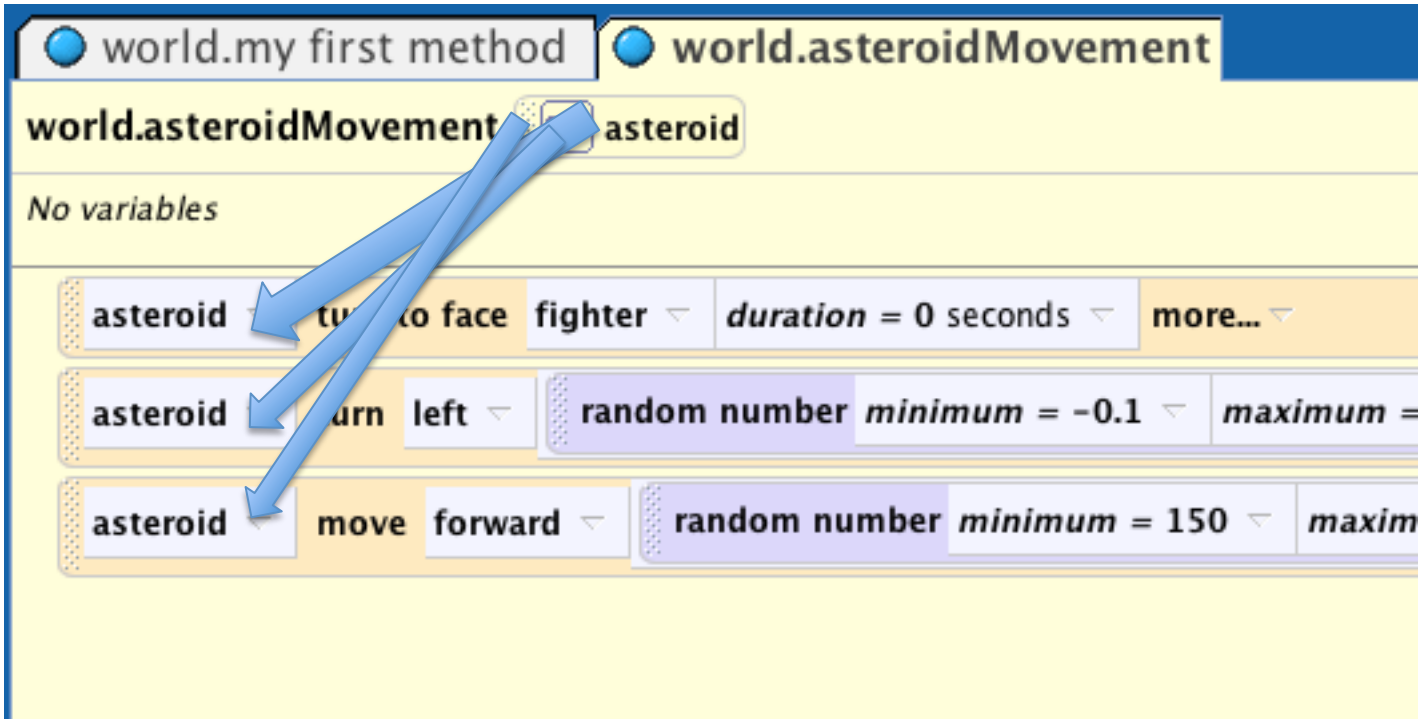
Parameterizing Asteroid Movement

- A box will pop up. Name the parameter “asteroid”.
- Click on “object”.
- Click “OK”.



Parameterizing Asteroid Movement

- You should notice Obj asteroid appear next to the name of the method.
- In your method, wherever “icosahedron” appears, you should drag in the Obj asteroid instead.



Putting It All Together

- Now we're going to write a method that makes all of the asteroids move at once.
- Pretty simple: go to world→methods and create a new method. Name it "gamePlay".
- Drag in a do together.
- Inside the do together, drag in thirty copies of the "asteroidMovement" and pick a different icosahedron for each copy.

Your Method Should Look Like This:

Check Collisions

- This is going to be the biggest method we write. It's going to check to see whether all the objects in the world are colliding with the fighter or the laser.
- To start, go to world→methods and create a new method named "check Collisions".
- Drag in a "for all together" and select "asteroidsList". Drag in 2 "if" statements into the "for all together", one after the other.

world.checkCollisions2 *No parameters*

No variables

For all world.asteroidsList , every Obj item_from_asteroidsList together

If true

Do Nothing

Else

Do Nothing

If true

Do Nothing

Else

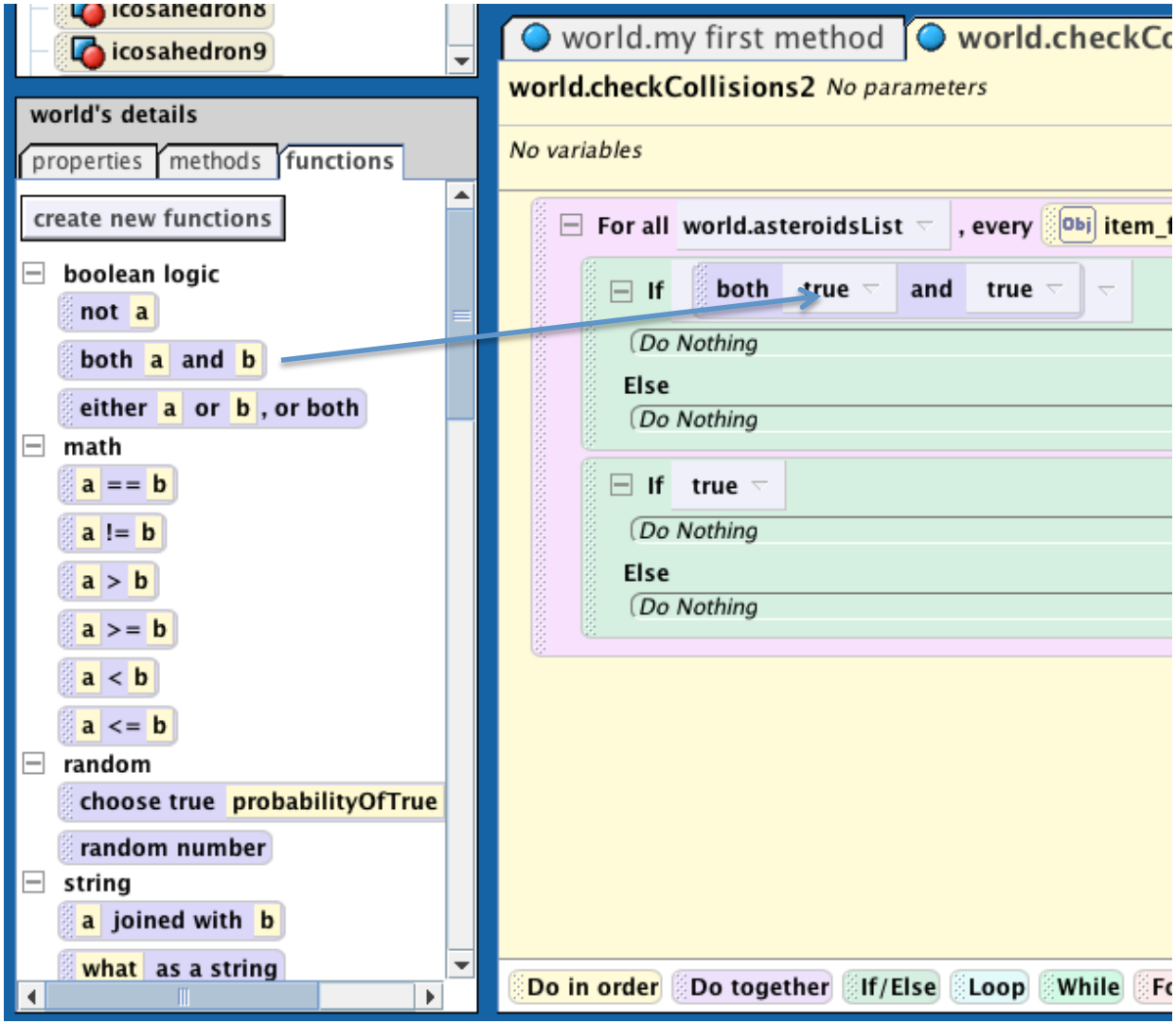
Do Nothing

Check Collisions

- In our first“if” statement, we want to check three things:
  - Is the laser not attached to the fighter? (Has it been shot?)
  - Is the laser touching the asteroid?
  - Is the asteroid visible (has it not already been hit)?
- We need to use a logic function to check three things at once. Go to world→functions and find “both a and b”. Drag it on to “true” in the first “if” statement. Pick “true”.

Check Collisions

- Now we want to add in another “both a and b” so we can check three things.
- Drag another “both a and b” onto the first true in the statement.

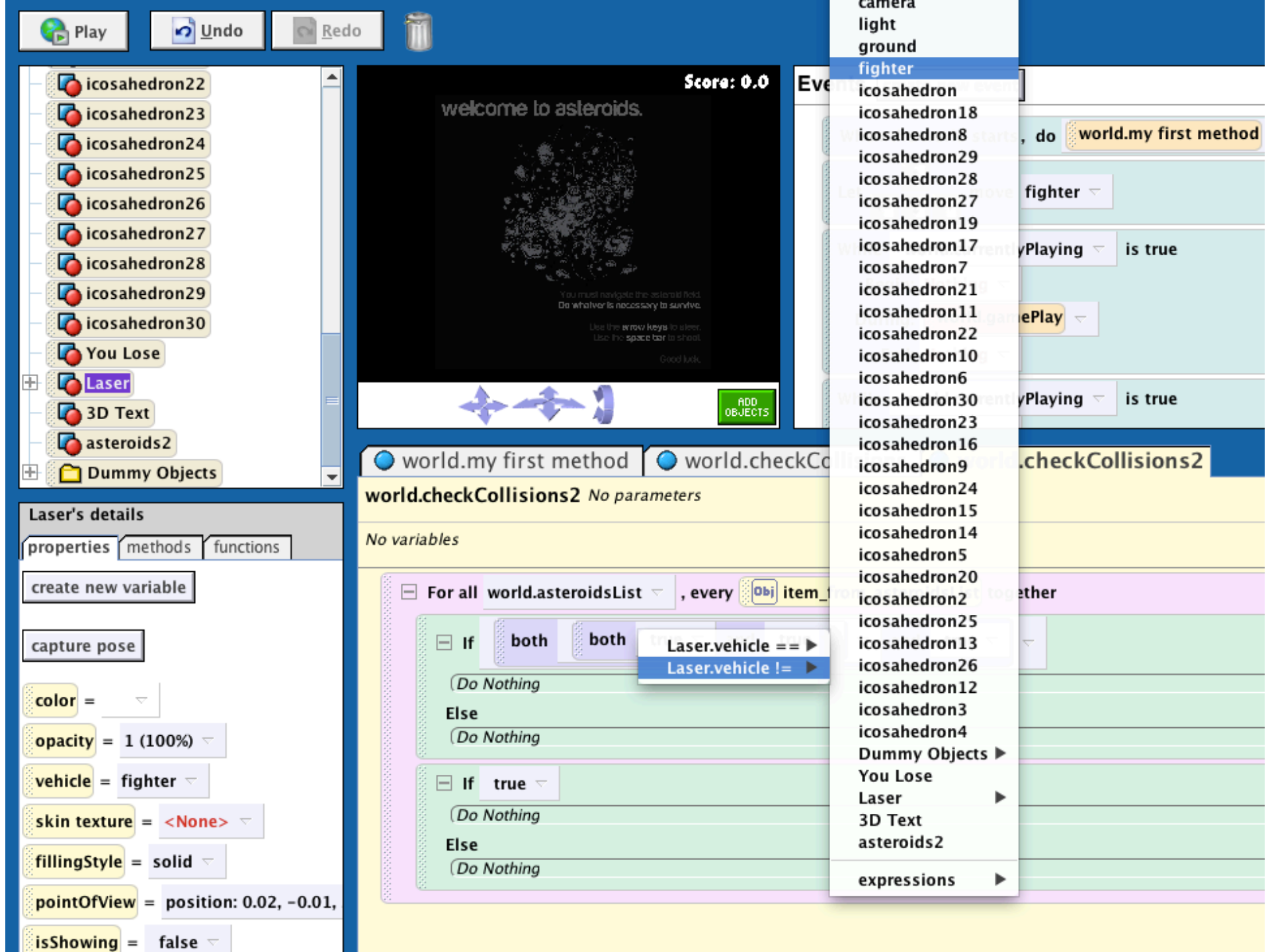


Check Collisions

- How do we know if two objects are touching?
  - Answer: If the distance between the two is less than the width of one of the objects.
  - Think about that for a second. Do you understand why this is?
- We're going to use our statements to check three things:
  - Is the laser not attached to the vehicle?
  - Is the laser touching the asteroid?
  - Is the asteroid visible (has it not already been hit)?

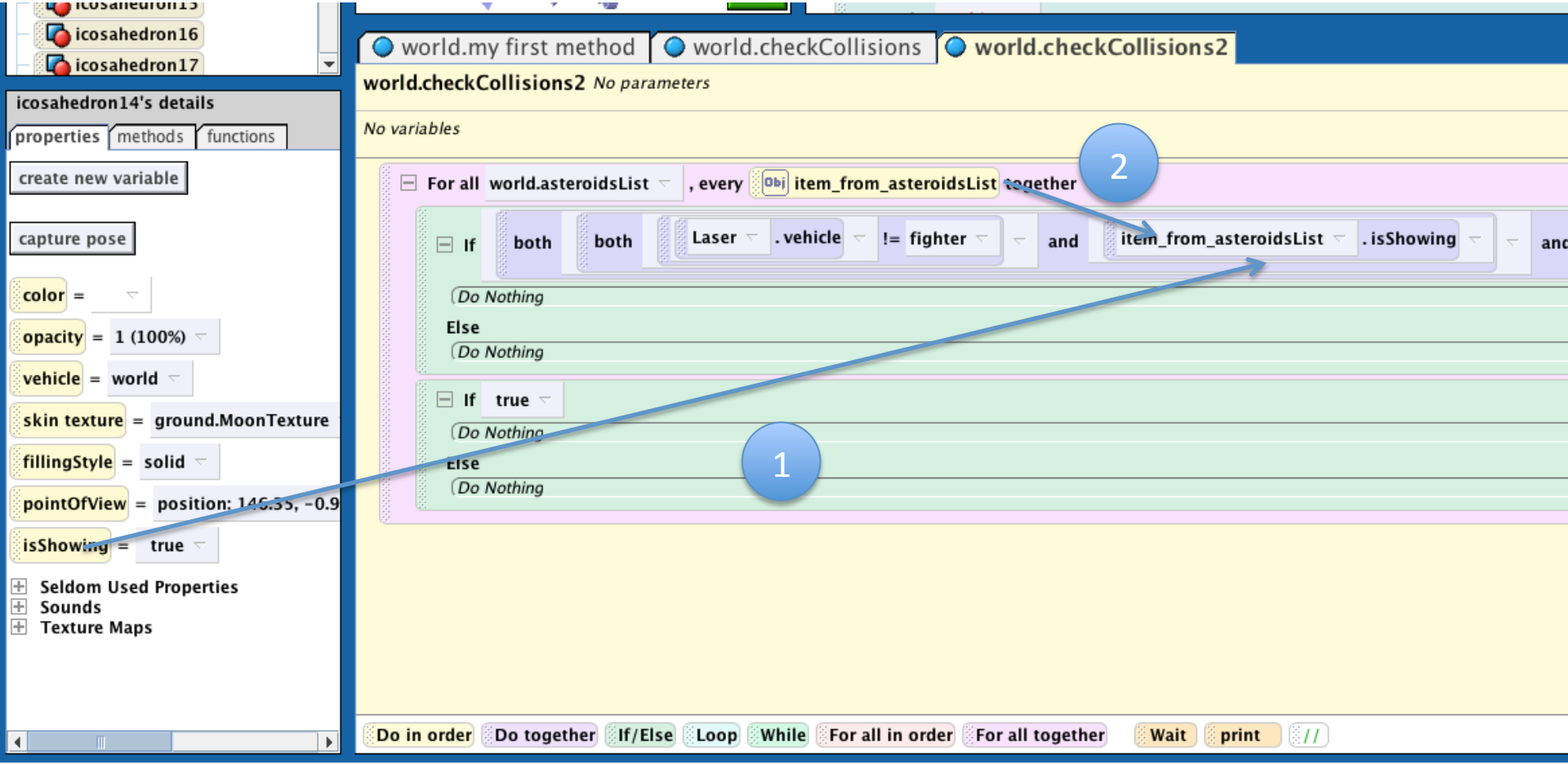
Check Collisions

- **First Condition: Is the laser not attached to the ship?**
  - Go to the “Laser” object you made out of the flag and go to “properties”.
  - Drag in the laser’s “vehicle” on to the first value.
  - A menu should pop up. Select “laser.vehicle !=“ and then select “fighter”.


Play
Undo
Redo
icosahedron22
icosahedron23
icosahedron24
icosahedron25
icosahedron26
icosahedron27
icosahedron28
icosahedron29
icosahedron30
You Lose
Laser
3D Text
asteroids2
Dummy Objects
Score: 0.0
welcome to asteroids.
You must navigate the asteroid field.
Do whatever is necessary to survive.
Use the arrow keys to steer.
Use the space bar to shoot.
Good luck.
ADD OBJECTS
Laser's details
properties
methods
functions
create new variable
capture pose
color =
opacity = 1 (100%)
vehicle = fighter
skin texture = <None>
fillingStyle = solid
pointOfView = position: 0.02, -0.01,
isShowing = false
world.my first method
world.checkCollisions2
world.checkCollisions2 No parameters
No variables
For all world.asteroidsList , every Obj item_
If both both
Laser.vehicle ==
Laser.vehicle !=
Do Nothing
Else
Do Nothing
If true
Do Nothing
Else
Do Nothing
camera
light
ground
fighter
icosahedron
icosahedron18
icosahedron8
icosahedron29
icosahedron28
icosahedron27
icosahedron19
icosahedron17
icosahedron7
icosahedron21
icosahedron11
icosahedron22
icosahedron10
icosahedron6
icosahedron30
icosahedron23
icosahedron16
icosahedron9
icosahedron24
icosahedron15
icosahedron14
icosahedron5
icosahedron20
icosahedron2
icosahedron25
icosahedron13
icosahedron26
icosahedron12
icosahedron3
icosahedron4
Dummy Objects
You Lose
Laser
3D Text
asteroids2
expressions
, do world.my first method
fighter
is true
is true

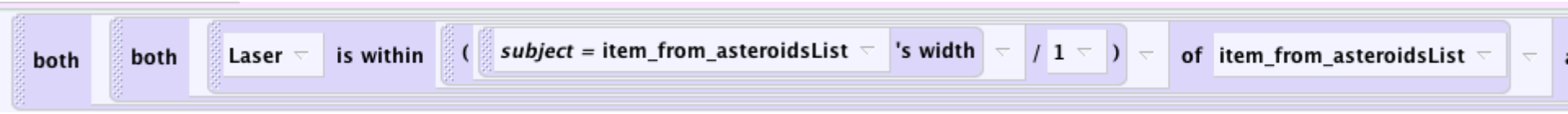
Check Collisions

- **Second Condition: Is the asteroid invisible? (Has it already been hit)?**
  - Pick any icosahedron in your object tree. Go to its properties and drag in “isShowing” on the second “true”.
  - Instead of the individual icosahedron, we want it to check all of the items in the list. Drag in “item_from_asteroidsList” at the top of the “for all together” to the icosahedron.


icosahedron16
icosahedron17
icosahedron14's details
properties
methods
functions
create new variable
capture pose
color =
opacity = 1 (100%)
vehicle = world
skin texture = ground.MoonTexture
fillingStyle = solid
pointOfView = position: 146.35, -0.9
isShowing = true
Seldom Used Properties
Sounds
Texture Maps
world.my first method
world.checkCollisions
world.checkCollisions2
world.checkCollisions2 No parameters
No variables
For all world.asteroidsList , every Obj item_from_asteroidsList together
If both both Laser . vehicle != fighter and item_from_asteroidsList . isShowing and
Do Nothing
Else
Do Nothing
If true
Do Nothing
Else
Do Nothing
1
2
Do in order
Do together
If/Else
Loop
While
For all in order
For all together
Wait
print
//

Check Collisions

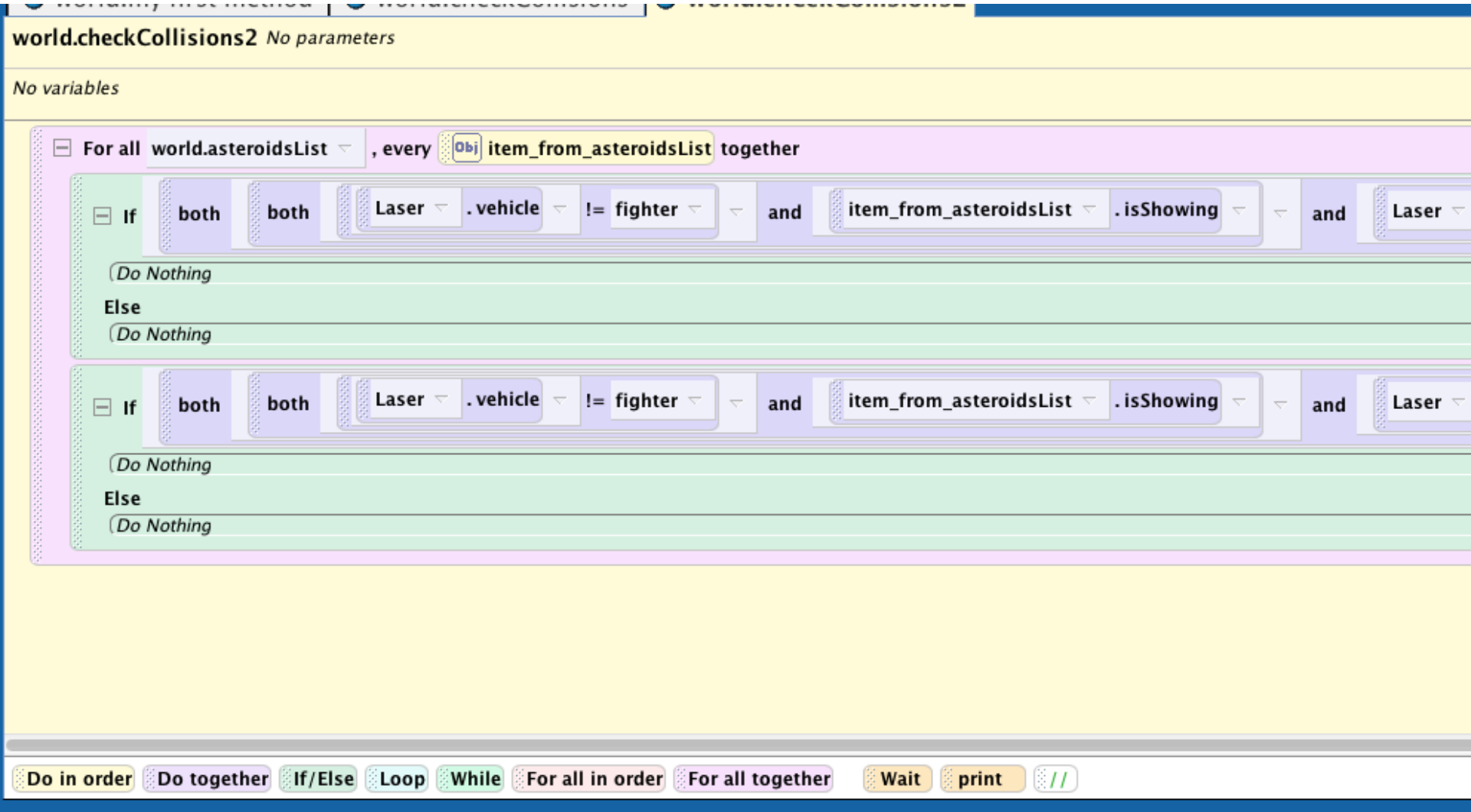
- **Third Condition: is the laser touching an asteroid?**
  - Go to **Laser**'s functions and drag in an "is within [threshold] of" to the last "true".
  - In the drop-down menu that will pop up, pick any icosahedron and any distance.
  - Drag in item_from_asteroidsList to the icosahedron.
  - Go to the icosahedron's functions and drag in "width" where the distance is.
  - Drag in item_from_asteroidsList to *subject = icosahedron*



Check Collisions

- Now we're going to move into the second "if" statement.
- We're going to make a copy of our first "if" block because this one will be very similar.
- Drag the first if block to the clipboard to make a copy. Drag in a copy just underneath the first "if" block within the "for all together".

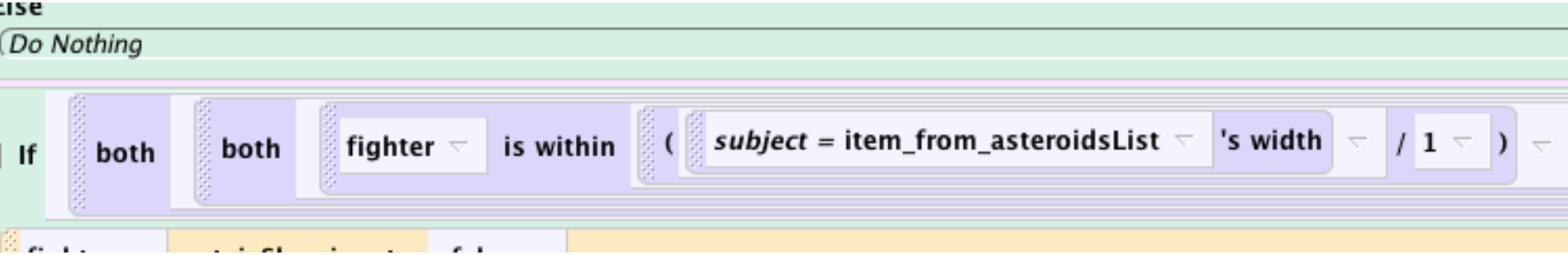
Your Code Should Look Like This



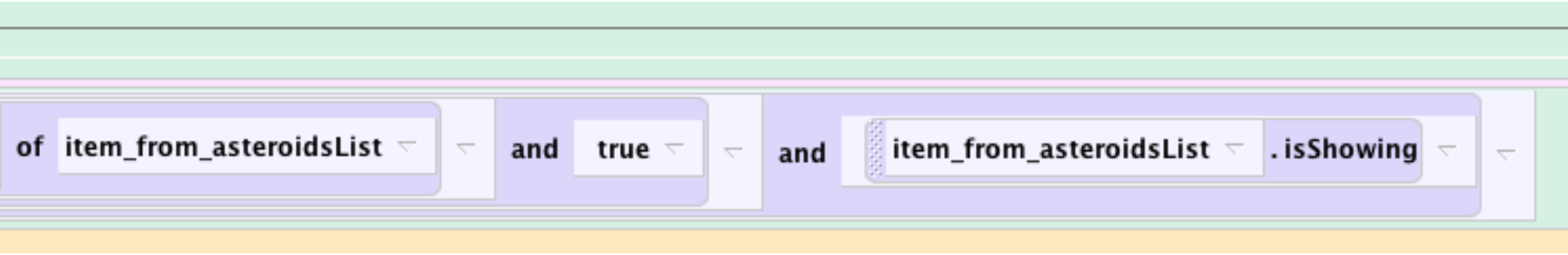
Check Collisions

- In “ [Laser] is within [subject = item_from_asteroid]’s width…” change “Laser” to “fighter”
- Remove the condition that says “Laser.vehicle == fighter” by dragging it to the trash. There should be a “true” value where it was. This is OK.

Your Code Should Look Like This

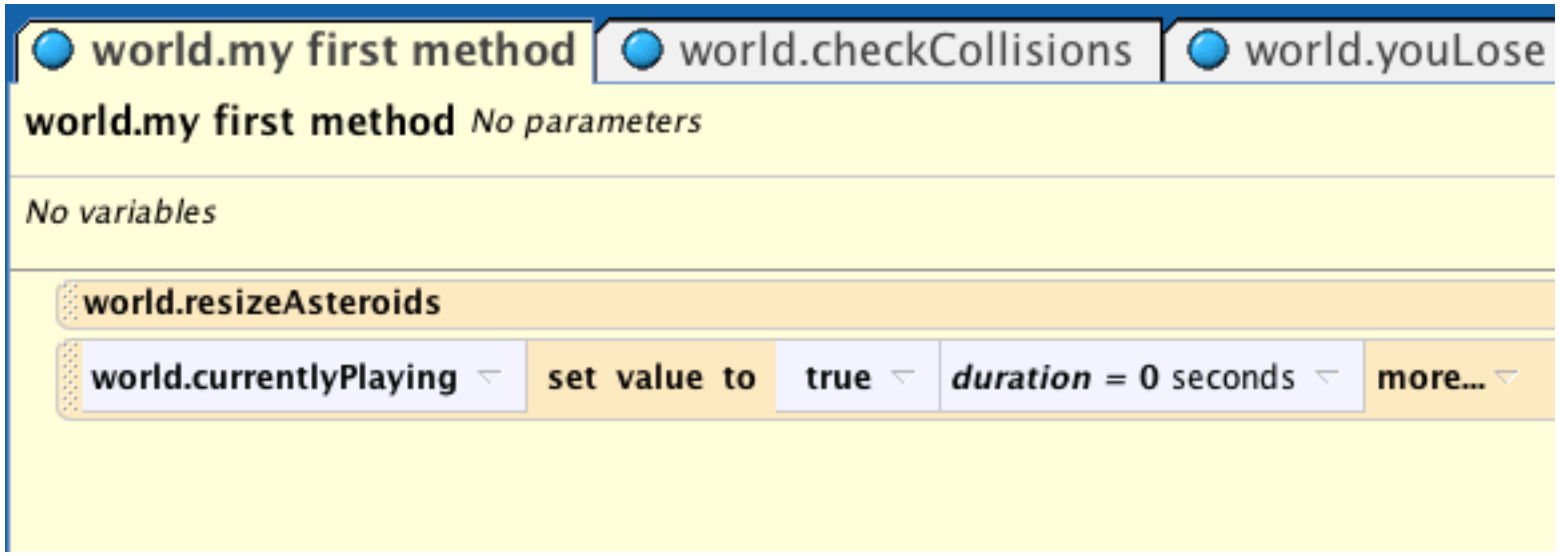


Continued, in the same line…



myFirstMethod

- Go to world.myFirstMethod.
- Drag in “world.resizeAsteroids”
- Go to world→properties and drag in currentlyPlaying. Set its value to “true”.

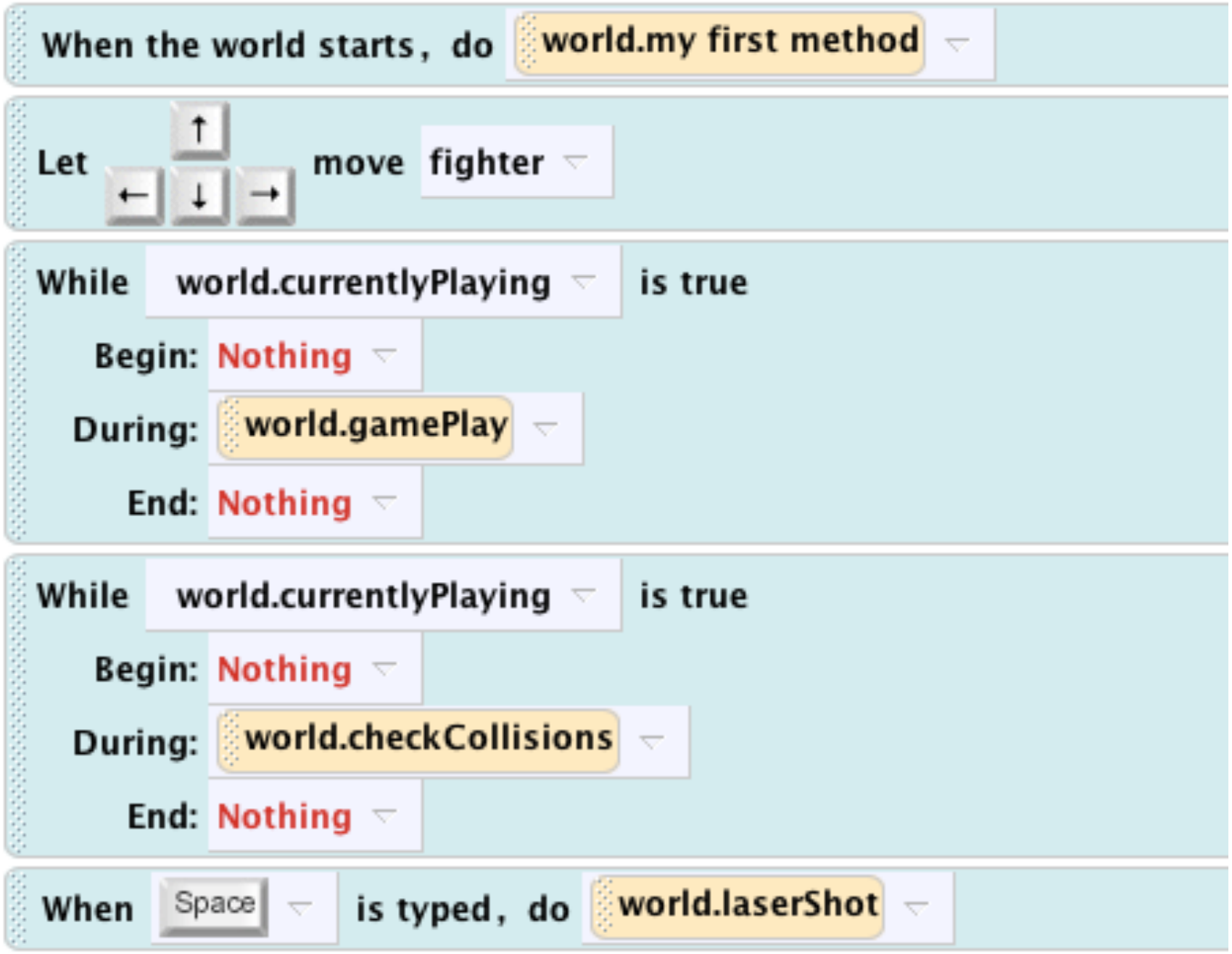


Events

- Go to Events in the top-right corner of the screen.
- There should already be one that says “when world starts, do world.myFirstMethod”.
- Create a new event. Pick “let arrow keys move subject”. Select “fighter”.

Events

- Create two events “while something is true”. Pick “world.currentlyPlaying” for the ‘something’.
- In the first “while” event, drag in “gamePlay” to the “during”.
- In the second “while event, drag in “checkCollisions” to the “during”.
- Create a last event – “when a key is typed.”
- Select space and then drag in “world.laserShot”.


When the world starts, do
world.my first method
Let
move
fighter
While
world.currentlyPlaying
is true
Begin:
Nothing
During:
world.gamePlay
End:
Nothing
While
world.currentlyPlaying
is true
Begin:
Nothing
During:
world.checkCollisions
End:
Nothing
When
Space
is typed, do
world.laserShot

Challenges

- Can you create a score object that counts the number of asteroids that have been hit?
- Can you create a billboard with instructions for the game? Can you make it disappear when the game starts?
- Can you create 3D text that appears when you win or lose that tells you whether you've won or lost?