Name________________________________ Date_____________________

Algebra
Unit 3 Line Master 8a

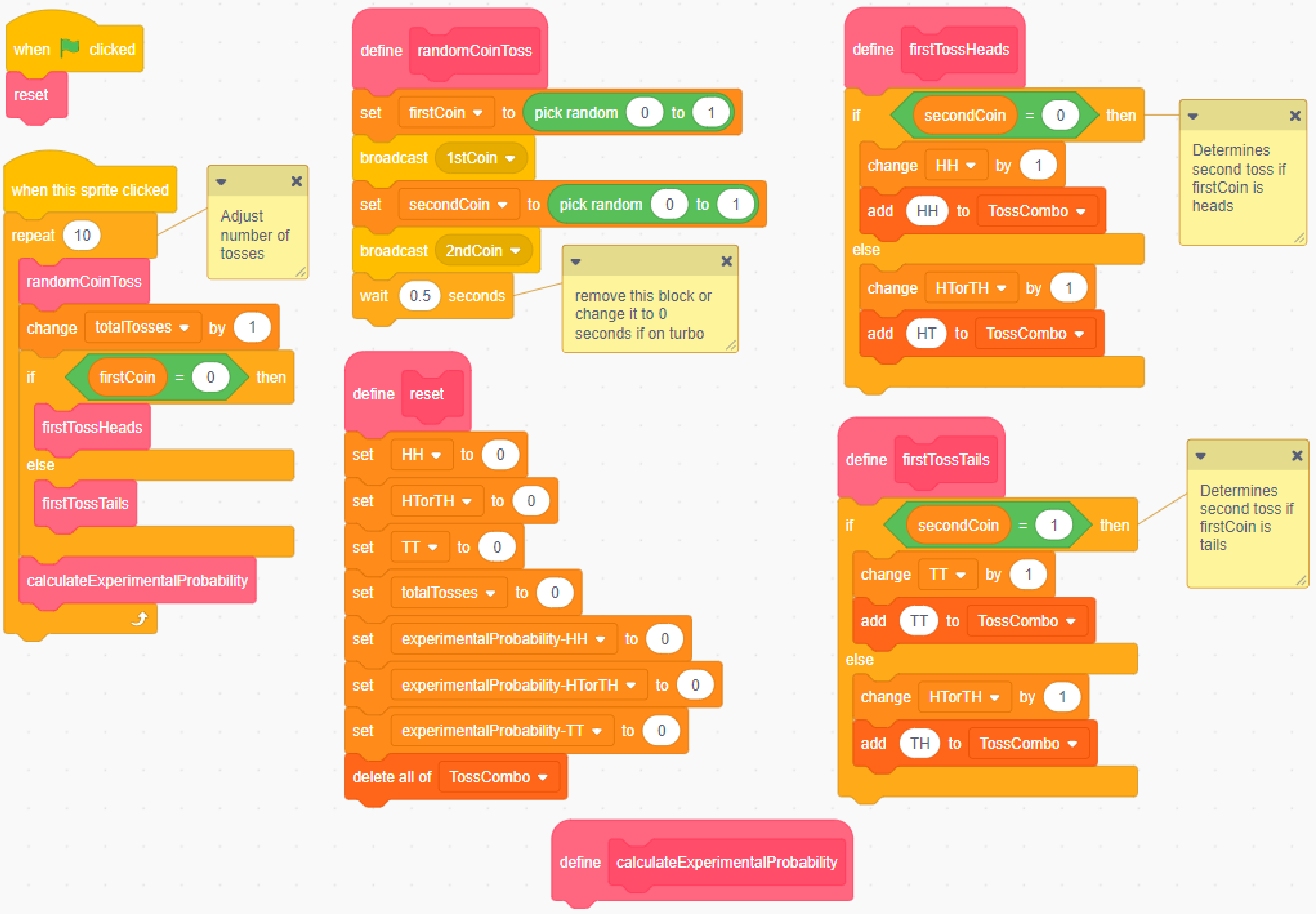
Writing and Altering Code for a Coin Toss Simulator

Here’s the starting Scratch code:

https://scratch.mit.edu/projects/719187744/editor/

If you have a Scratch login, save the project in your Scratch account by selecting **Remix** at the top of the screen. A login is not required to work with the code, but you will not be able to save your changes without it.

The code simulates repeatedly tossing two coins.



```
when 🏁 clicked
reset

when this sprite clicked
repeat 10
    randomCoinToss
    change totalTosses by 1
    if firstCoin = 0 then
        firstTossHeads
    else
        firstTossTails
    calculateExperimentalProbability
```

Adjust number of tosses

```
define randomCoinToss
set firstCoin to pick random 0 to 1
broadcast 1stCoin
set secondCoin to pick random 0 to 1
broadcast 2ndCoin
wait 0.5 seconds
```

remove this block or change it to 0 seconds if on turbo

```
define reset
set HH to 0
set HTorTH to 0
set TT to 0
set totalTosses to 0
set experimentalProbability-HH to 0
set experimentalProbability-HTorTH to 0
set experimentalProbability-TT to 0
delete all of TossCombo
```

```
define firstTossHeads
if secondCoin = 0 then
    change HH by 1
    add HH to TossCombo
else
    change HTorTH by 1
    add HT to TossCombo
```

Determines second toss if firstCoin is heads

```
define firstTossTails
if secondCoin = 1 then
    change TT by 1
    add TT to TossCombo
else
    change HTorTH by 1
    add TH to TossCombo
```

Determines second toss if firstCoin is tails

```
define calculateExperimentalProbability
```

Name______________________________ Date____________________

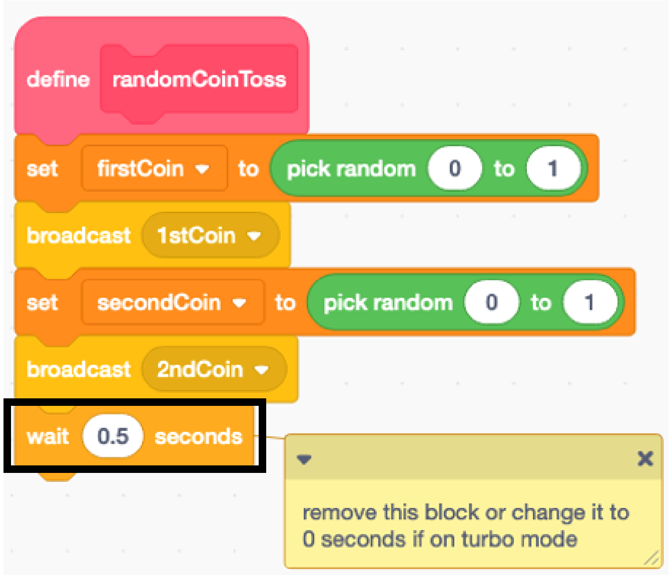
Algebra
Unit 3 Line Master 8b

Writing and Altering Code for a Coin Toss Simulator (cont'd)

Click on the **green flag** ⚑ to reset the application.

Click on the **Toss** button Toss to execute the code.
The starting code tosses two coins 10 times.

1. Where in the code is the number of tosses specified?
2. Which random number is used to represent heads?
   To represent tails?
3. Alter the code to toss the two coins 100 times.
   Notice the coins toss every 0.5 s, which is specified in the **randomCoinToss** subprogram.



```
define randomCoinToss
set firstCoin to pick random 0 to 1
broadcast 1stCoin
set secondCoin to pick random 0 to 1
broadcast 2ndCoin
wait 0.5 seconds
```

remove this block or change it to 0 seconds if on turbo mode

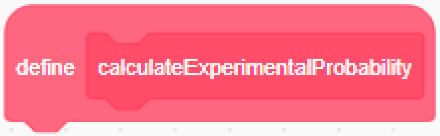
   Toss the coins faster by reducing the wait time in the code.
4. Notice that the experimental probability variables are set to 0 and never change when the code is executed.
   That's because you need to write the code to do these calculations.
   This code will be part of a subprogram called **calculateExperimentalProbability**.

Name______________________________ Date____________________

Algebra
Unit 3 Line Master 8c

Writing and Altering Code for a Coin Toss Simulator (cont'd)

Look through the code to locate the block that says

define calculateExperimentalProbability (

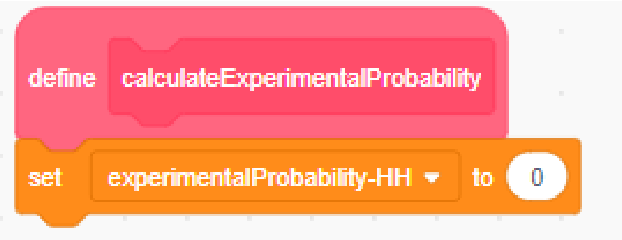
```
define calculateExperimentalProbability
```

).

When the file opens, there is no code in this block.

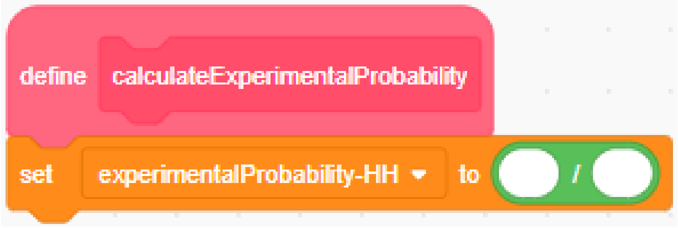
Follow these steps to create the code for this block.

- Start by writing code to calculate the experimental probability of tossing two heads. Store this number in a variable called **experimentalProbability-HH** that has already been created.
- To do this, under **Variables**, select the **set** block and place it beneath the **define calculateExperimentalProbability**.
- Ensure the **experimentalProbability-HH** variable is selected from the pulldown menu.



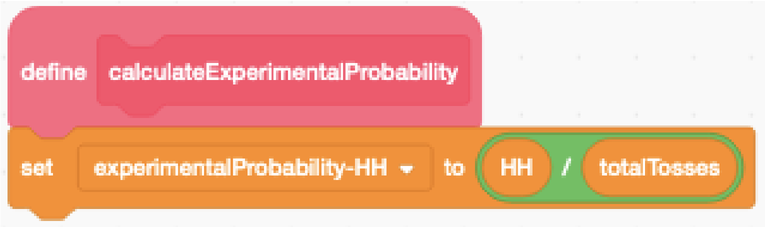
```
define calculateExperimentalProbability
set experimentalProbability-HH ▾ to 0
```

- Under **Operators**, select the **division** operator ( ) and place it inside the **set** block.



```
define calculateExperimentalProbability
set experimentalProbability-HH ▾ to ( ) / ( )
```

- From **Variables**, drag the **HH** variable block inside the first part of the **division** operator.
  Drag the **totalTosses** variable block inside the second part of the **division** operator.



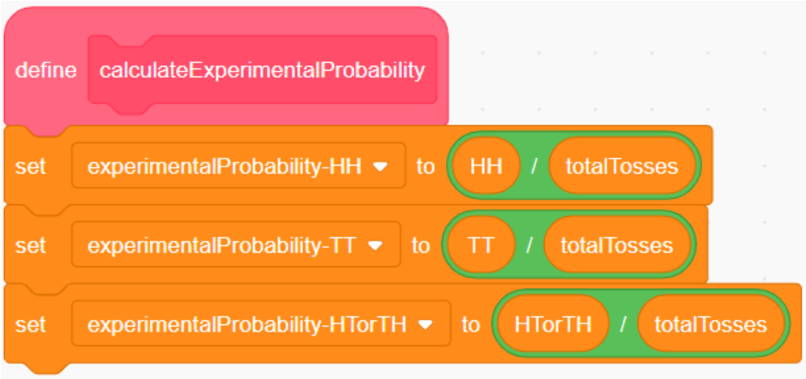
```
define calculateExperimentalProbability
set experimentalProbability-HH ▾ to (HH) / (totalTosses)
```

Name________________________________ Date_____________________

Algebra
Unit 3 Line Master 8d

Writing and Altering Code for a Coin Toss Simulator (cont’d)

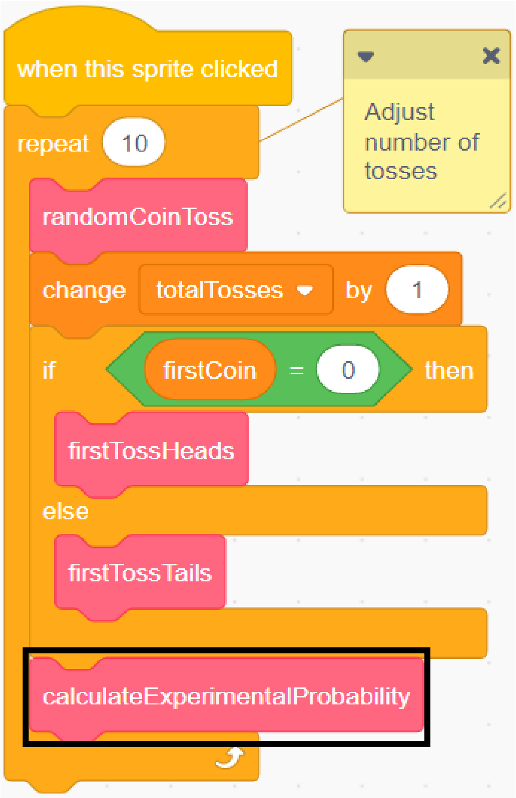
- Repeat this process by adding additional set blocks and division operators to this subprogram for:
  experimentalProbability-TT
  experimentalProbability-HTorTH



```
define calculateExperimentalProbability
set experimentalProbability-HH to (HH / totalTosses)
set experimentalProbability-TT to (TT / totalTosses)
set experimentalProbability-HTorTH to (HTorTH / totalTosses)
```

Notice that the **calculateExperimentalProbability** block is inside the repeat.
This means that it will calculate the experimental probability with each toss as the code is executed.

Record the experimental probability for 10 trials.



```
when this sprite clicked
repeat 10
    randomCoinToss
    change totalTosses by 1
    if firstCoin = 0 then
        firstTossHeads
    else
        firstTossTails
    calculateExperimentalProbability
```

Adjust number of tosses

Name________________________________ Date_____________________

Algebra
Unit 3 Line Master 8e

Writing and Altering Code for a Coin Toss Simulator (cont’d)

5. Test your new code.

- Change the **wait** time to 0 in the **randomCoinToss** subprogram.
- Alter the **repeat** value to 1000.
- Click on the **green flag** to reset the variables, then click on the **Toss** button to execute the code.
- Check that the numbers are close to what you expected based on the theoretical probability of tossing two coins many times.

If the numbers seem wrong, look through your code to identify any errors.

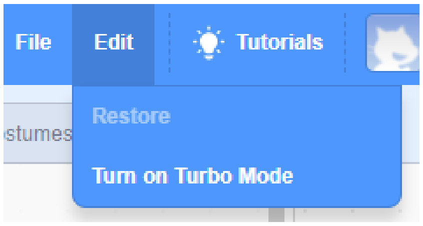
Name________________________________ Date_____________________

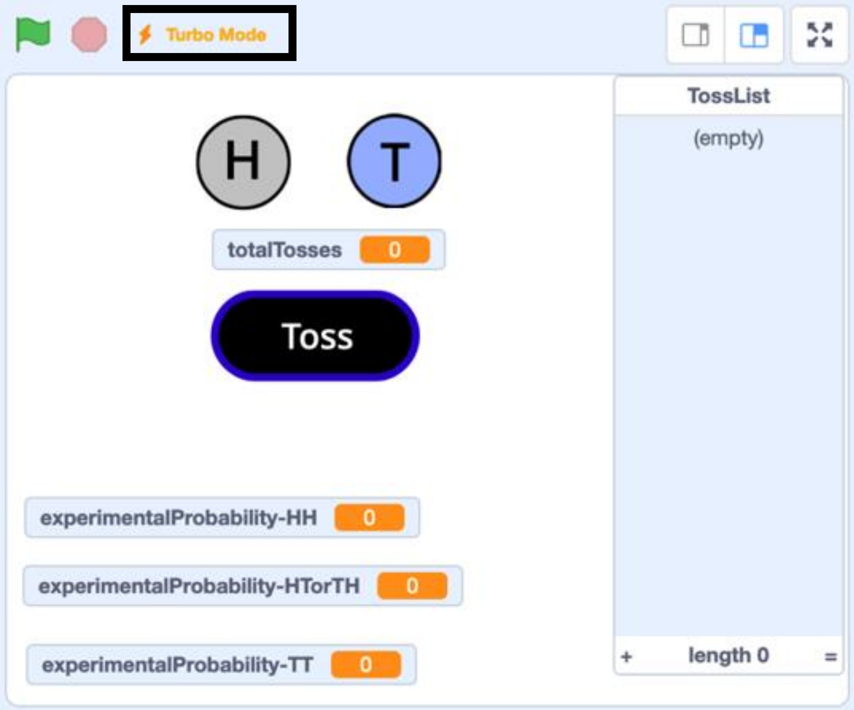
Algebra
Unit 3 Line Master 8f

Writing and Altering Code for a Coin Toss Simulator (cont’d)

6. Alter the code to do a large number of trials.

- First, turn on **Turbo Mode** so that you don’t have to wait for the results. Under **Edit**, select **Turn on Turbo Mode**. You will know that **Turbo Mode** is on because it will indicate this above the **Stage.**




Turbo Mode
TossList
(empty)
H
T
totalTosses 0
Toss
experimentalProbability-HH 0
experimentalProbability-HTorTH 0
experimentalProbability-TT 0
+
length 0
=

- Click on the **green flag** to reset the variables.
- Alter the repeat value to 10 000.
  What are the experimental probabilities for each event?
- Alter the repeat value to 1 000 000. Compare the expermental probability to the value you recorded for 10 trials.
  Explain why the numbers are different.