While Loops

A loop allows you to execute the same statements multiple times. `while` loops continue running as long as a condition is true.

Manager: Recorder:

Presenter: Reflector:

Content Learning Objectives

After completing this activity, students should be able to:

- Identify the three main components of a `while` loop.
- Use the `random` module to generate random numbers.
- Explain when to use a `while` loop versus a `for` loop.

Process Skill Goals

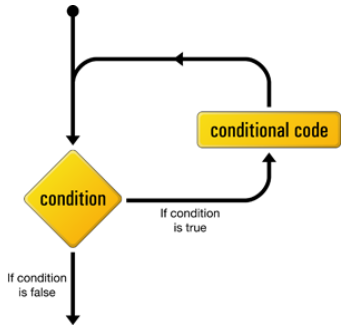
During the activity, students should make progress toward:

- Tracing the execution of while/for loops and predict their final output. (Critical Thinking)

Model 1 `while` Statements

A `while` statement is a general loop that continues to run while the condition is true. Run the following code, and record the output.

```
i = 0
while i < 3:
    print("the number is", i)
    i = i + 1
print("goodbye")
```



Questions (15 min) Start time:

1. What must the value of the Boolean expression (after the `while`) be in order for the first print statement to execute?

2. Circle the statement that changes the variable `i` in the above code.

3. What happens to the value of the variable `i` during the execution of the loop?

4. Explain why the loop body does not execute again after "the number is 2" is output.

5. Reverse the order of the statements in the loop body:

```
while i < 3:
    i = i + 1
    print("the number is", i)
```

a) How does the order impact the output displayed by the `print` function?

b) Does the order impact the total number of lines that are output?

6. Identify three different ways to modify the code so that the loop only executes twice.

7. Describe the three parts of a `while` loop that control the number of times the loop executes.

8. Comment out the statement `i = i + 1`, and run the code. Then press Ctrl-C (hold down the Ctrl key and press C). Describe the behavior you see, and explain why it happened.

9. Consider the following program:

```
1  total = 0
2  count = 0
3
4  n = None
5  while n != 0:
6      n = float(input("Next number: "))
7      total += n
8      count += 1
9
10 print()
11 print("Total:", total)
12 print("Count:", count)
```

a) Which line initializes the loop variable?

b) Which line updates the loop variable?

c) Can you predict how many times the loop will run? Explain why or why not.

d) Does the code have the potential to loop forever? Explain why or why not.

Model 2 Random Numbers

You can generate a seemingly random sequence of numbers using the Python `random` module. A mathematical function is used to produce the sequence based on a ***seed*** value. If no seed is given, the current system time is used.

Python code	Shell output
`import random`	
`randint(1, 10)`	NameError: name 'randint' is not defined
`random.randint(1, 10)`	5
`random.randint(1, 10)`	2
`seed(100)`	NameError: name 'seed' is not defined
`random.seed(100)`	
`random.random()`	0.1456692551041303
`random.random()`	0.45492700451402135
`random.seed(100)`	
`random.random()`	0.1456692551041303
`random.random()`	0.45492700451402135

Questions (15 min) Start time:

10. What is the name of the module that must be imported to generate random numbers?

11. Based on Model 2, what are the names of three functions defined in the `random` module?

12. Explain the reason for the name errors in the table above.

13. What is the effect on the "random" numbers generated after calling the `seed` method?

14. Describe one reason to set the same seed each time a program is run, and one reason *not* to use the `seed` method.

15. Run `random.random()` in a shell multiple times. Based on the results, describe:

a) the range of numbers returned by the `random` function

b) the nature of the distribution of numbers generated. (Do they appear clustered around a particular value, or are they spread out uniformly over the range?)

c) Type `help(random.random)` in the shell to check your answers.

16. Run `random.randint(1, 10)` in a shell multiple times. Based on the results, describe:

a) the range of numbers returned by the `randint` function

b) the nature of the distribution of numbers generated. (Do they appear clustered around a particular value, or are they spread out uniformly over the range?)

c) Type `help(random.randint)` in the shell to check your answers.

17. Write an if statement to simulate a coin toss. The code should print "Heads!" or "Tails!", with 50% probability. *Hint:* `random.random()` is less than 0.5 about 50% of the time.

18. Write a statement that generates a random integer between 80 and 100, inclusive, and assigns the integer to a variable named `score`.

Model 3 `while` vs `for`

Program A (while loop)

```
import random

print("Guess my number!")
number = random.randint(1, 100)

guess = 0
while guess != number:
    guess = int(input("Guess: "))
    if guess > number:
        print("Too high!")
    elif guess < number:
        print("Too low!")

print("You got it!")
```

Program B (for loop)

```
import random

heads = 0
tails = 0
times = 1000000

for _ in range(times):
    if random.random() < 0.5:
        heads += 1
    else:
        tails += 1

heads = round(heads / times * 100, 2)
tails = round(tails / times * 100, 2)

print(f"Head: {heads}%, Tail: {tails}%")
```

Questions (15 min) Start time:

19. Run each program three times. Describe what each program does.

a) Program A:

b) Program B:

20. How many times did the loop run in each program?

a) Program A:

b) Program B:

21. Why would Program A be more difficult to write using a `for` loop?

22. Program B could be written to use a `while` loop. What code would be needed to replace the `for` statement on Line 7?

a) Initialize loop variable:

b) Test the loop variable:

c) Update loop variable:

23. Summarize when you should use a `while` loop, and when you should use a `for` loop.

24. Should a `while` loop be used to iterate each element of a list? Explain why or why not.