

CS108L Computer Science for All Module 4: NetLogo Experiments using Random Walk and Wiggle Walk

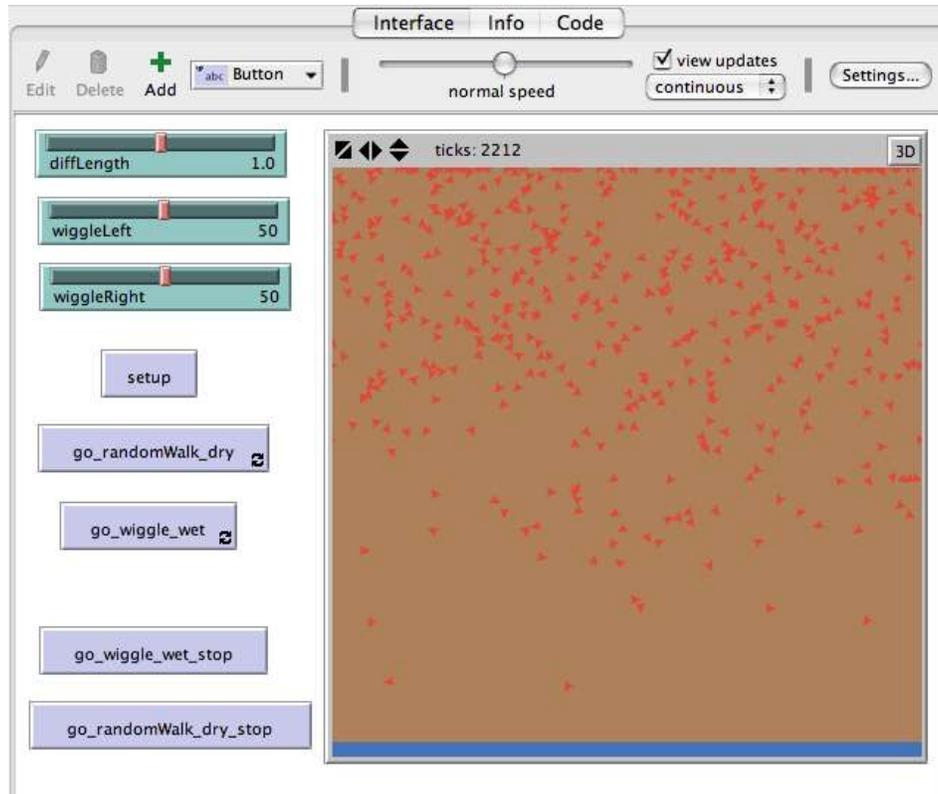


Figure 1: Sample Interface for the Diffusion Lab. The screen capture above shows the required layout of your program’s interface tab.

In this lab you will be creating a simple model of the movement of a contaminant through soil from the surface to the water table below the surface. The movement of a contaminant through soil is a very complex problem. Different types of contaminants move at different rates and react differently with different soils and other materials present. The amount of rainfall also affects how quickly contaminants move through soil. The model you will create will be greatly simplified but it will allow us to run experiments and perform our first simulation. We will be evaluating the movement of contaminants in wet and dry soil.

In this lab, you will be writing a program that lets you experiment with two different types of turtle movement: the “*random walk*” and the “*wiggle walk*”. These simple movements have useful behaviors and we will use them in more advanced models later in the semester.



There are two NetLogo video lectures this week:

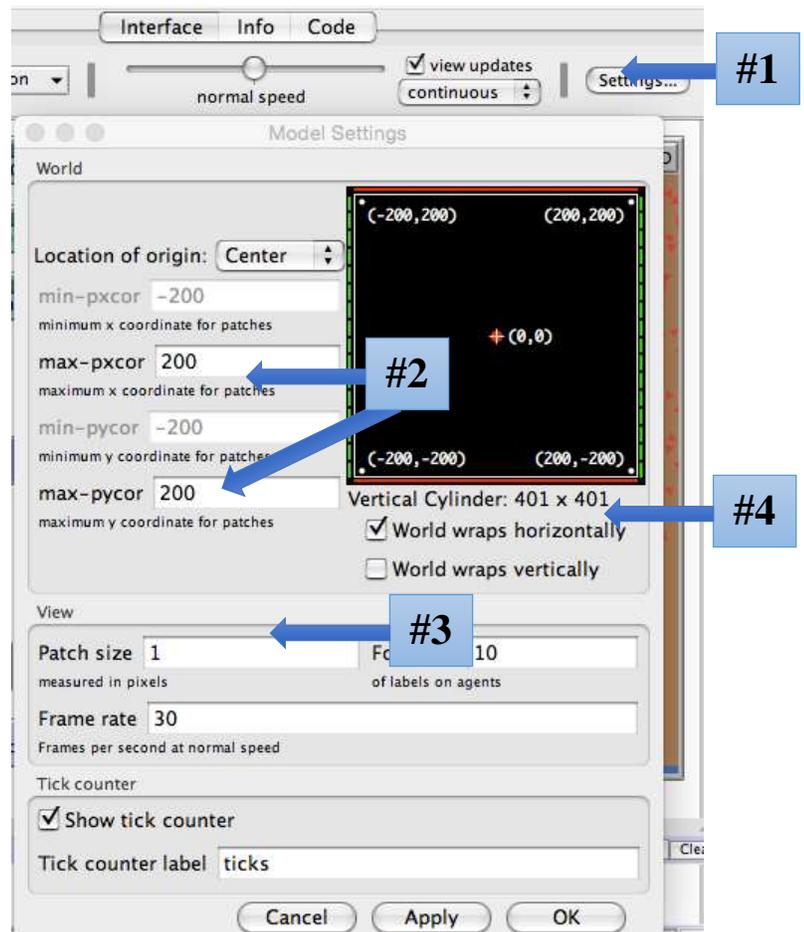
- 1) NetLogo and the Random Walk – this can be used to simulate simple diffusion.
- 2) NetLogo and the Wiggle Walk – this can be used to simulate more directional movement and is frequently used to simulate animal movement.

These videos explain the two types of walks and show how to create and use the *slider* on the Graphical User Interface to control the value of *variables*.

Resize Your World

NetLogo's default World View settings show an area from -16 to +16 on the x and y-axis. For this lab, you will need to change these settings.

- Go to the Interface tab and select the Settings Button (#1 to the right).
- The **max-pxcor** and **max-pycor** must be 200 while **min-pxcor** and **min-pycor** must be -200 (#2 to the right).
- To keep this from making a world too large to fit on your display, set the **Patch size** to 1 pixel (#3 on right)
- We want the world to wrap only horizontally so turn off wrapping Vertically (#4 on right).



Set Up Model

Here is what the world should look like when you press the **setup** button in your model. NetLogo clears the world. It creates agents and colors the patches as follows:

Agents

- You have 500 turtles that represent the contaminant.
- They are red, size 10 and have an initial heading of 180.
- They are all at the top of the world. To do this the following command must be included in the create turtles block



```
setxy random-xcor max-pycor
```

Patches

- Set the color of the patches to be brown
- Then color the bottom of the world blue to represent the aquifer. To do this the following command must be included in the ask patches block in the setup procedure

```
if pycor < min-pxcor + 5  
[set pcolor blue ]
```

Where the Action is....

You will be running experiments using the model you create. In order to do that, you need to be able to alter the variables and measure the outcomes after those changes. Please set up the interface so that you can change the variables using sliders (as shown in figure 1 on the first page). The variables that need sliders are and the values needed are shown in the table below:

Slider	Minimum Value	Maximum Value	Increment
diffLength	0.1	2	0.1
wiggleLeft	0	100	1
wiggleRight	0	100	1

You will have two procedures that will be used to model the movement of contaminants through the soil.

1. The **go_random_dry** procedure - This procedure uses the random walk you learned about in the NetLogo and the Random Walk video – this will be used to simulate simple diffusion of a contaminant through dry soils. Instead of using **forward 1** you will be using **forward diffLength**.
2. The **go_wiggle_wet** procedure - This procedure uses the wiggle walk you learned about in the NetLogo and the Wiggle Walk video – this will be used to simulate simple diffusion of a contaminant through wet soils (after it has rained). Instead of using **forward 1** you will be using **forward diffLength**. The angles used in the left turn portion of the wiggle walk is wiggleLeft (**left** wiggleLeft) and the right turn portion of the wiggle walk is wiggleRight (**right** wiggleRight).

“Time” is Important



In order to be *quantitative* with our experiments, we need a way of counting the amount of “time” needed for the contaminants to reach the water table using the two different types of walks. For this, you will use NetLogo’s built-in *tick* feature. As shown in the table below, you will need to put in the command **reset-ticks** at the end of the setup procedure and **tick** at the end of EACH go procedure. This does not actually measure time but the of iterations (cycles) through the procedure being run.

In the screen capture on the first page, the random walker took approximately 2212 ticks before it reached the blue water table. The number of ticks is approximate because as the walker neared the blue water table, I slowed the model speed and tried to click the **RandomWalk** button to stop when I believed the walker touched the boundary.



reset-ticks	Call this at the end of setup.
tick	Advances the tick counter by one. Call this ONCE EACH TIME the walker takes a STEP in both “ go_random_dry ” and in “ go_wiggle_wet ”. It must be called OUTSIDE any ask turtles blocks, usually at the end of the procedure.

Running Your Experiments

Now comes the fun part – running experiments. Both the Random Walk and Wiggle Walk use randomness. The random quality of the walk means that every time you run your model, your answer will be somewhat different. So to get a clearer picture of what’s really going on, you will need to repeat your experiment using the same input variables and average your results.

For each experiment you will:

- 1) Set the sliders to the correct numbers for that experiment.
- 2) Click **setup**.
- 3) Click either **go_random_dry** or **go_wiggle_wet** depending on the experiment being run. Let the program continue and the turtles (contaminants) move until one touches the blue water table. Stop the program manually before the walker hits the boundary.
- 4) Record the number of ticks it takes for your contaminants to reach blue water table on your experimental data sheet in Google Sheets. You will either manually stop the program when the contaminant reaches the blue water or you can figure out how to have the procedure automatically stop when it reaches the blue water (patches). (You can get extra credit for doing the second option.)



- 5) Repeat the experiment (steps 2 -4 above) 10 times, recording the number of ticks in the data sheet each time.
- 6) Go to the next experiment and start.

Each student in the class will be assigned a contaminant to study: “Petroleum”, “Pesticide”, “Benzene”, or “Bacteria”. Each contaminant has a different transport rate in the soil that is represented by its **diffLength** variable as shown in the following table.

Values of diffLength for Each Contaminant	
Contaminants	diffLength
Petroleum	0.2
Pesticide	1.3
Benzene	2.0
Bacteria	0.7

After creating your program, you must perform 10 experiments for each of the 4 wetness settings given in the following table. The wetness level will affect what procedure you use and the values you use for the variables wiggleLeft and wiggleRight. Thus, you will perform a total of 40 experiments.

Wetness Levels for the Experiments Conducted			
Wetness Level	Procedure Used	wiggleLeft Value	wiggleRight Value
Dry	go_random_dry	N/A	N/A
Moist	go_wiggle_wet	100	100
Wet	go_wiggle_wet	70	70
Saturated	go_wiggle_wet	45	45