Review:

Briefly define the following terms

- Biogeography -
- Endemic -
- Cosmopolitan -
- Neutral Model -

Clarifications/questions from the lecture:

PART 1: The Experiment

Materials: A Martian rock microbial community, this worksheet and a pen/pencil. At least one group member should have a laptop to record the final values your group finds.

Instructions: You and your colleagues have characterized the environmental conditions present at the sites you previously sampled. You expect that these conditions are driving community structure and have received permission to test this hypothesis.

You and your colleagues have planted sterile rocks of known composition and can watch real time as microbes colonize these new habitats! Each team will independently and carefully evaluate the microbial diversity of one newly colonized rock community at several time points.

- Each collection of pompoms is a Martian rock microbiome
- Each piece of pompom is individual from the microbiome community
- Each type of pompom is an operational taxonomic unit (OTU; i.e., or species of microbe).

EXPERIMENTAL PROCEDURE:

1. On the Environmental Gradients sheet (page 3), mark the columns relevant to your environment.
2. Each row is an OTU. If there are any "skulls and crossbones" in the relevant columns for that row/taxon, then that taxon will go extinct in your environment.
3. Mark these with X's in the Start Column of the Community Simulation table (page 4).
4. Get a scoop of pom poms. Sort them out into OTUs. Determine which OTUs can persist in your environment and which go extinct (note potential interaction between OTU's 3 & 10).
5. Return the OTUs that go extinct to a TA and count the population sizes for each of the surviving OTUs.
6. Record your counts in the "Start" column of the Community Simulation table.

Use the environment gradient sheet to determine the appropriate multiplier for your taxa:

1. For each OTU in your community, look across the 4 columns relevant to your environment.
2. Whichever of these columns has the lowest number, that number is your multiplier.

Time Point 1 = multiplier * Start

Wind Storm!

1. Put your living OTU pompoms back in your take-out box & shake them up, then pass ~10 random pompoms to your neighboring group.
2. Determine if any of the new OTUs go extinct & record the surviving OTU counts in the Wind Storm column.

Time Point 2 = multiplier * (Time Point 1 + Wind Storm)

Finish = multiplier * Time Point 2, rounded up to whole integers (e.g., 1.2 → 2).

Enter the Finish values in the shared spreadsheet.

********** **Simulation Complete** **********

Environmental Gradients

OTU No.	OTU Description	pH															Salinity		Carbon		Water	
		4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	Low	High	Low	High	Scarce	Abundant
1	Small Sparkly Green	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Small Sparkly White	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2
3	Small Purple ***	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4	Small Black	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	2	2	2
5	Small Green	☠	☠	1	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2	2	2	2	2	2	2
6	Small Yellow	2	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1	☠	☠	☠	☠	2	2	2	2	2	2
7	Small Blue	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
8	Small Red	2	2	2	2	2	2	2	2	1	1	1	☠	☠	☠	☠	2	1	2	2	2	1
9	Small Orange	1.1	1.2	1.3	1.4	1.5	1.6	1.8	2	1.8	1.6	1.5	1.4	1.3	1.2	1.1	2	2	2	2	2	2
10	Small Pink	☠	☠	☠	☠	☠	☠	1	1.5	1.5	2	2	2	2	2	2	☠	2	☠	2	☠	2
11	Small Brown	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2	2	2	2	2	2
12	Small White	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	2	2	2
13	Large Sparkly Orange	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	2	2	2
14	Large Sparkly Yellow	☠	☠	☠	☠	☠	☠	☠	☠	☠	☠	2	2	2	☠	☠	☠	2	☠	2	☠	2
15	Large Sparkly Green	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	2		2
16	Large Sparkly Pink	☠	☠	☠	☠	☠	☠	2	2	2	2	2	2	2	☠	☠	2	2	☠	2	☠	2
17	Large Sparkly White	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	2	2	2
18	Large Sparkly Purple	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	☠	☠	2	2	2
19	Large Sparkly Blue	☠	☠	☠	☠	☠	☠	1	1	1.5	1.5	2	2	2	2	2	2	2	☠	2	2	2
20	Large Sparkly Red	☠	☠	☠	☠	☠	☠	1	1	1.5	1.5	2	2	2	2	2	2	2	☠	2	2	2

*** CANNOT survive when OTU 10 (Small Pink) is present

☠ Goes extinct

YOUR COMMUNITY: _____

Community Simulation Data Table

OTU No.	OTU Descriptor	Start	Multiplier	Time Point # 1	Wind Storm!	Time Point # 2	Finish
1	Small Sparkly Green						
2	Small Sparkly White						
3	Small Purple						
4	Small Black						
5	Small Green						
6	Small Yellow						
7	Small Blue						
8	Small Red						
9	Small Orange						
10	Small Pink						
11	Small Brown						
12	Small White						
13	Large Sparkly Orange						
14	Large Sparkly Yellow						
15	Large Sparkly Green						
16	Large Sparkly Pink						
17	Large Sparkly White						
18	Large Sparkly Purple						
19	Large Sparkly Blue						
20	Large Sparkly Red						

Original Survey Data

OTU No.	OTU Descriptor	Community/Environment														
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Small Sparkly Green	33	33	34	33	33	34	33	33	34	33	33	34	33	33	34
2	Small Sparkly White	63	6	60	8	56	0	58	6	61	0	60	6	56	4	56
3	Small Purple	9	10	10	12	11	11	10	12	14	0	16	0	14	0	17
4	Small Black	0	20	0	16	0	16	0	18	0	19	0	15	2	22	0
5	Small Green	0	0	1	2	3	4	5	6	7	7	10	13	14	22	30
6	Small Yellow	20	19	18	15	10	9	8	6	6	5	3	0	0	0	0
7	Small Blue	7	9	7	7	7	10	7	10	7	9	7	6	7	8	6
8	Small Red	10	14	22	20	14	24	0	1	0	1	2	0	0	0	0
9	Small Orange	1	2	5	5	7	10	13	14	10	9	8	7	6	2	0
10	Small Pink	0	0	0	0	0	0	0	0	0	28	0	33	0	25	0
11	Small Brown	2	3	4	2	2	2	3	4	1	2	1	2	3	3	2
12	Small White	0	3	0	3	0	1	0	1	0	3	0	4	0	1	0
13	Large Sparkly Orange	0	1	0	1	0	0	0	2	0	1	0	2	0	1	0
14	Large Sparkly Yellow	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0
15	Large Sparkly Green	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
16	Large Sparkly Pink	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0
17	Large Sparkly White	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0
18	Large Sparkly Purple	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0
19	Large Sparkly Blue	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
20	Large Sparkly Red	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

PART 2: Analysis & Synthesis

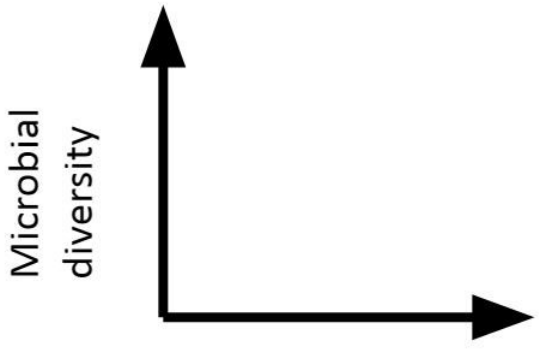
1. Compare the class simulation values in the shared spreadsheet to those you found in the rarefaction exercise (page 5, Original Survey). Are the general trends in abundance similar or different? Briefly explain.

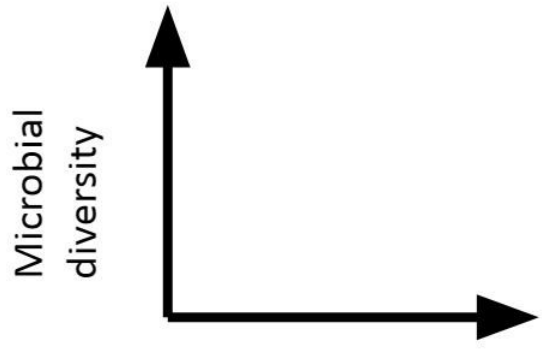
2. In simple terms, what do you think the multiplier represent(s)?

3. What ecological process does the wind-storm simulate?

4. Based on the Environmental Gradients sheet and your experience in Part 1, which two environmental factors do you think are most driving the biogeography of these organisms? Briefly explain.

5. Based on your data and what you learned from the lecture, sketch the general relationship you expect to observe between microbial diversity and the environmental factors you selected. Label your axes!





6.a. Looking at the **Original Survey data table (page 5)**, place the 20 taxa on the Endemic-to-Cosmopolitan graph below:

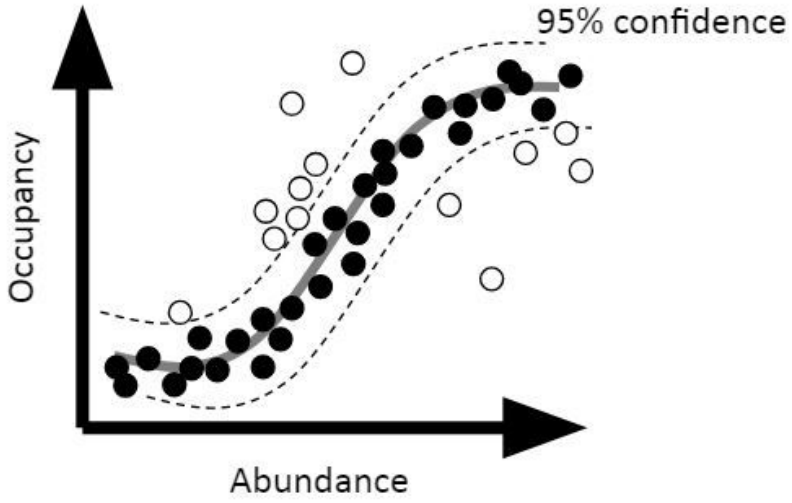
6.b. How confident are you in these placements? Why?

6.c. What additional data would increase your confidence in these placements?

7.a. What biogeographical variable is described by terms like endemic and cosmopolitan (e.g., area, connectivity, abundance, occupancy, spatial scale)?

7.b. What is the other major variable used in this class to describe the biogeography of organisms?

8.a. On the graph below, 1) circle the axis that describes endemism/cosmopolitanism, and 2) draw lines roughly showing the regions corresponding to endemic and cosmopolitan taxa.



8.b. In the above graph, what does the solid gray line represent?

8.c. What does it mean when taxa are outside the confidence interval (dashed lines)?