DESIGNING AND IMPLEMENTING AN EXPERIMENT
using *Rhizopus stolonifer*

**Objectives:** After completing this lab, a student should be able to do the following:
- Define observation, hypothesis, prediction, independent variable, dependent variable, controlled variable and conclusion.
- Form a hypothesis.
- Design an experiment to test a hypothesis.
- Collect and analyze data from an experiment.
- Draw conclusions from data.
- Write a scientific paper about scientific research.

**Introduction**
In this exercise you will use the mold *Rhizopus stolonifer* in an experimental design. Review what you know about the growth of fungi and molds. You may want to use your text book to study the basic biology of the Zygomycota; the lineage that includes *Rhizopus* species.

You will grow the fungus on Sabouraud’s agar. This is a medium that contains glucose as the nutrient source for the fungus. It also contains peptones (small protein molecules) that provide nitrogen to the fungi. The medium is adjusted to a pH of 5.6 which prevents bacterial growth. Overall, it is the standard medium used to grow fungi in the lab.

**A. DESIGNING AN EXPERIMENT:**

Working in groups, follow the steps below. Ask your instructor if you need help with any section.

1. Define observation.

2. Write one observation you have made about the growing conditions for Zygomyctes such as *Rhizopus* in your life. (example of an observation: Some brands of chili powder are hotter than others.)

3. Rewrite your observation as a question. (ex. Are some brands of chili powder really hotter than others?)
4. From this question you now can form a **research hypothesis**. You do this be a process of induction. **Induction** is a process by which all pertinent observations are combined and considered before producing a general statement. Your research hypothesis should be a statement that you would like to test. Rewrite your question (above) as a statement. (This statement might be a lot like your first observation. Try to make a specific statement that addresses one observation only.) This will be your research hypothesis.

5. Now formulate a **prediction**. If your research hypothesis is correct you should be able to predict what will happen in a particular situation (your experiment). The process of producing a prediction is deduction. **Deduction** is a logical process by which a prediction is produced from a general statement. Look at your research hypothesis (above). Predict what will happen if you test this and find it to be true. Write your prediction.

6. Now you must design an **experiment** to test your prediction. To do this effectively, you must first identify a **null hypothesis**. A null hypothesis is a hypothesis of "no difference". It is the hypothesis that states there is no difference between the things you are testing. When you analyze the results of an experiment you will either accept or reject the null hypothesis. Only if you reject the null hypothesis can you accept the research hypothesis. Write your null hypothesis here.

7. Now brainstorm a way to test your hypotheses. You have the following equipment available for your design: Cultures of *Rhizopus stolonifer*, Sterile Sabouraud agar, glucose, fructose, maltose, lactose, sucrose, starch, vinegar, ammonia, UV light, freezer, refrigerator, incubator, and distilled water. You do not have to use all of the available equipment. If there is something you need that is not on the list, ask your instructor.
8. In any test, there are three kinds of variables. The **independent variable** is the condition, thing or event that is being studied. The **dependent variable** is the condition, think or event that may change due to the independent variable. The **controlled variables** are all the other conditions, things and events that are kept the same throughout the experiment. Think about your experiment and determine what the independent, dependent and controlled variables are.

   Independent variable:

   Dependent variable:

   Controlled variable:

9. Consider what data you will collect and how you will analyze that data.

10. You are probably aware that doing an experiment once may lead to misleading results. Discuss this with your partner and decide how you will deal with this. (Consider how to accomplish multiple replicates on a single plate.)

   **11. In your notebook, prepare a short proposal that includes your hypotheses and your experimental design.**

12. You will be presenting your proposal to your peers. Be sure you can justify all aspects of your experimental design.

13. After your peers have helped you refine your proposal, you can set up your experiment!

14. **PUT EVERYTHING AWAY WHEN YOU HAVE COMPLETED SET UP FOR YOUR EXPERIMENT.**
Next Lab:

Collecting Data:

15. First determine how you will collect the data. Usually, a **data table** is constructed. This table lists the independent variable in the left hand column and the dependent variable for each repetition in right hand columns. *Set up a data table in your notebook* for your experiment.

16. Before you begin collecting data, show your data table to your instructor!

17. Collect your data in your data table.

Analyzing your data:

18. Now you must analyze your data. Usually, scientists perform statistics on their data to determine whether or not they may reject the null hypothesis. If the null hypothesis is rejected, then the research hypothesis is supported. It is important to bear in mind that scientists never prove their research hypothesis. Science is really a system of rejecting hypotheses and therefore, by default, accepting other hypothesis.

19. Create a graph on the sheet provided that will present your findings in an easy way for others to understand. Be sure to give a title to your graph and to label the axes.

Drawing conclusions:

20. After analysis, you think about what the data mean. This is called drawing **conclusions**. What does this analysis tell you about your subject? You should consider alternate explanations for the data you obtained.

Assignment:

21. You will write a report in scientific format for this experiment. See the separate handout on how to do this.