



# **Divide and Conquer (Fertilization of Sea Urchins)**

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# Divide and Conquer

## (Fertilization of Sea Urchins)

(For Grades 9-12)

### Purpose:

To test various factors against normal fertilization conditions among Sea Urchins and to observe if these factors affect fertilization and the division/cleavage of a zygote.

### Objectives:

1. Students will be able to identify various conditions that could influence or prevent the fertilization of sea urchin eggs.
2. To create a hypothesis and an experiment to test one factor that could affect or prevent the fertilization of a sea urchin egg.
3. To observe and understand how an egg cell becomes a zygote and undergoes division/cleavage.

**Materials:** (The class should be divided into groups of 3 or 4 students)

- ▶ Aprons
- ▶ Dissecting microscope
- ▶ Goggles
- ▶ Graph paper
- ▶ Hot plate
- ▶ Petri dish
- ▶ Salt water (use different concentrations – normal concentration is 3.5%)
- ▶ Sea urchin embryology kit (from Carolina Science & Math: Catalog 67, pg. 201)
- ▶ Water (various temperatures: 50 °, 60 ° - normal, 70 °)

### Safety:

Students should be careful of the needles that are in the kits. Aprons and goggles, which are **not** provided in the kits, should be worn at all times.

## Preparations:

Prior to this lab, **mitosis** and **meiosis** should be covered in class. The students will then have the necessary knowledge to understand the focus of this lab. They will be able to see up close how cells divide and how “new” life is created.

It would also be good to discuss normal sea urchin development and the normal reproduction process of this marine animal.

## Procedure:

1. Brainstorming: use focus question

**What type of environmental conditions could effect the union of the sperm egg of a sea urchin?**

(Jot down the responses from the students on the board or on a large sheet of poster paper.)

2. Choose 3 environmental factors that are testable in a class setting:
  - ▶ temperature of water
  - ▶ salt concentration of water
  - ▶ rough sea vs. normal sea movement.
3. Use the “lottery system” (random drawing) to assign one environmental factor to each student group. The group will focus on that particular factor to complete the lab assignment.
4. Set-up of experiment

Give each group a list of materials available for them to carry out an experiment. Everyone will use the same materials.

Focus question: **What type of experiment could you create to test your environmental condition?**

5. Students should use the experimental design form to complete this lab. The format should include the following:
- Urchins)
- Title (ex: The Effect of Temperature on the Fertilization Process of Sea
  - Hypothesis
  - Independent variable
  - Trials (with a control)
  - Dependent variable
  - Constant(s)
  - Graph of results
6. Request for funding/approval of research

In this section, the teacher can explain to the students how scientists begin research. In order for a study to be conducted, one must find the necessary funds to carry out the research. Just as the students have created an experiment, a scientist must go through the same procedure. The teacher can explain this to the students and provide “funding” amounts if they so desire.

The student design/set-up of their experiment must be approved (or funded) by the teacher. Once it has been approved, the students should collect the materials needed to carry out their procedure. This part of the lab should begin the next class period.

### **Suggestions for Assessment:**

- oral feedback with questions **\*see attached sheet\***
- concept map (to reinforce knowledge of the subject)
- practicums (using different stages of division to make sure students can identify the stages of fertilization)
- written exams
- lab report/teacher resource key **\*see attached sheets\***

## References and Resources:

- Conway, C.M., D. Igelsrud, and A.F. Conway. 1984. Sea Urchin Development, pp. 53-89. In L. Harris (editor), *Tested Studies for Laboratory Teaching*. Proceedings of the Third Workshop/Conference of the Association for Biology Laboratory Education (ABLE). Kendall/Hunt Publishing Company, Dubuque, Iowa.

- MacGinitie, G.E., and Nettie MacGinitie, 1949. **Natural History of Marine Animals**, pp. 232-241. McGraw-Hill Book Company, Inc.

## Where to Go from Here:

This lab can be a wrap-up lesson for mitosis/meiosis and it can also be an excellent introduction to genetics. This can also provide an opportunity to discuss cloning, in vitro fertilization, and other medical techniques that work with living cells.

## Oral Feedback Questions

1. How can you tell that an egg has been fertilized by a sperm?
2. What is the first sign of cleavage?
3. What are the physical differences between the Blastula and Gastrula stages?
4. Describe the shape of the Prism stage.
5. Does change in temperature, salinity, or sea movement change the success of fertilization?
6. How important is it to carefully and accurately observe and record data?

**\*As the teacher, you might come up with more questions that address the specific laboratory procedures required at your school.\***

## Key to Feedback Questions

- ▶ A ring will form around the egg that has been fertilized.
- ▶ The center of the fertilized egg will begin to pinch inward.
- ▶ The Blastula stage is characterized by the movement of cells to the outer perimeter of the zygote, followed by the formation of cilia (which causes the Blastula to “roll”. The Gastrula stage is characterized by the formation of the blastopore (indentation) in the cell that eventually grows in the middle of the egg. **\*Refer to MacGinitie in “References” for illustration.\***
- ▶ The Prism stage will have a very distinct shape. **\*Refer to MacGinitie in “References” for illustration.\***
- ▶ Temperature plays a key role in the fertilization of sea urchin eggs. **\*Refer to “References” for more information.\***
- ▶ It is very important to record the exact time of insemination, and maintain a constant observation of the process of fertilization. Without proper observation, the data will be void and the results would be skewed.

## Student Lab Write-Up Template

\* The lab write-up can vary according to how detailed you want to make this lab. The following is a template that can be used to get you started. It will be very simple, but the purpose of this lab is to get your students to compile a report on their own that has the items listed in the procedures of this lab.

### **Part I:        Directions**

Follow the directions in the kit for preparation of fertilized egg cultures.

### **Part II:        Observations of Echinoderm Development Using Living Sea Urchin Embryos**

- ▶ illustrate the appearance of a fertilized egg.
- ▶ use graphs to illustrate results of experiment.
- ▶ students **must** give a precise conclusion as to why the fertilization process did or did not work.