

Lab

Adaptations of a Chicken Egg

**Background Information**

Among the vertebrates, reptiles and birds represent the first completely terrestrial organisms. Life on land, as opposed to life in an aquatic environment, poses a number of challenges. Reptiles and birds, in turn, evolved adaptations that allowed them to survive. One such adaptation was the development of **lungs** and an internal respiratory system. Another was the development of an excretory system that removes nitrogenous wastes in the form of **uric acid** in order to conserve water. A third adaptation was related to reproduction. Although fertilization in these organisms was internal and no longer depended on water, life on land required **eggs** that would not dry out. In this laboratory investigation, you will consider the characteristics of a bird egg that adapted it to life on land.

**Problem**

How are birds adapted to reproduction on land?

**Materials** (per group)

2 500mL beakers / class  
2 hot plates / class  
2 tongs / class

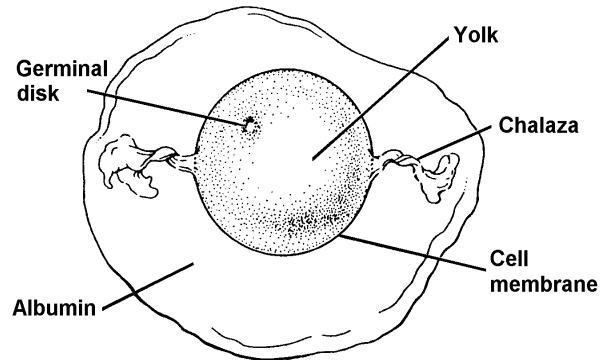
1 dozen chicken eggs (raw) / class  
12 culture dishes  
12 aluminum pans

**Procedure**

1. Hold a raw chicken egg in the palm of your hand. Gently close your fingers around the egg. Begin to squeeze the egg slowly, increasing the pressure until you are squeezing quite firmly. Note how much force the egg can withstand. Please don't break the egg.
2. Gently shake the egg back and forth in your hand. Can you hear or feel a sloshing sound?
3. Place the egg in the 500 mL beaker. Add enough water to barely cover the egg. Heat the water slowly on a hot plate just enough to make the water quite warm but still comfortable to the touch. **CAUTION: Do not touch the surface of the hot plate.** Watch the blunt end of the egg to see if tiny bubbles of air escape from the shell. Use the tongs to gently remove the egg from the beaker.
4. Gently crack open the egg over a culture dish. Carefully pour the contents of the egg into the dish.
5. Examine the structure and texture of the shell. Look in the blunt end of the shell. Locate the membrane and the air space.
6. Examine the contents of the egg in the culture dish. Refer to Figure 1 as you work. The **germinal disk** is a small white spot on the top of the yolk. This is the spot where fertilization and the development of the embryo occur.
7. Find the whitish strands attached to both sides of the yolk. These are the **chalaza**. When the egg is intact, the chalaza stretch from the yolk to the membrane located just beneath the shell. The chalaza twist when the egg rolls, keeping the germinal disk and the embryo at the top of the egg.
8. The clear fluid in the culture dish is the **albumin**. In an intact egg, the albumin completely fills the space between the yolk and the membrane beneath the shell.

9. The yolk is the yellow material. Note how the yolk appears to form a slightly flattened sphere. The yolk is surrounded by a membrane that helps it maintain its shape. The yolk is the actual egg that the hen produces when she ovulates. It is considered to be a single cell.

**Figure 1**



### **Observations**

1. After gently squeezing the egg, do you think the egg would be strong enough to support the weight of the parents' body as they enter and exit the nest?
2. Did you hear a sloshing sound when you shook the egg back and forth?
3. What was coming out of the shell when you heated the egg?
4. Is the egg shell solid or porous?
5. What is the largest single cell on Earth?

### **Analysis and Conclusions**

1. Name two structures of an egg that help the egg survive on land?

2. Based on your observations, how does a developing chick get the oxygen it needs for respiration?
3. For what practical purpose does the air space serve at the blunt end of the egg?
4. For what purpose do developing chicks use the egg yolk and albumin?

### **Critical Thinking and Application**

1. Why are bird eggs better adapted for a terrestrial environment than amphibian eggs?
2. Does fertilization in birds occur before or after the shell is formed? Explain.
3. Explain what is meant by the “cloacal kiss”.
4. What is an amniotic egg and which vertebrates form them?
5. Your teacher will place a drawing of a developing bird inside an egg on the blackboard. Copy the drawing and label the four extraembryonic membranes that form to help the embryo develop properly.