

Unit D: Egg Production

Lesson 2: Egg Production

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Discuss how eggs are formed.
2. Identify the parts of an egg.
3. Discuss the grading of eggs.
4. Identify practices used in processing an egg.

Recommended Teaching Time: 5 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed for use with this lesson plan
- <http://www.ces.purdue.edu/extmedia/AS/AS-525-W.pdf>
- <http://www.poultrypages.com/>

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Master Copies
Student Worksheet Copies
Student Labsheet Copies
Materials for Labs (see pages 14 and 15 of this lesson)
A variety of eggs

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide # 2):

Air cell	Infundibulum
Albumen	Isthmus
Calcite	Magnum
Candling	Oiling
Chalazae	Shell
Cloaca	Shell gland
Follicles	Vitelline membrane
Germinal disc	Yolk

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Display eggs on a safe surface to show the different colors, grades, and weight classes. Start a discussion asking students to think of reasons that the eggs may be different. Ask them how they think eggs are made. Use the discussion to move into the content.

Summary of Content and Teaching Strategies

Objective 1: Discuss how eggs are formed.

(PowerPoint Slide #3)

- I. Egg production begins inside the hen's body.
 - A. A hen has two ovaries and an oviduct inside her body but only the left side is functional.
 1. The ovary has **follicles**, which look like tiny clusters of grapes.
 2. Each one of these follicles can turn into an egg if it is fertilized with sperm.
 3. When the follicle is fertilized, it separates from the ovary and goes down the oviduct.

(PowerPoint Slide #4) This picture shows the follicles inside a hen. The arrow is pointing to what will be a yolk.

(PowerPoint Slide #5)

- B. The oviduct is about 80 cm and has 5 distinct areas serving a specific function in the egg formation.
 1. The **infundibulum** is the first part of the oviduct.
 - a. This receives the yolk which has separated from the ovary.
 - b. The "egg" will spend about 15 minutes in here.

(PowerPoint Slide #6) This shows a picture of a hen's oviduct. The infundibulum is indicated by number 1.

(PowerPoint Slide #7)

2. The second section of the oviduct is called the **magnum**.
 - a. In here the inner and outer shell membranes are added.
 - b. Also added are some minerals and water.
 - c. The "egg" will spend about 3 hours in here.

(PowerPoint Slide #8) The magnum is shown at number 2 on this slide.

(PowerPoint Slide #9)

3. The third section is called the **isthmus**.
 - a. In here, the albumen and Vitelline membrane will form.
 - b. The "egg" will spend about 1 hour here.

(PowerPoint Slide #10) The isthmus is shown at number 3 on this slide.

(PowerPoint Slide #11)

4. The fourth section of the oviduct is called the **shell gland**.
 - a. On the vitelline membrane that is now surrounding the yolk and albumen inside the hen, there are evenly spaced points where columns of **calcite** form.
 - b. **Calcite** is a form of calcium carbonate.
 - c. The columns of calcite form side by side and eventually make the shell of the egg.
 - d. The calcite is floating in solution around the egg, and then it attaches itself to the membrane to form a shell.
 - e. The “egg” spends about 21 hours here.

(PowerPoint Slide #12) The shell gland is shown at number 4 on this slide.

(PowerPoint Slide #13) This slide shows an eggshell that is not hard. It was most likely caused by a lack of minerals in the feed.

(PowerPoint Slide #14)

5. The last and final section is the **cloaca**.
 - a. Here, the shell will become hard when it reaches air close to the opening.
 - b. The egg is complete at this point and will spend less than a minute here.

(PowerPoint Slide #15) The cloaca is shown at number 5 on this slide.

(PowerPoint Slide #16)

- C. A malnourished hen may lay soft eggs because she is not getting the proper vitamins and minerals.
- D. This process for a hen to form and lay an egg takes about 24 hours.
 1. Eggs will be formed whether it is fertilized or not.
 2. When she lays her egg, the next egg starts forming inside of her.

Use TM: D2-1 to illustrate the parts of the hen’s reproductive system. Have the students draw this diagram out on a piece of paper to help them better recognize and understand the structures and functions. If possible you could also process a chicken and show the student the actual reproductive parts and compare them to the diagram.

Objective 2: Identify the parts of an egg.

(PowerPoint Slide #17)

- II. Eggs may look simple but they actually have many parts that all work together to form a perfect egg.
 - A. **Shell**—The outside covering of the egg.
 1. The shell may come in many colors but it typically is white.
 2. It is composed primarily of calcium carbonate, which is similar to limestone.

(PowerPoint Slide #18) This slide shows a cracked egg shell. Discuss with the students the different sizes and colors of eggs and why the differences occur.

(PowerPoint Slide #19)

- B. **Albumen** The white of the egg.
 1. In raw eggs, albumen is clear.
 2. It becomes white when it is cooked.

(PowerPoint Slide #20) The albumen of this egg is outlined in black. Notice the large area that this egg covers. Surface area will be discussed in grading but ask the students how they think surface area relates to egg age.

(PowerPoint Slide #21)

C. **Yolk**—The center part of the egg.

1. In a fertilized egg, this becomes the embryo for a baby chick.

(PowerPoint Slide #22) This picture shows a yolk which is outlined in black.

(PowerPoint Slide #23)

D. **Air cell**—This pocket forms as the egg cools and the inner and outer membranes separate.

(PowerPoint Slide #24) This picture shows the air cell in an egg. The top left picture is an egg which is being candled. The orange area is the air cell. Ask the students if they think the air cell will increase or decrease as the egg ages. The bottom right picture shows an illustration of an egg with the air cell identified.

(PowerPoint Slide #25)

E. **Chalazae**—Ropy strands of egg white that anchor the yolk in place.

1. The more prominent the chalazae, the fresher the egg is.

(PowerPoint Slide #26) This slide shows two pictures of chalazae. Ask the students, “What do you think would happen if an egg didn’t have a chalazae?”

(PowerPoint Slide #27)

F. **Germinal disc**—Channel leading to the center of the egg.

1. When the egg is fertilized, sperm enter through the germinal disc of the blastoderm and travel to the center of the yolk.

(PowerPoint Slide #28) This slide shows a germinal disc.

(PowerPoint Slide #29)

G. **Membranes**—Inner and outer membranes between the shell wall and the albumen protect the egg.

(PowerPoint Slide #30) This slide shows an egg shell which has been cracked. The outer membranes are separated from the shell.

(PowerPoint Slide #31)

H. The **vitelline membrane** is the covering of the yolk.

1. Its strength protects the yolk from breaking.

(PowerPoint Slide #32) This slide shows the vitelline membrane outlined in black.

Split the class into groups of two students each. Provide each group with a plate and an egg. Have them observe the egg and write down their observations. Next have them crack the egg and place the contents on the plate. Have them observe the inside of the shell and also the contents of the egg. State a part of the egg, the albumen for example, and have each group point to the albumen of the egg. Do this for each part of the egg discussed in this objective. If

eggs are not available use WS: D2-1. Use TM: D2-2 as an example to describe the parts of an egg to the class.

Objective 3: Discuss the grading of eggs.

(PowerPoint Slide #33)

III. For optimal egg production, all environmental conditions inside of an egg-laying facility are carefully controlled.

A. A hen will produce between 250 and 300 eggs per year.

B. Grading is determined by considering both the internal and external characteristics of the egg.

(PowerPoint Slide #34)

C. Grades are designated by the letters AA, A, or B.

1. No nutritive value exists between the different grades.

2. Due to the speed at which eggs reach the consumer, minimal quality differences exist between grades AA and A.

3. Grade B eggs rarely reach the grocery store; they are typically used by food processors to make other products.

(PowerPoint Slide #35)

4. Grade AA eggs tend to stand up taller when cracked onto a surface.

a. They also have a larger proportion of thick white versus thin white. Grade A eggs do not stand up quite as tall, but still cover a small surface area.

5. Grade B eggs tend to spread out more when they are cracked.

6. There is about as much thin and thick white in Grade B eggs.

(PowerPoint Slide #36)

D. Eggs are also sorted by size.

1. Size and grades are not related.

2. The graded egg is weighed, determining its size.

a. It is grouped with other eggs of similar size to make up a specific minimum weight per dozen.

(PowerPoint Slide #37) This slide shows a comparison between the grades of eggs. If possible, provide the class with real-life examples of the grades of eggs.

(PowerPoint Slide #38)

3. Weights are as follows:

Size	Weight in grams
Jumbo	850 or more
Extra large	765
Large	680
Medium	595
Small	510
Peewee	425

(PowerPoint Slide #39)

E. Eggs can be stored at -1°C for up to six months in the shell and even longer out of the shell.

F. The inside of the egg shell is generally considered sterile.

1. However, a strain of salmonella has been found in some eggs.

2. This occurs very rarely, but there is a potential risk.

Show TM: D2-3 to illustrate egg grades and characteristics. Provide the students with LS: D2-

1. Complete the section on egg grading.

Objective 4: Identify practices used in processing an egg.

(PowerPoint Slide #40)

- IV. After an egg is laid, it is not ready to be sold in the grocery store.
- A. It must go through a series of processes before it can be marketed.
 - B. These processes include various steps.

(PowerPoint Slide #41)

1. Collection at a modern egg farm, the egg either drops automatically from the hen's cage to a conveyor belt below or it is mechanically collected from a special nest.

(PowerPoint Slide #42)

2. Washing—After collection, the egg is washed and sanitized to remove any dirt.

(PowerPoint Slide #43)

3. **Oiling**—The washed and sanitized egg is lightly coated with a harmless, invisible oil to seal the shell pores, slow down aging, and prevent bacteria from entering the shell pores.
4. **Candling**—After oiling, the egg passes over an intense light and is rotated mechanically so its contents can be examined without cracking its shell.
 - a. A candler checks the condition of each egg's shell, albumen, and yolk.
 - b. If the egg does not meet grade requirements for AA, A, or B, it is removed.

(PowerPoint Slide #44) This slide shows some examples of eggs being candled. Candling can be done with various devices as simple as a flashlight. As a class, think of ways to construct a candler in the class. Various designs can be found on the internet. At the end of this objective a lab will be conducted where the students will candle eggs.

(PowerPoint Slide #45)

5. Grading—As discussed earlier, each egg is graded AA, A, or B.
6. Sizing—The next step is to weigh the egg and put into one of the size categories.
 - a. Sizing is done by the dozen.

(PowerPoint Slide #46)

7. Packing—To minimize breakage and maintain freshness, eggs are packed in specially designed cartons marked with their grade and size.

(PowerPoint Slide #47)

8. Cooling—After packing, the eggs are placed in a cooling room with a temperature of 7°C to lower their temperature and maintain their quality.

(PowerPoint Slide #48)

9. Sales—To maintain freshness, eggs should be kept in a refrigerated display case.
 - a. Eggs are considered fresh if eaten within four or five weeks of their packing date or three or four weeks after being purchased by the consumer, as long as they are properly stored at home.

Complete the section on candling on LS: D2-1

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used to determine which objectives need to be reviewed or re-taught with a different approach. Questions on **PowerPoint Slide #49** can also be used.

Application: Have the students complete LS: D2-2 on Egg Shells.

Evaluation: Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

Answers to Sample Test:

Matching

1. h
2. i
3. f
4. a
5. b
6. c
7. e
8. d

Short Answer

9. This egg would be considered large.
10. It takes a little over 24 hours to produce an egg.
11. The main component of an egg shell that gives it its strength is calcite.
12. The five sections of the hen's oviduct are the infundibulum, magnum, isthmus, uterus and cloaca.
13. Grade AA eggs do not spread out much when cracked. Also, the yolk on AA eggs stands up very high. Grade A eggs covers about the same surface area as AA but the yolk does not stand up as high. Grade B eggs cover a wide surface area and have a very low yolk.

Test

Unit D Lesson 2: Egg Production

Part One: Matching

Instructions. Write the letter of the correct answer next to the statement.

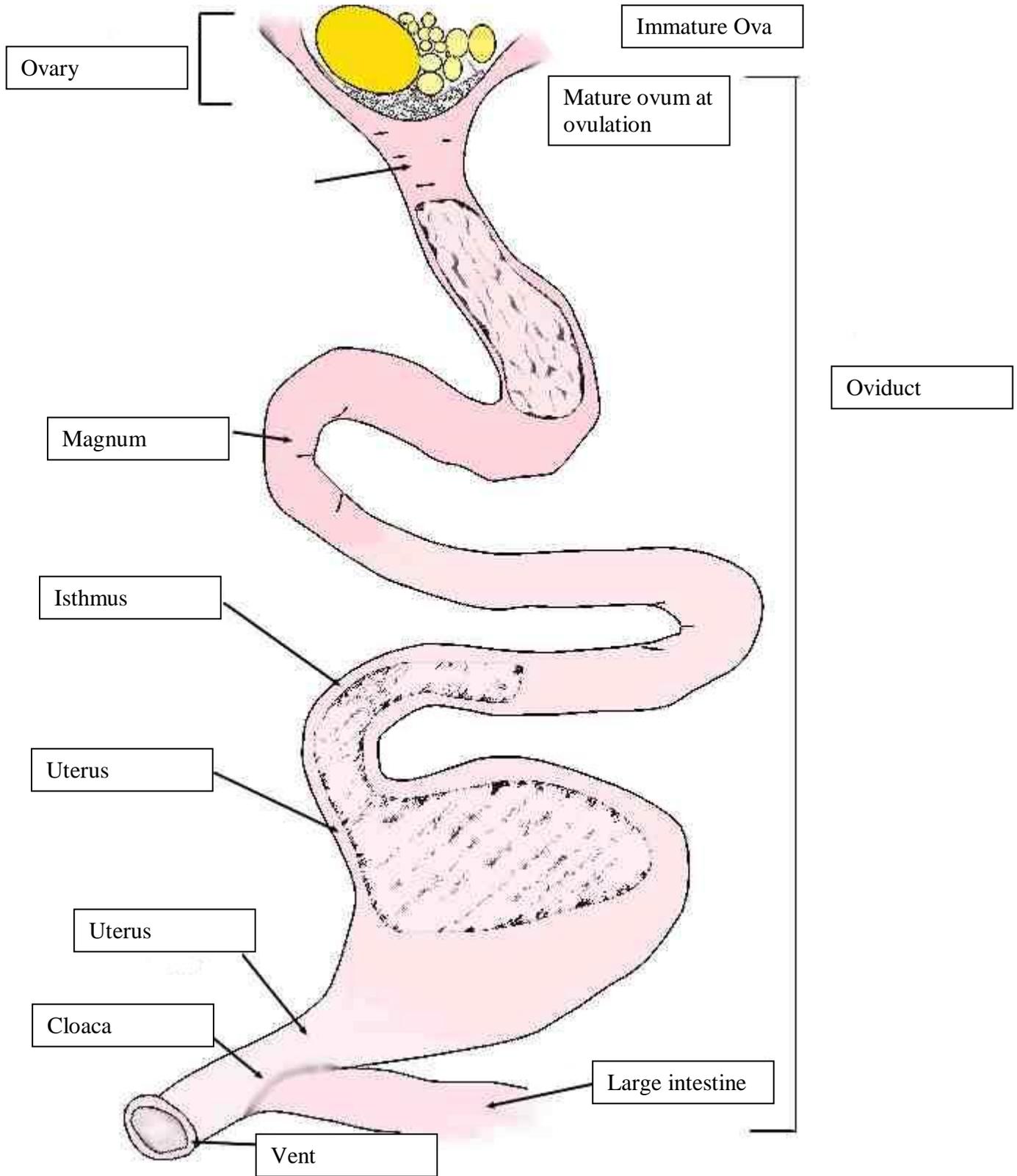
- | | | | |
|-------------|------------|-------------|-----------------------|
| a. Shell | b. Oiling | c. Yolk | d. Vitelline membrane |
| e. Chalazae | f. Albumen | g. Candling | h. Germinal disc |

- _____ 1. Passing an egg over an intense light to determine if it meets grade requirements
- _____ 2. Channel leading to the center of the egg
- _____ 3. The fluid inside of the egg that is nearest the shell
- _____ 4. The structure of the egg that consists mainly of calcium carbonate
- _____ 5. Used to seal shell pores and slow down the aging of eggs
- _____ 6. The structure of the egg that becomes the embryo for a baby chick when the egg is fertilized
- _____ 7. Ropy strands of egg white that anchor the yolk in place
- _____ 8. The structure of the egg which encloses the yolk.

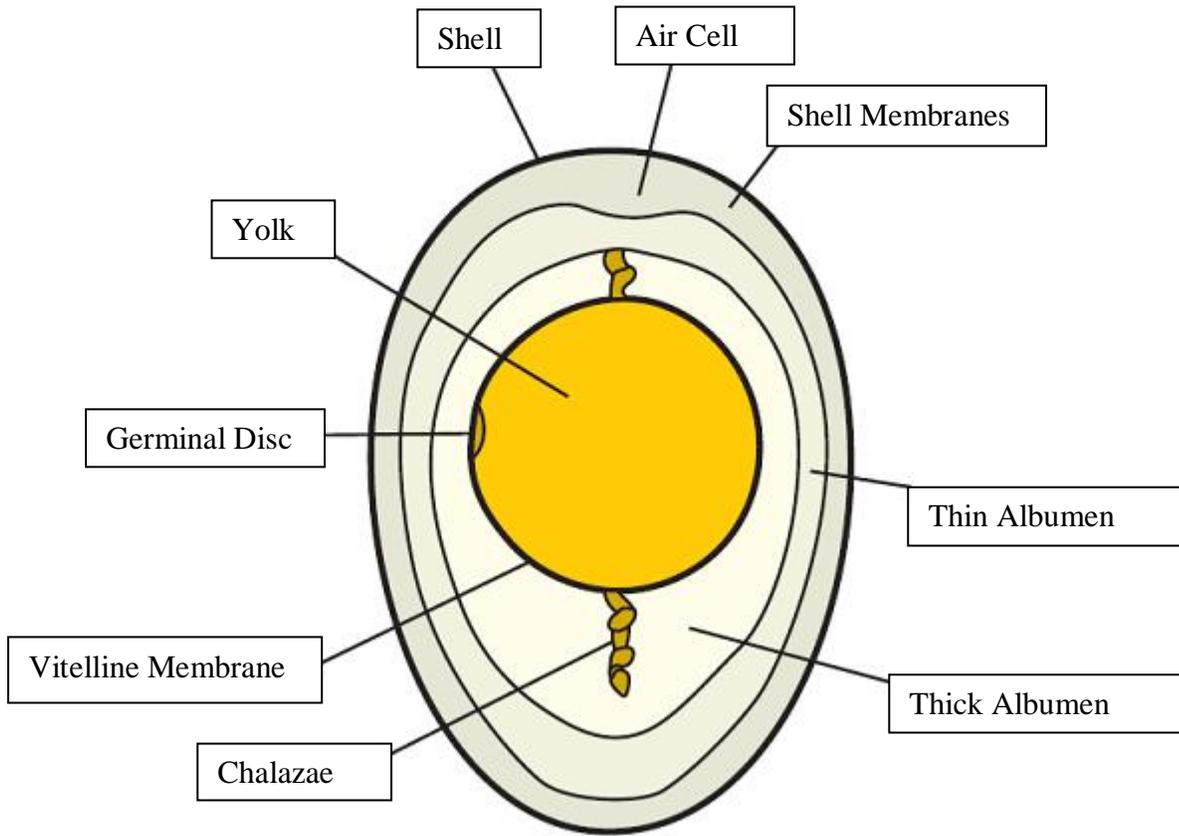
Part Two: Short Answer

9. An egg that weighs 700 grams would be considered what size?
10. About how long does it take for a hen to produce an egg?
11. What is the main component of an egg shell that also gives it hardness and strength?
12. What are the 5 sections of the hen's oviduct?
13. What are the differences between the grades of eggs?

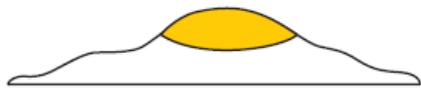
Reproductive Organs of the Hen



Parts of an Egg



Egg Grades and Characteristics



Grade AA

- tend to stand up taller when cracked onto a surface
- They also have a larger proportion of thick white versus thin white.



Grade A

- Do not stand up quite as tall as AA, but still cover a small surface area.



Grade B

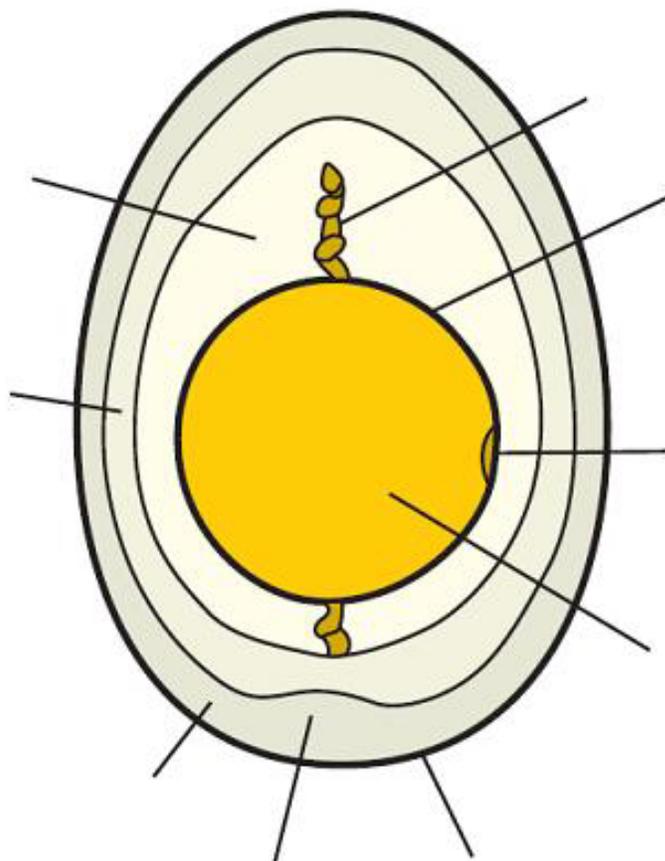
- Tend to spread out more when they are cracked.
- Thin and thick whites are about equal.

No nutritive value exists between grades of eggs!

WS: D2-1

Parts of an Egg

Instructions: Label the parts of the egg.



LS: D2-1

Egg Grading and Candling

Candling

In this lab you will candle eggs to determine if they are suitable for commercial sale or not.

Materials:

Eggs of varying ages, grades and size
Strong flashlights or a really bright light bulb

Procedure:

1. Get into groups of 2-3
2. Obtain eggs from the teacher. Be careful with them!
3. Begin candling eggs by putting the egg in front of the flashlight or bright light bulb.
4. Look for anything unusual inside. Observe the air cell and note its size. Try and find the yolk.

Grading

In this lab you will grade eggs and determine their size.

Materials:

Various eggs
Scale

Procedure

1. Obtain a variety of eggs from the instructor. Be careful not to break them as the entire class will share these eggs.
2. Weigh each egg and record the weights on a chart you create.
3. Once all of the eggs have been weighed, determine their size according to the following chart:

Size	Weight in grams
Jumbo	850 or more
Extra large	765
Large	680
Medium	595
Small	510
Peewee	425

LS: D2-2

Egg Shells

Before this lab the instructor will need to prepare some dyed eggs.

Interest Approach:

Hold up an egg which has been dyed. Tell the students you want to make a green egg so you put the eggs in dye like dyeing eggs at Easter time. Ask them if they think the egg will dye all the way through or not. Break open the egg and show them that it didn't turn green inside. Ask them some ways in which you think you could turn the inside green. Tell them they are going to devise an experiment to find out how to make green eggs.

Method:

Give the students different items like vinegar, tea, lemon juice, sugar, baking soda, salt- anything they think will work. Be careful using items like cleaners or similar liquids because harmful reactions could take place when the students begin mixing. Tell them to take careful notes about what they're doing. The scientific method should have already been covered in class but put the scientific method up on an overhead projector or write it out on the board so they can follow the steps when creating their experiment.

Experiment:

Materials Needed

Eggs with shells dissolved (teacher will need to prepare these 2-3 days ahead of time.)

Eggs with shells on

Green food coloring

Various solvents and solutes like vinegar, salt, water, baking soda, etc

Cups

Markers

Masking tape

Plastic wrap

Scale

A copy of "Egg Lab Sheet" for each student

Procedure

This procedure creates green eggs in all three cups but let the students try their own methods. Let the students determine which solutions would be best for the experiment. For example they can use regular eggs or they can dissolve the shells. They could alter the amount of dye used, the concentration of a solution could be diluted or strengthened.

1. If regular eggs will be tested, weigh the eggs and move to step 3. For 'jellied' eggs, place an egg in each cup and submerge it in vinegar. Let this sit for a few days until the shell is completely dissolved. The eggs will be very delicate once the shell is dissolved and will break easily.
2. Once the shell is dissolved dump out the vinegar and rinse the eggs and cups and place the eggs back in the cups. Students should weigh their eggs at this point if they are using jellied eggs.
3. Mix a sugar solution by placing equal amounts of sugar and water into a pot on the stove and heat until the sugar dissolves.

LS: D2-2 Continued

4. Mix a salt solution by heating water and an equal amount of salt until the salt is dissolved.
5. In one cup pour enough sugar solution to cover the egg. In the second cup pour salt solution and the third cup pour water to cover the egg.
6. Place an equal number of food coloring drops in each cup and *gently* swirl the cup to thoroughly mix it.
7. Cover the cups and let them sit for 2 days. After day 1 have the students observe the eggs in the cups. After day 2 remove the eggs from the solutions and observe the exterior color noting any color change. Carefully break open each egg and observe the color inside.
8. Students should fill out the egg lab sheet and questions. This will help them create a presentation for the class.

LS: D2-2 Continued

Name: _____

Egg Lab Sheet

Remember: one egg is a control which has no experiment done to it.

Egg Number	Solute	Solvent	Observations (color, weight, size, shape, smell, DO NOT TASTE)
1			
2			
3			
4			

LS: D2-2 Continued

Name: _____

Egg Lab Questions

1. Were your eggs jellied or regular?
2. Which solution carried the most dye across the membrane?
3. Why do you think it carried the most dye across?
4. Which dye carried the least amount of dye?
5. Why do you think it carried the least amount?
6. What changes could you make to your experiment that would impact the results? (think about temperature and other factors)
7. Was your hypothesis proven or disproven? Were your results surprising?