Lyn Murphy
Tioga Junior High
Tioga, La.

Grade Level
Middle School (6-8)

Duration
One 45-minute class period

Subject Area
Inquiry
Life Science

Materials List
- Video microscope
- TV
- VCR, blank tape
- Books, see references
- 3 computers, see observation stations
- BioQuest Frog Development Kit teacher/student guide (Walz 1996)
- Hard-boiled chicken egg (for size comparison)
- Metric rulers
- Magnifying glasses
- Chart and questions (BM #1-3)
- "Life History and Management of Paddlefish" (Reed 2003)
- Images of frog, chick and paddlefish development
- Teacher/class-made video of paddlefish egg development

Grade/Benchmark/GLE
Science
6,7,8/SI-M-A3/6,7
7/LS-M-A3/6
HS/LS-H-C1/15 (biology)

BM = Blackline Master

Comparing Eggs and Embryos

Focus/Overview:

The purpose of this lesson is to learn about eggs and embryos by observing paddlefish, chicks and frogs. Students will observe a videotape of paddlefish development, paddlefish eggs in the classroom tank, computer images of frog and chick embryos from *BioQuest* Frog Development Kit and books with photographs of frog and chick embryos. They will complete a chart comparing the eggs and embryos.

Background Information:

Paddlefish, frogs and chicks are three organisms in which the embryonic development is easy to observe either directly or by viewing photographs. All are vertebrates, but paddlefish and frog hatchlings differ greatly from the adults, while chicks do resemble the adult chicken. While frogs and paddlefish eggs have a jelly-like covering, chicken eggs have a hard shell, and must be fertilized internally. Students need to understand that the shell is an adaptation for living out of the water. The hard shell prevents the egg from drying out. All three embryos have gills in the beginning, although they may be difficult for students to observe. All three have yolk sacs that nourish the embryo until it is able to feed independently.

Learning Objectives:

Students will:
- Develop an understanding of the similarities and differences among three vertebrate embryos.
- Use a variety of resources to find information on eggs and embryos.

Procedure:

Prepare before lesson:
When the teacher first acquires paddlefish eggs, the video microscope should be used to observe and record the paddlefish egg development. A VCR should be attached so that the development can be preserved for later viewing. Classroom time constraints may prevent students from directly observing all the stages prior to hatching.

Lesson setup:
1. Attention-grabber. Ask the students if they have observed metamorphosis in any animals, including frogs, moths or butterflies. Ask what they may know about the development of chicks in the egg.

During lesson:

2. Assign groups to study paddlefish eggs, frog eggs (*BioQuest* kit), and chicken eggs. Each group will study all three, rotating from one study station to another. Provide students with the "Comparing Eggs and Embryos" worksheet (BM #1) and "Worksheet Answer Key" (BM #2).

Lesson setup. Set up five stations for student rotation during the activity.

A. TV/VCR with an in-class-made videotape of paddlefish development
B. Computer #1 with a bookmarked Web site on frog embryos (http://www.erodent.co.uk/GardenPond/March2002.htm)
C. Computer #2 with *Encarta* "Frogs"
D. Books on frog and chick embryology. (See BM #3.)
   1. *Chicken and Egg* (Back), Pages 11-25
   2. *Tadpole to Frog* (Owen), Pages 22, 24
   3. *A Frog is Born* (White), Pages 29-37
   4. *Frogs and Toads* (Zim), Pages not numbered
E. Computer #3 with Bobby Reed's PowerPoint presentation, "Life History and Management of Paddlefish (*Polyodon spathula*) in Louisiana"

3. Students will rotate from station to station, make observations, answer questions and fill in the chart on the worksheet.

Assessment:

Students will take a brief quiz (BM #4) after a class discussion of their observations. (See BM #5 for Answer Key to quiz.)

Extensions:

- Raise tadpoles in the classroom and have students directly observe their development into frogs. Another option would be to raise chickens from eggs, although observation of the embryology may be somewhat limited.
- Students draw pictures of different stages of development for chicks, frogs and paddlefish during their observations and use them to observe similarities and differences.

References:

Teacher References (BM #3)

Blackline Master #1

Name_____

Comparing Eggs and Embryos

Visit each station to observe and measure the eggs. Fill in the chart below.
Answer the questions on the back of this sheet.

Observation	Paddlefish eggs	Frog eggs	Chicken eggs
Size (diameter) – measure with a metric ruler			
Egg covering			
Yolk			

Questions:

1. Discuss the differences in the egg coverings of the frogs and paddlefish and chicken.

2. Based on what you already know about the size of the adult chick, frog and paddlefish and what you have observed about the embryos, is there a relationship between the size of the embryos and the size of the adults?

3. When the paddlefish eggs first started to divide, were they the same size as the cells in later divisions or different? If different, how are they different?

4. Compare the development of the paddlefish when it first hatches to that of the tadpole and the chick. How are they alike? How are they different?

Blackline Master #2

Answer Key

Observation	Paddlefish eggs	Frog eggs	Chicken eggs
Size (diameter) – measure with metric ruler	2 to 3 mm	0.5 to 3 mm	24 to 35 mm
Egg covering	Jelly-like	Jelly-like	Hard
Yolk	Still present when hatched	Still present when hatched	Large in comparison, gone when hatched

Questions:

1. Explain the significance of the differences in the coverings of the frog, paddlefish and chick.
   Frogs and paddlefish spend all or part of their lives in the water, whereas the chick is adapted for living on land. Eggs of paddlefish and frogs are laid in the water, and chicken eggs are laid on land. Chicken eggs have a hard shell; paddlefish and frog shells are gelatinous and sticky.

2. Based on what you already know about the size of the adult chick, frog and paddlefish and what you have observed about the embryos, is there a relationship between the size of the embryos and the size of the adults?
   No, the chick egg is much larger than paddlefish or frog eggs, but the paddlefish adult can get much larger. Frog eggs are similar in size to paddlefish, but adults frogs are smaller than both chickens and paddlefish.

3. When the paddlefish eggs first started to divide, were they the same size as the cells in later divisions or different? If different, how are they different?
   The first cells are much larger than the cells in later divisions.

4. Compare the development of the paddlefish when it first hatches to that of the tadpole and the chick. How are they alike? How are they different?
   When the chick hatches, it resembles a chicken but its feathers and wings are not fully developed. Newly hatched paddlefish do not yet have a rostrum, but do have a fishlike appearance, whereas tadpoles do not resemble the adult frog. The chick can eat on its own after hatching, but paddlefish and tadpoles must rely on the yolk for nourishment until mouthparts are developed.

Blackline Master #3

TEACHER REFERENCES:

Publications

Back, Cristine and Bo Jarner (photo). 1986. *Chicken and Egg*. 1st U.S. Ed. Silver Burdett Company: Morristown, N.J. pp 11-25.
Pictures for students use to fill in the chart about chicken development.

Owen, Oliver S. 1994. *Tadpole to Frog*. Abdo Consulting Group, Inc.:Minneapolis, MN. pp 22,24.
Information relating to variations in frog reproduction. Many photographs, including tadpole pictures.

White, William, Jr. 1972. *A Frog is Born*. Sterling Publishing Co.: New York, NY. pp 29-37.
Excellent source on frog embryology. Both the text and the pictures will be useful to students in filling in their charts.

Zim, Herbert S and Joy Buba. 1950. *Frogs and Toads.* William Morrow & Co.: New York, NY.
Drawings rather than photographs, but the text is especially useful to students.

Internet sources

Cebra-Thomas, Judy. *Overview of Chick Development*. Swarthmore College.
http://www.swarthmore.edu/NatSci/sgilber1/DB_lab/Chick/Chick_dev.html.
Accessed July 20, 2003.
College-level description of chick embryology, reference for teachers, although the site does include some images that might be helpful to students.

Gallon, Paula. *March 2002 and Frog Spawn Watch*. eRodent.
http://www.erodent.co.uk/GardenPond/March2002.htm. Accessed July 20, 2004.
This site has excellent pictures and may be used for one of the study stations.
Author has given permission to use the pictures.

Gallon, Paula. *March 2002 and Frog Spawn Watch*. eRodent.
http://www.erodent.co.uk/GardenPond/Frogspawn.zip. Accessed June 14, 2004.
This zip file provides a better quality version of the pictures to be used for one of the study stations. Author has given permission to use the pictures.

Jones, David. *The Frog and Pond Diary – March 2002*. My Bit of the Planet. Accessed July 20, 2004.
http://www.mybitoftheplanet.com/2002/frogmarch.html#latest.
Detailed photographs of tadpoles.

Miscellaneous resources

Reed, Bobby. “Life History and Management of Paddlefish (*Polyodon spathula*) in Louisiana.”
PowerPoint presentation. Presented July 7, 2003. Inland Fish Division Louisiana Department of Wildlife and Fisheries. For a copy, contact Angela Capello, capelloa@centurytel.net, or Rachel Somers, rsomer1@lsu.edu.

Walz, Gari. *Bio-quest Frog Development Study Kit Teacher’s Guide*. 1996. Nasco: Fort Atkinson, Wisconsin. Can be obtained from Fisher Scientific, p. 183, 2003-2004 catalog, $78.00 Catalog # AJS11011.The teacher’s guide and a student’s guide come with with the plastic mounted Frog Development Study Kit. It is an excellent teacher reference, but may be too advanced for middle school students.

Blackline Master #4

Name_____

Comparing Eggs and Embryos Quiz

1. Name three similarities between frog and paddlefish embryos.

2. Name one similarity between paddlefish embyos and chick embryos.

3. Explain the significance of a hard shell as an adaptation for living on land.

Blackline Master #5

Comparing Eggs and Embryos Quiz

Answer Key

1. Name three similarities between frog and paddlefish embryos.
   a. jelly-like covering
   b. yolk sac present
   c. gills

2. Name a similarity between paddlefish embyos and chick embryos.
   both have yolks

3. Explain the significance of a hard shell as an adaptation for living on land.
   The hard shell prevents the embryo from drying out, if the egg is not in the water.
   The hard shell also indicates that internal fertilization is necessary.