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Krotz Springs Elementary
Krotz Springs, La.

Grade Level
Middle School (6-8)

Duration
45 minute class period

Subject Area
Inquiry
Life Science

Materials
For each group:
- Tree cookie transparency (BM #1)
- Tree cookie image (BM #2)
- Paddlefish jawbone picture (BM #3 and 4)
- Fish otolith image (BM #5)
- 1 hand lens per group
- Pencils and color pencils
- Rulers

For each student:
- Vocabulary handouts
- Student journals

Grade/Benchmark/GLE
Science
6-8/SI-M-A3/7
6-8/SI-M-A5/16
6-8/SI-M-B3/31

BM = Blackline Master

How Old *Is* That Fish?

Focus/Overview:

Students will examine actual cross sections or pictures of cross sections of a tree cookie, an otolith and a paddlefish dentary (jawbone). They will note similarities and differences. Students will then use their observations to make inferences about the relationships among them.

Background Information:

The age of a tree can be determined by counting the growth rings. Each spring's new growth is seen as an area of light-color wood surrounded by a darker area, which is the result of the tree's fall transition. Ring size tends to vary, depending on the environmental conditions the tree is exposed to.

Poor environmental conditions, such as drought and infestations, result in narrow or damaged rings, while thicker, smooth rings indicate better environmental conditions.

Scientists have determined that the same type of relationship exists in the otoliths (ear bones) of some fish species. Paddlefish, a cartilaginous species, can be aged in the same manner using their dentary (jaw) bones. Like tree cookies, otoliths and dentaries are cross-sectioned and then examined under a microscope to determine the age of the fish and the varying environmental conditions that have affected growth. Each ring correlates to one year for all of these species.

Learning Objectives:

Students will:
- Observe and interpret seasonal growth changes in plants and animals by analyzing and describing their growth rings.
- Ask appropriate questions about organisms and events in the environment.
- Base explanations and logical inferences on scientific knowledge, observations and evidence.
- Recognize that there is an acceptable range of variation in collected data.

Procedures:

Focus:

Instruct students to examine and discuss rings on tree cookies. Explain that trees put on new growth in the spring, which is indicated by the presence of the light-colored wood. Point out the dark wood produced in the fall when the tree is preparing for winter. Ask, "How do scientists determine how old a tree is?" Give students the opportunity to explain how the rings are counted.

Explain that both the dark and light wood together make up one growth ring, indicating one year in the tree's life cycle. Ask them if all rings are the same and ask why this is so or not. (Tell students that to answer the question they will make an inference, a conclusion based on facts).

Explain that the tree's environment during growth can change, which results in rings that reflect those changes, good or bad. It is possible in some years to make more than one ring. These false rings are due to disease, injury or frost damage. Therefore, students should recognize an acceptable range or variation in the data collected from some of their samples. Have students make inferences about the environmental factors that may have affected the tree's growth.

Presentation:

Demonstration

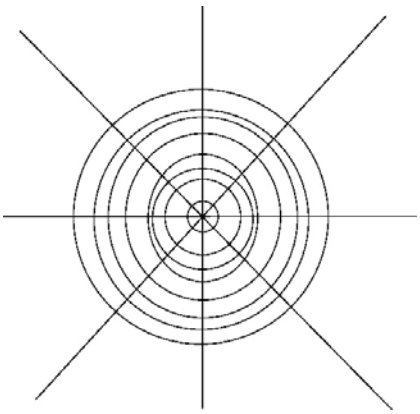
Using the overhead projector and a tree cookie transparency (BM #1), show the correct method to count the rings**. * Use a ruler to divide the cookie into pizza-like wedges.** Students select a wedge that is clear and easily counted.

Counting Rings on Tree Cookies

1. Locate the darker colored heartwood (inactive wood tissue) in the center of the tree cookie. The outer edge of the heartwood is the starting point for counting the rings.

2. Count the number of rings of sapwood (active wood tissue) extending to the region of inner bark. Remember, the light-colored rings are springwood and the dark-colored rings are summerwood, together encompassing one year's growth.

Show that it doesn't matter if you choose to count dark or light rings as long as you choose one and count consistently. Do not count the bark as a growth ring. Its growth is not complete.



3. Explain that other types of living things can be aged in a similar way, like black drum and paddlefish. Explain that some fish species like the black drum have inner ear bones called **otoliths,** which are large enough to be cross-sectioned and counted to determine the fish's age. In black drum each ring represents a year.

   A paddlefish though, is a fish that does not have hard bones; it is a cartilaginous fish. The only solid bone-like structure is the **dentary** or jawbone. This bone can be dried and cross-sectioned and then the annual rings can be counted to age the fish. Aging the paddlefish dentaries should be done in the same manner as the tree cookie.

Note: Paddlefish that live in the South have a "halo" effect on the rings of the dentary bone cross section from uneven summer feeding. In northern regions the paddlefish have distinct rings. A dentary cross section of a paddlefish from a northern state could be used for comparison.

Activity:

1. Divide students into groups of three or four.
2. Give each group a picture of an otolith, dentary or a tree cookie. (BMs #2, 3, 4 and 5)
3. Students will record, in their journals, their own prediction of which organism they are aging and approximately how old it is.
4. Students will work together to draw "pizza" lines and then count the growth rings on their sample. Have each student individually count rings.
5. Students will record their outcomes, compare them to their predictions and make inferences about the characteristics of the environment based on growth ring sizes Emphasize as findings are shared, that there is an acceptable range of variation in collected data.
   - Age of tree in BM #1 is 20 years; an acceptable range is 19 to 21 years.
   - Age of tree in BM #2 is 11 years; an acceptable range is 9 to 12 years.
   - Age of paddlefish on BMs #3 and #4 is 7 years; an acceptable range is 6 to 8 years.
   - Age of black drum in BM #5 is 23 years; an acceptable range is 22 to 24 years.
6. Students will compare results with one another. Provide sufficient time for discussion and recounting.
7. Groups will present their findings to the class orally.

Review

1. Name three organisms whose age can be determined by counting growth rings.
   Counting growth ring can age trees, black drum and paddlefish.

2. What is an otolith?
   An otolith is an ear bone from a fish.

3. How do growth rings act as an indication of the environmental factors that have affected the organism's growth?
   Wide rings indicate good growing conditions, adequate nutrition, the right temperature, and other proper conditions for growth. Thin rings indicate poor conditions and delayed or retarded growth.

4. What is an inference?
   An inference is a conclusion based on facts.

Assessment Method:

- Use a rubric to score student journals. (BM #6).
- Add a discussion question to a regular weekly test.
  For example: What inferences can be made from examining growth rings?
  What makes up a growth ring?
  Explain "aging an organism."

Extension:

- Students research environmental factors that might affect the growth ring development in each of the three species.

TEACHER REFERENCES:

Publications

Eymard, Tami and Brian T. Hardcastle. *A Practical Handbook on Otolith Removal for LDWF Age and Growth Studies.* Lyle S. St. Amant Marine Laboratory: Grand Terre Island, LA. Pp 1-9.

Project Learning Tree, Environmental Education Activity Guide "*Tree Cookies*". 2000. American Forest Foundation, Washington, D.C. pp 402. www.plt.org. Accessed July 22, 2003. Pages 289-292.
Reproducible information on dendrochronology, complete with lessons.

Internet sources

Grissino-Mayer, Henri D. *Ultimate Tree Ring Web Pages*. Department of Geography, University of Texas. http://web.utk.edu/~grissino/. Accessed July 22, 2003.
Web site with multiple links and many levels of information, pictures, and even printable lessons on annular tree rings.

Louisiana Department of Wildlife and Fisheries. www.wlf.state.la.us
Accessed July 22, 2003.
Source of many things including otolith and dentary pictures.

"Paddlefish" Page 3, Life History and Ecology. Montana Department of Fish, Wildlife and Parks, Miles City, Montana.

Scarnecchia, Denis L. and Brad Schmitz. *Paddlefish.* Montana Department of Fish, Wildlife and Parks, Miles City, Montana. www.fisheries.org/AFSmontana/SSCpages/Paddlefish.htm. Accessed July 22, 2003.

School of the Coast and Environment, Louisiana State University. *Coastal Fisheries Institute Age and Growth Laboratory*. http://www.cfi.lsu.edu/lifehistory/. Accessed July 23, 2003.
Web site contains images of otoliths. Author has given permission to use the pictures.

Blackline Master #1

Tree Cookie #1

Photo courtesy Dr. HD Grissino-Mayer, University of Tennessee, used by permission granted Oct. 17, 2003

Blackline Master #2

Tree Cookie #2

Photo courtesy Dr. HD Grissino-Mayer, University of Tennessee, used by permission granted Oct. 17, 2003

Blackline Master #3

Paddlefish Dentary #1

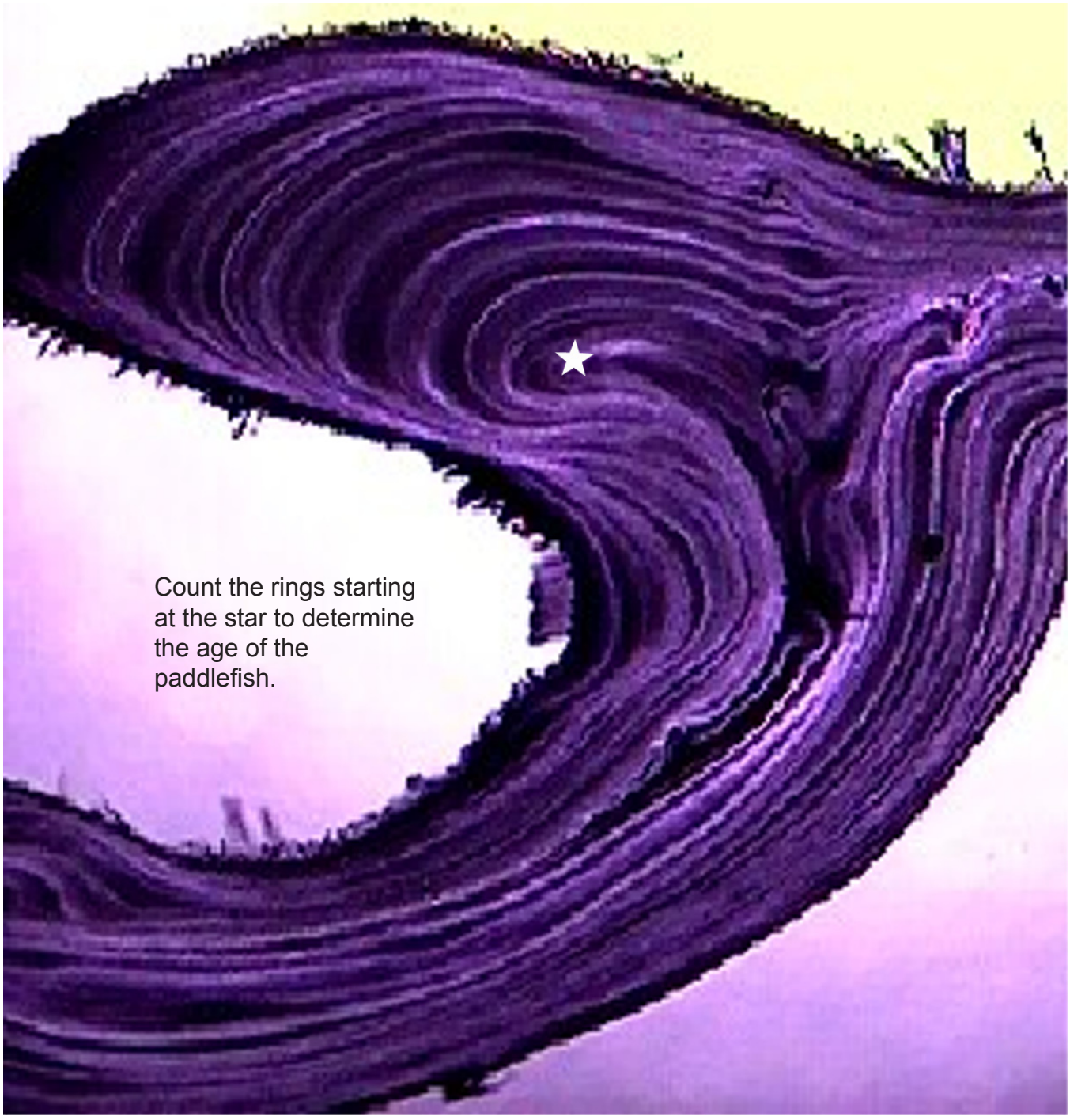


Photo courtesy Bobby Reed, Louisiana Department of Wildlife and Fisheries

Blackline Master #4

Paddlefish Dentary #2

Count the rings starting at the star to determine the age of the paddlefish.

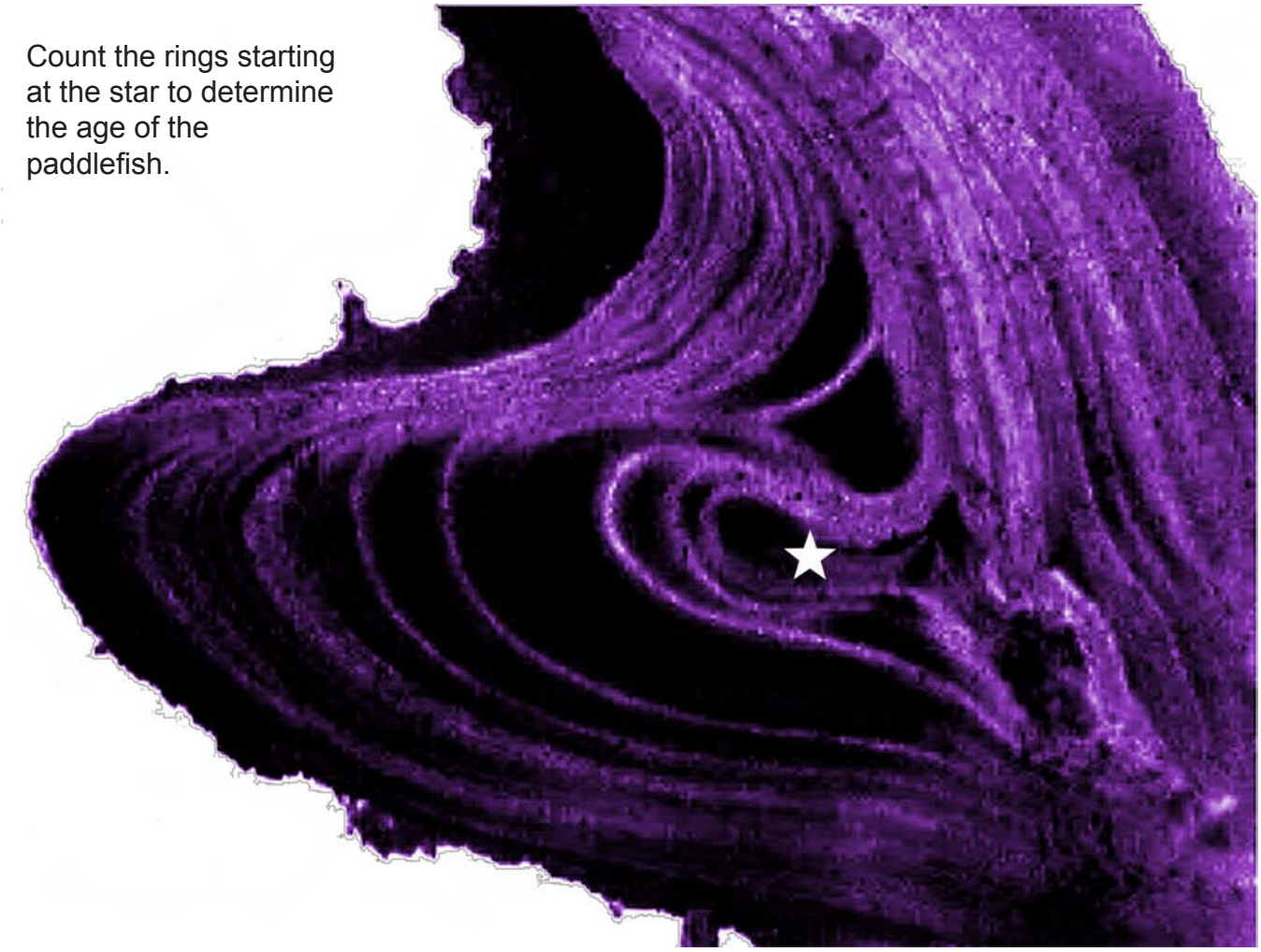


Photo courtesy Jeff Quin, Arkansas Game and Fish Commission

Blackline Master #5

Black Drum Ototlith

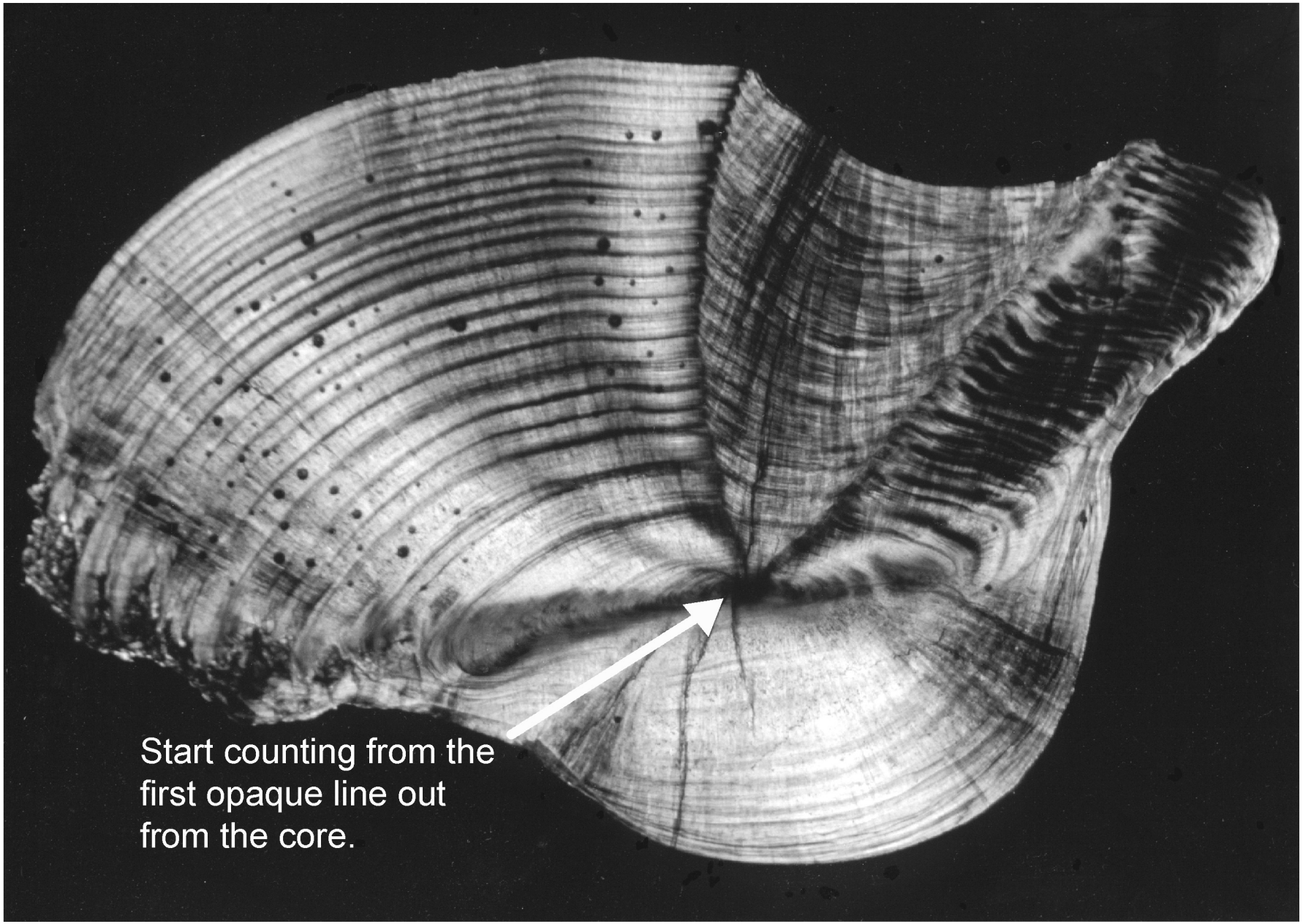


Photo courtesy Coastal Fisheries Institute, Louisiana State University

Blackline Master #6

Journal Rubric – How Old IS That Fish?

Entry Topic: Student journals should reflect their own prediction of the age, species and environmental conditions that affected their species' growth. They should be able to explain the correlation between the annual rings of the three organisms.

_____ 0 pts. No effort – Nothing written.

_____ 1pt. Student predicts and correctly ages the species.

_____ 2 pts. Student predicts, correctly ages and determines the type of organism. Student hints at reasons for differences in ring thickness.

_____ 3pts. Student predicts, correctly ages and determines the type of organism. Student gives good possible reasons for the differing thicknesses of the rings, and tells which years were better growth years.

_____ 4pts. Student predicts, correctly ages and determines the type of organism. Students gives good environmental reasons for differences in ring sizes, and makes clear inferences about the similarities among otoliths, dentaries and tree rings.

Point Assignment _____ Date _____ Student name _____

Entry Topic: Student journals should reflect their own prediction of the age, species and environmental conditions that affected their species' growth. They should be able to explain the correlation between the annual rings of the three organisms.

_____ 0 pts. No effort – Nothing written.

_____ 1pt. Student predicts and correctly ages the species.

_____ 2 pts. Student predicts, correctly ages and determines the type of organism. Student hints at reasons for differences in ring thickness.

_____ 3pts. Student predicts, correctly ages and determines the type of organism. Student gives good possible reasons for the differing thicknesses of the rings, and tells which years were better growth years.

_____ 4pts. Student predicts, correctly ages and determines the type of organism. Students gives good environmental reasons for differences in ring sizes, and makes clear inferences about the similarities among otoliths, dentaries and tree rings.

Point Assignment _____ Date _____ Student name _____

Blackline Master #7

Answer Key

Paddlefish Dentary #1

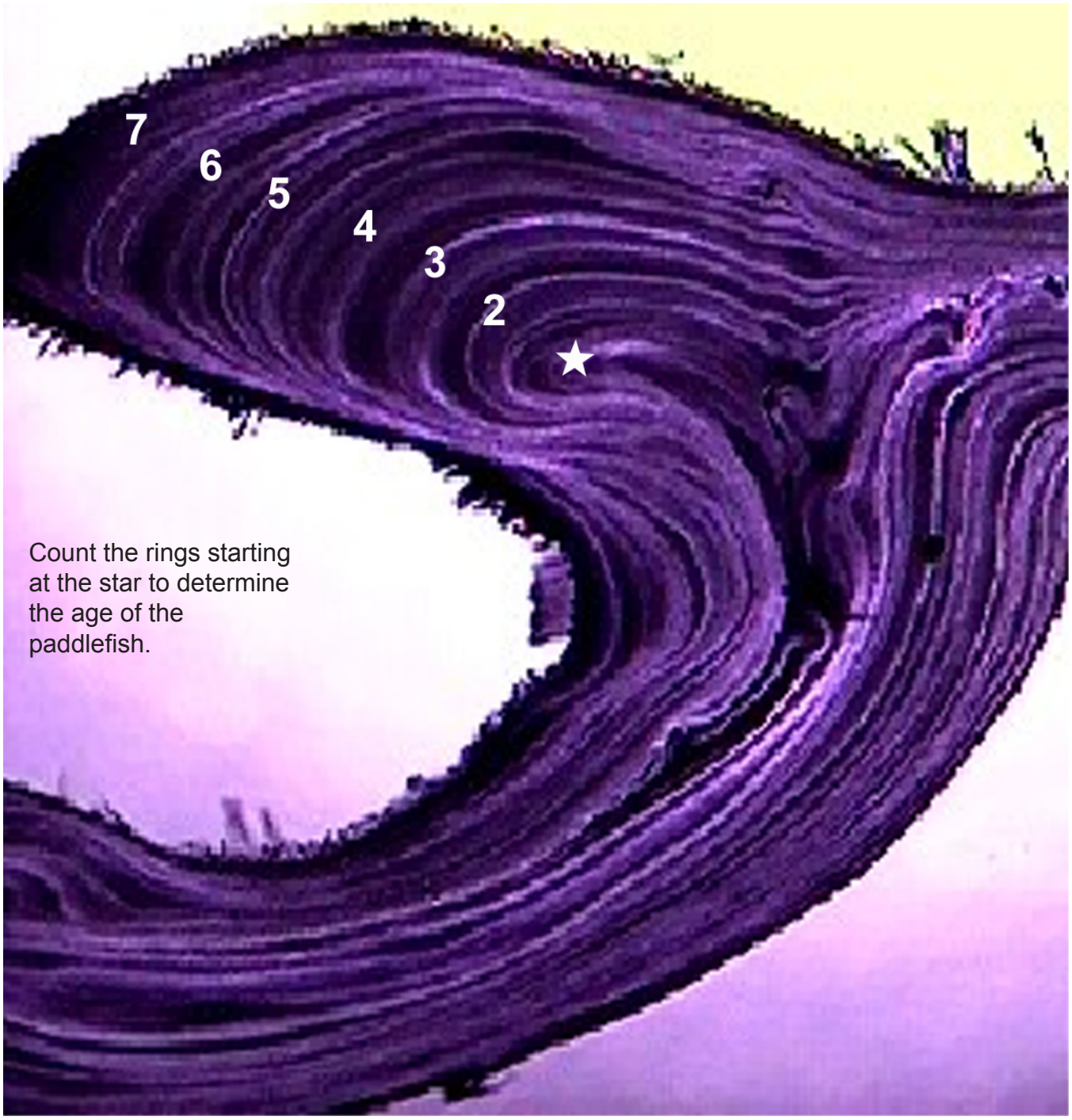


Photo courtesy Bobby Reed, Louisiana Department of Wildlife and Fisheries

Blackline Master #8

Answer Key

Paddlefish Dentary #2

Count the rings starting at the star to determine the age of the paddlefish.

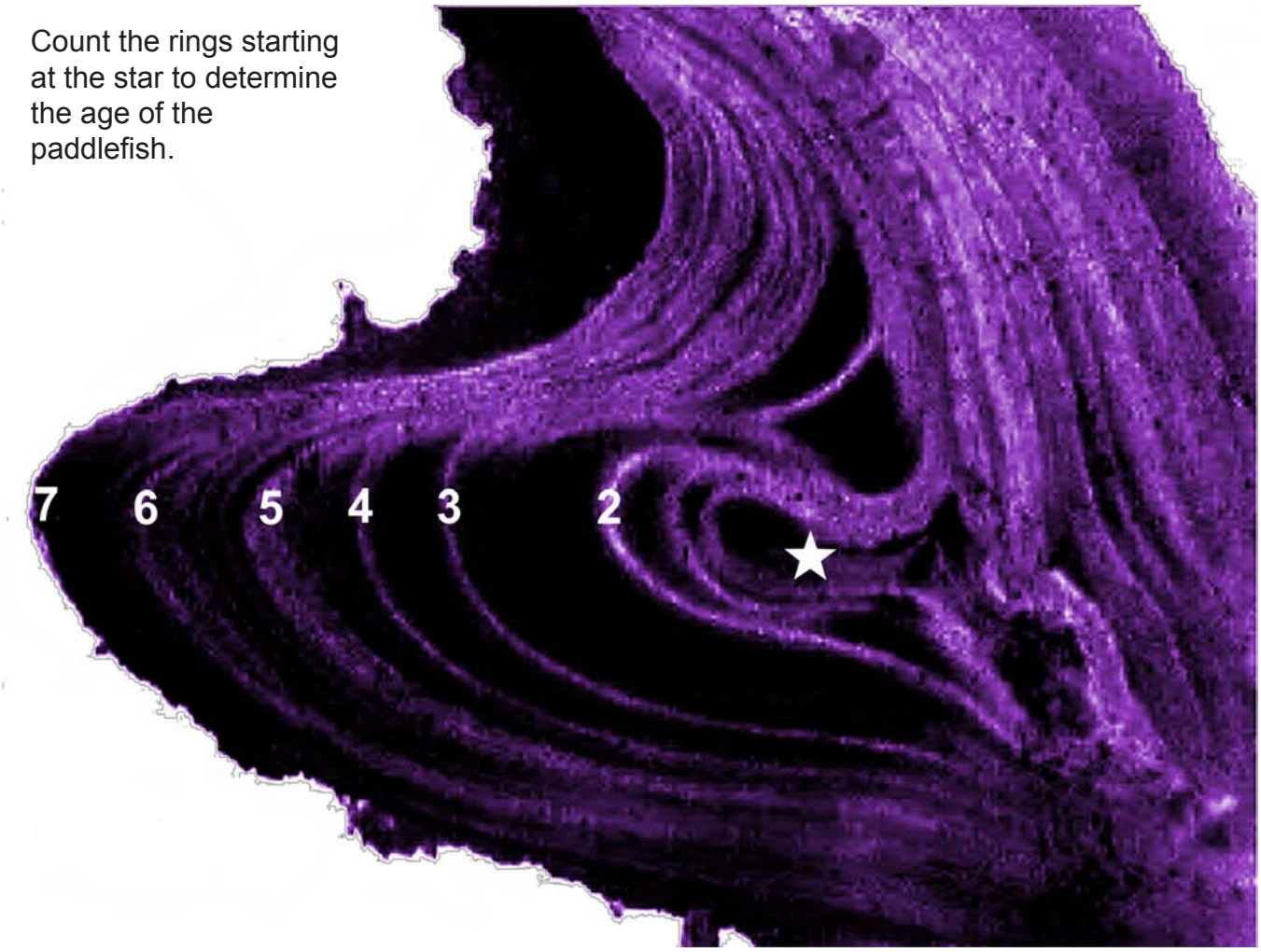


Photo courtesy Jeff Quin, Arkansas Game and Fish Commission