Survival of the…Luckiest?

(Adapted from: "The Great Anadromous Fish Game" from *Living in Water*, Kendall/Hunt Publishing Co)

Grade Level: Upper Elementary, Middle School
Subject Areas: Biology, Environmental Science, Math
Duration: 45 minutes

Next Generation Science Standards:
- 3-LS3-1 – Develop models to describe that organisms have unique and diverse lifestyles, but all have in common birth, growth, reproduction, and death.
- 3-LS4-3 – Construct and argument with evidence that in a particular environment, some organisms can survive well, some survive less well, and some cannot survive at all.
- MS-LS1-4 – Use argument supported by empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors…affect the probability of successful reproduction.
- MS-LS2-1 – Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
    - Practices of science
        - Developing and using models
        - Analyzing and interpreting data
        - Using mathematics and computational thinking
        - Constructing explanations
        - Engaging in argument from evidence
    - Cross cutting concepts
        - Cause and effect:
        - Scale, proportion, and quantity.
        - Systems and system models.
        - Stability and change.

Common Core State Standards:
- Math
    - MP4 – Model with mathematics
    - 6,RP.A.3.c - Find a percent of a quantity as a rate per 100
    - 7.RP.A.2 – Recognize and represent proportional relationships between quantities.
- ELA/Literacy
    - SL.4-5.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade appropriate topics and texts, building on others' ideas and expressing their own clearly.
    - SL.6-8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade

appropriate topics, texts, and issues, building on others' ideas and expressing their own clearly.

Environmental Literacy:
- 2.B.2 – Use models and computer simulations to extend his/her understanding of scientific concepts.
- 4.A.1 – Explain how organisms are linked by the transfer and transformation of matter and energy at the ecosystem level.
- 4.B.1 – Analyze the growth or decline of populations and identify a variety of factors.

Objectives:
- Students will understand that very few bluegills survive to adulthood.
- Students will understand that the mortality rate depends on the life stage.
- Students will understand that bluegill mortality may be due to natural or man-made causes.

Materials:
- For each group of 2-3 students - game board, set of game cards, a penny, copy of "Life Stages of Fish"
- For each student - one game piece, worksheet, calculator (optional)

Teacher Preparation:
- Use a color copier to copy the game board.
- Copy the five kinds of hazard cards onto colored paper. This makes them easier to sort. It is easier if the cards match the colors on the game board.
  - Eggs in Nest – brown
  - Sac Fry in Nest – tan
  - Bluegill Larvae - light blue
  - Juvenile Bluegills – dark blue
  - Adult bluegills - green
- If you plan to use the game board and cards more than once, you might want to laminate them.

Activity:
- Engage
  - Ask students to think about the following scenario: Each spring, a female bluegill may lay up to 60,000 eggs. What would happen if all the eggs survived?
  - What do the students think happens to all those eggs? At what stage in a bluegill's life is it most likely to die? Is the mortality from natural or human causes? *Accept any reasonable answers.*
  - Tell them that they are going to do an activity to find out.
- Explore
  - Divide the students into groups of 2-3.

- Give each group a copy of "Life Stages of Fish" so they know what each stage looks like and its characteristics.
- Give each group a game board and a set of hazard cards.
  - Tell them not to look at the cards. Have them put the hazard cards facedown into five piles
  - The color of the cards matches the colors on the game board.
- Give each group a penny; give each student a worksheet and have him/her find something to use as a game piece.
- Explain that each student represents a bluegill nest. The average nest contains about 15,000 eggs.
  - Each student will start with 15,000 eggs.
  - The object of the activity is to see how many of those eggs survive to become mature and spawn successfully themselves.
- Have each player flip the penny three times. The student with the most "heads" goes first, the one with the next highest goes second and so forth.
  - At each turn, the player will flip the penny. Heads = move one space; tails = move two spaces. .
  - If the player lands on a space that says "Take a hazard card", the player is to draw a hazard card from the appropriate colored pile.
    - Remind the students that the color of the cards matches the color on the game board.
    - If the card says that a certain percentage of fish were lost, the student will have to calculate how many fish were lost and how many fish remain.
      - They are to calculate mortality every time they draw a hazard card. The use of a calculator is up to the teacher.
      - Any fraction is to be rounded up to the next whole number (After all, you cannot have half a fish!)
- Give students time to play the game.
- Explain
  - Bring the students back together and take a class survey. Who had the highest number of survivors? The lowest? Did anyone lose all their fish?
  - At what life stage did most of the mortality occur? *Most of the mortality usually occurs in the egg, sac fry or larval stage.*
  - At each life stage was most of the mortality natural or man-made?
- Extend
  - How realistic do the students feel this activity is? If they were designing the activity, what changes would they make?
  - Have students try doing the activity using the suggested ideas