GloFish Genetics Investigation

Grade Level: 9–12 Biology
Time Required: 2–3 class periods (45–50 minutes each)
Topic: Mendelian Genetics, Inheritance Patterns, Chi-Square Analysis
Phenomenon: GloFish® offspring display different fluorescent colors and patterns based on inherited traits.

Learning Objectives

By the end of this lesson, students will be able to:

- Identify phenotypic traits in GloFish and track inheritance patterns.
- Formulate genetic hypotheses based on observed traits.
- Use Punnett squares to predict offspring phenotypes.
- Analyze experimental data using chi-square statistics.
- Interpret chi-square results to support or reject genetic hypotheses.
- Explore patterns in sex-linked inheritance.

Disciplinary Core Ideas (DCIs):

- **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits.
- **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits.

Science & Engineering Practices (SEPs):

- Analyzing and interpreting data
- Constructing explanations and designing solutions
- Engaging in argument from evidence

Crosscutting Concepts (CCCs):

- Cause and effect
- Patterns

- Systems and system models

Materials

- GloFish tanks or video/photo simulation
- Lab worksheet (student copy)
- Calculator
- Chromebooks or other devices (optional for simulations or digital chi-square calculators)
- Chi-square distribution table
- Colored pencils (optional)

ENGAGE (10–15 minutes)

- Show short video or images of GloFish under normal and UV light.
- Ask: “What makes these fish glow different colors? Are these traits inherited?”
- Create a class anchor chart of student observations and questions.

EXPLORE (1–2 class periods)

- Students observe GloFish tanks (live or simulated).
- In groups, they count phenotypes and record observations on the **lab worksheet**.
- Students form hypotheses and run chi-square analysis to test their predictions.
- If available, students repeat the activity with additional tanks (Tank 2, 3, etc.).

EXPLAIN (20–30 minutes)

- Review Punnett squares, dominant/recessive traits, and Mendelian inheritance.
- Teach/review chi-square statistical analysis and interpreting degrees of freedom and p-values.

- Class discussion: What do your results tell you about how GloFish traits are inherited?

ELABORATE (20–30 minutes)

- Students analyze male vs. female ratios in specific tanks.
- Introduce possibility of sex-linked inheritance.
- Students design a **test cross** using their own hypotheses to predict offspring.

EVALUATE (Final 15–20 minutes or assigned as homework)

- Students complete the “Final Step: Set Up a Test Cross” section.
- Students write a short paragraph summarizing what their chi-square value told them about their original hypothesis.
- Optional: Students present their findings or compare across groups.

Differentiation & Extensions

Support:

- Provide scaffolded chi-square tables or completed examples.
- Use pre-counted fish photos for students with IEP/504 needs.

Extension:

- Have students design their own genetic experiment with a new GloFish cross.
- Integrate with biotechnology by comparing GloFish to bacteria transformed with GFP.

Assessment

Formative:

- Group discussions and hypothesis explanations
- Completed chi-square tables

Summative:

- Final “Test Cross” prediction
- Analysis paragraph interpreting data
- Optional quiz on Mendelian and sex-linked inheritance