Getting Started with Inquiry-Based Teaching and Learning

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Abstract

Inquiry-based instruction refers to different ways we study the natural world, practice to ask and try to answer a scientific question, and propose explanations based on the evidence derived from conducting experiments. For this study, we engaged in developing science process skills by actively conducting research using Drosophila, the fruit fly as a model organism for studying the phenomenon that animals have traits inherited from parents. The phenomenon is a performance expectation in the Next Generation Science Standards (3-LS3-1). We observed the phenomenon, developed hypotheses, conducted experiments, collected data, analyzed and communicated our findings through discussions and presentations. We developed lesson plans using inquiry-based instruction from out first-hand experience of engaging with it in our research. We will discuss how teachers scaffold guide the inquiry and how inquiry based instruction supports active learning.

Introduction

- Research has shown that by using inquiry learning and scaffolding students, they are able to use what they know to dig into science to help them improve their questions and inquiries (Harris & Rooks, 2010).
- Students are able to ask real questions and solve real world problems through their own learning and inquiry as well as by our scaffolding as teachers.
- The goal of this study was to understand the impact of scaffolding and inquiry based instruction by doing research and using problem solving skills to increase the understanding of science.

Research Purpose and Questions

The purpose of this study is to explore the process of inheritance and how it affects the traits that are passed to offspring. We will use this knowledge to guide our discussion as to how teachers can effectively scaffold inquiry instruction as well as how inquiry-based instruction supports students' active learning.

1. How does inquiry-based instruction affect student understanding?
2. How can teachers effectively scaffold inquiry-based instruction?

Methods

Research Design:
1) Explored phenomenon: Animals have traits inherited from their parents.
   a) Performance expectation from Next Generation Science Standards (3-LS3-1)
2) Completed over a 10 day period

Experiment:
Organism: *Drosophila* (fruit fly)
1) Observed traits of mutant and natural flies
   a) Varying traits: red eye color (wild type) versus white eye color (mutant)
2) Bred male and female flies
   a) Red eye males and females in 1 vial & white eye males and females in 1 vial
3) Collected data through observations via vials & microscope
   a) Day 1: males & females; Day 5: only larvae; Day 10: offspring present & injected with CO2 for observation under microscope
   b) Practiced learning through inquiry by asking questions based on observations
      i) E.g. Is eye color inherited from parents?
4) Analyzed and interpreted phenomenon of inherited traits

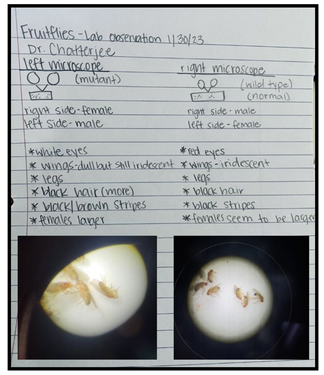
Data Collection:
1) Practiced learning through inquiry before, during, and after experiment
   a) Lab observations; data collected through microscope
   b) Notes and collaborative discussion
   c) Images taken using a microscope (Leica EZ4) and software application LAS EZ)

Analysis

To further understand the importance of inquiry-based learning, we conducted a lab in which we studied inheritance of traits using *Drosophila*. Throughout the lab, we incorporated the aspects of inquiry-based learning by interacting with hands-on experiences, asking questions, working collaboratively, and holding discussions in order to further our understanding of inheritance of traits.

After the flies mated together, we used a microscope to take images of the larvae. We also used the LAS EZ software application to take high-quality pictures of the fruit flies for further investigation and analysis.

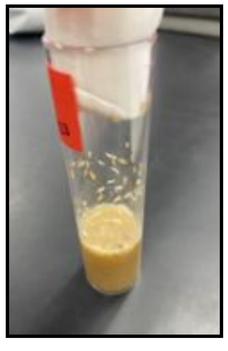
From the lab results, we found that:
- When the white-eyed males and females mated with each other, they bred only white-eyed offspring.
- When red-eyed males and females mated with each other, they bred only red-eyed offspring.



a.

a) Notes taken during first day in the lab

Findings



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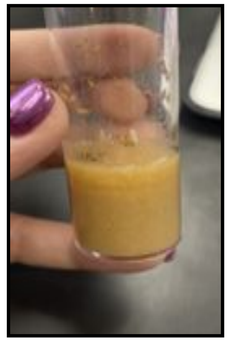

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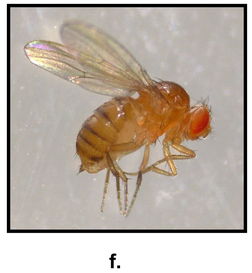

f.

g.

b) Vial Day 5, **c)** Vial Day 10, **d)** White-Eye *Drosophila*, **e)** White-Eye *Drosophila*, **f)** Red-Eyed *Drosophila*, **g)** Red-Eyed *Drosophila*

Discussion

Question 1 answered: How does inquiry-based instruction affect student understanding?
   a) high level of engagement, interaction, and participation in learning
   b) questions posed, methods designed, and data interpreted by students led to deeper understanding of content
   c) problem-solving skills developed

Question 2 answered: How can teachers effectively scaffold inquiry-based instruction?
   a) assess prior knowledge
   b) consider learning objective
   c) model inquiry
   d) use strategies such as visual aids, formative assessments, open-ended questions

- Suggests inquiry-based instruction leads to a higher level of engagement in students and frequent hands-on experience in student understanding of the phenomenon
- Suggests teacher scaffolding leads to deeper understanding of content through use of inquiry, manipulatives, visual aids, and assessments

Implications

Overall, this was a very impacting learning experience for our group. Through research and interaction with the lab, we were able to grow our understanding of the importance of inquiry-based learning in the classroom. From this experience, we learned:

- Scaffolding impacted our understanding of science learning
- Our findings are based off of experiments using inquiry learning
- Inquiry-based instruction enhances learning for our own comprehension
- Conducting hands-on experiments led to deeper understanding of phenomenon
- Inquiry-based learning led to a student-centered approach to learning
  - Ownership of our own questions and ideas
- Questioning leads to deeper analysis and understanding of phenomena

References

1. Harris, Christopher J., and Deborah L. Rooks. "Managing Inquiry-Based Science: Challenges in Enacting Complex Science Instruction in Elementary and Middle School Classrooms." Journal of Science Teacher Education, vol. 21, no. 2, 31 Feb. 2010, pp. 227–240., https://doi.org/10.1007/s10972-009-9172-5
2. Lange, Alissa A., et al. *Teaching Early and Elementary STEM*. Digital Commons East Tennessee University, 2021.