Odysseyware®

CURRICULUM OVERVIEW

Scientific Research
Career and Technical Education Series

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Scientific Research Course Overview

The course Scientific Research describes these activities from the point of view of a professional scientist. While this inside look should appeal to students of all ages, the lessons provide support, accessible ideas, and specific language that do not dumb down the content but rather guide students at their own pace through most of the steps, insights, and experiences they would eventually face if they continue through higher education toward a graduate degree. On the other hand, knowing the practical, everyday basics of scientific thinking and laboratory activity could also serve as a necessary first step to a career as a technician or a lab assistant. While these jobs are hands-on and technical, the intellectual and historical background covered in the course provides an awareness that is essential to working in such an atmosphere.

- **Introduction to Scientific Research and Exploration:** In this unit, students will study evidence vs. proof in science, the dynamic vs. static nature of science and scientific discovery, peer-review and "junk science," scientific journals vs. popular press, and the work of Mendel, Harvey, Fleming, and Florey.

- **The Scientific Method and Scientific Inquiry:** Students will investigate the steps of the scientific method and learn how to apply them to answer questions they might have about their world.

- **Designing and Conducting an Experiment:** In this unit, students will go through a progressive analysis of converting a research question into an actual, feasible research design. While each major aspect they could encounter will be explained separately, the analysis throughout is focused on practical applications in exemplary situations.

- **The Data:** Evaluating Results and Drawing Conclusions: This unit looks at data: how data are collected, analyzed, and evaluated. There is an overview of statistical analysis and the related concept of statistical significance. Very basic statistical tests are covered, including the chi-square test, Student's t-test, and the use of contingency tables.

- **Reporting your Findings:** This unit illustrates the fact that the entire scientific research process is always distilled into a publishable report of a very specific type.

Scientific Research

Unit 1: Introduction to Scientific Research and Exploration

Assignments

1. Course Overview
2. What is Scientific Research?
3. Why Do Scientists Change Their Minds?
4. Project: Mapping Scientists' Minds
5. Core Principles of Scientific Research
6. Project: Testing 1, 2, 3
7. Quiz 1: Principles of Scientific Discovery and Research
8. Fleming, Chain, and Florey: The Discovery of Penicillin
9. William Harvey and Blood Circulation
10. Project: Model of the Heart
11. Gregor Mendel and Genetics
12. Project: Punnett Square for Third Generation
13. Quiz 2: History of Scientific Discovery
14. Special Project*
15. Test
16. Course Project Part 1: Choose a Research Question that is Meaningful and Empirically Based*
17. Glossary and Credits

Scientific Research

Unit 2: The Scientific Method and Scientific Inquiry

Assignments

1. Observation and Scientific Inquiry
2. Formulating Questions that Enable Scientific Investigation and Experimentation
3. Project: Now, That's Saying Something!
4. Creating a Testable Hypothesis: Simplicity is the Key!
5. Project: What Were They Thinking?
6. Quiz 1: Observations, Questions, and the Testable Hypothesis
7. Research Questions in Chemistry
8. Project: Chemistry Sub-Disciplines
9. Research Questions in Environmental Sciences
10. Genomics and Cancer
11. Project: Genomics in the Lab and the Courtroom
12. Quiz 2: Identifying a Research Topic
13. Special Project*
14. Test
15. Course Project Part 2: Plan the Details and Methods; Perfect Your Research Design and Hypothesis*
16. Glossary and Credits

Scientific Research

Unit 3: Designing and Conducting an Experiment

Assignments

1. Experimental Design
2. Dependent and Independent Variables
3. Project: Clearing up Confusion about Confounders
4. Experimental Controls: What Are They? Why Do We Need Them?
5. Project: Bias in Control Groups
6. Quiz 1: Applying the Scientific Method to Answer Research Questions
7. Random Sampling and Sample Size
8. Project: Sample Size and Medical Research
9. Record Keeping
10. Conducting the Experiment: Materials, Methods, Reproducibility
11. Project: The Role of the Lab Assistant
12. Quiz 2: Research Basics
13. Special Project*
14. Test
15. Course Project Part 3: Conduct Tests, Gather Data*
16. Glossary and Credits

Scientific Research

Unit 4: The Data: Evaluating Results and Drawing Conclusions

Assignments

1. What is Statistical Analysis?
2. Statistical Significance
3. Project: P-values
4. Commonly Used Statistical Tests
5. Project: Training Dolphins
6. Quiz 1: Statistical Analysis of Data
7. Data Replication, Reproducibility, and Accuracy
8. Project: Looking Behind the Curtain of Published Research
9. Making Assumptions and Drawing Conclusions
10. Controversy: Relevance and Research
11. Project: Research in Your Area
12. Quiz 2: Interpreting Results and Drawing Conclusions
13. Special Project*
14. Test
15. Course Project Part 4: Analyze Data, Determine Statistical Significance*
16. Glossary and Credits

Scientific Research

Unit 5: Reporting Your Findings

Assignments

1. Poster Presentations
2. Project: On Display: Creating a Scientific Poster
3. Scientific Papers
4. Publishing: Scholarly vs. Popular Press
5. Project: Comparing Science Reporting
6. Quiz 1: Posters and Publishing
7. Integrity in Research
8. Project: Validity of Research
9. Working with Human Subjects
10. Teamwork and Collaboration in Science
11. Project: Six-Step Social Networks
12. Quiz 2: Ethical Considerations in Research
13. Special Project*
14. Test
15. Course Project Part 5: Make a Poster*
16. Glossary and Credits

Unit 6: Course Project, Review, and Exam	
Assignments	
1. Course Project Part 6: Report Your Results*	2. Review 3. Exam

(*) Indicates alternative assignment