

FHSU CORE Outcome Rubric

Objective 2.1: Knowledge of the Liberal Arts

Course: CHEM 120 University Chemistry I

Students will possess a broad understanding of how to think about the world, having studied the modes of inquiry characteristic of humanities, mathematics, natural sciences, and social and behavioral sciences.

Outcomes 2.1-D: Natural Scientific Mode of Inquiry (lecture course)

By graduation students will:	Not Proficient	Developing Proficiency	Proficient	Exceeding Proficiency
1. Identify essential characteristics of natural science questions (questions of empirical study and applications of scientific methodologies).	Student scores 0-59% on CORE Assessment Exam Group 1 Questions.	Student scores 60-79% on CORE Assessment Exam Group 1 Questions.	Student scores 80-89% on S CORE Assessment Exam Group 1 Questions.	Student scores 90-100% on CORE Assessment Exam Group 1 Questions.
2. Evaluate the merits of examples of natural scientific research at the level of an informed citizen.	Student scores 0-59% on CORE Assessment Exam Group 2 Questions.	Student scores 60-79% on CORE Assessment Exam Group 2 Questions.	Student scores 80-89% on CORE Assessment Exam Group 2 Questions.	Student scores 90-100% on CORE Assessment Exam Group 2 Questions.

Assignment meeting CORE Outcome 2.1-D1 and 2.1-D2: CORE Assessment Exam will be used to assess these outcomes.

Note: A example of CORE Assessment Exam is attached here.

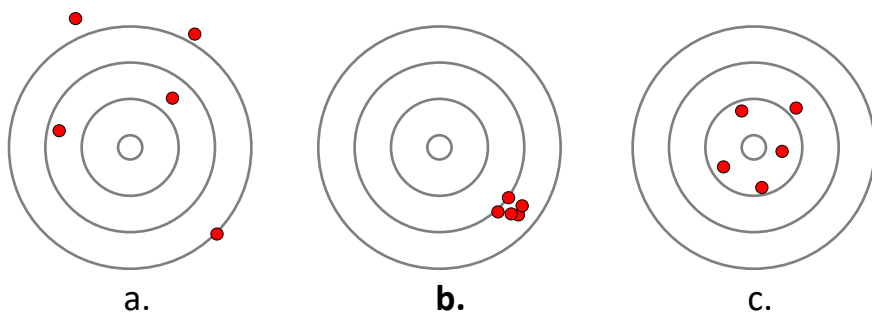
CHEM 120 CORE Assessment Exam*
SCIENTIFIC APPROACH TO KNOWLEDGE

Group 1 Questions

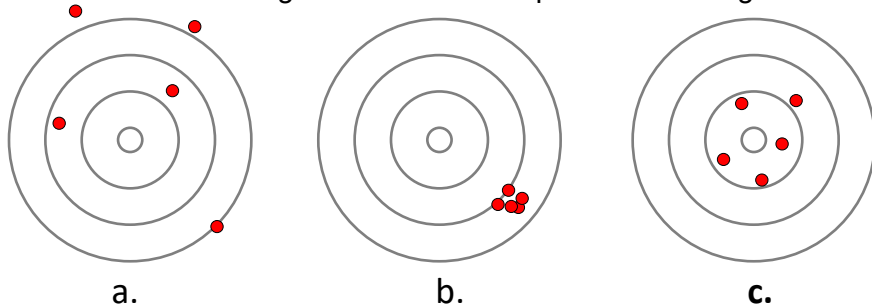
Outcome 2.1-D1: Identify essential characteristics of natural science questions (questions of empirical study and applications of scientific methodologies).

1. What is the most likely reason for a scientist to develop a model of natural phenomena?
 - a. To predict the future
 - b. To showcase their research findings
 - c. To test their understanding of processes**
 - d. To learn about past events

2. Which of the following collections of samples shows the greatest precision?



3. Which of the following collections of samples shows the greatest accuracy?



4. Scientific processes or results must be observable, measurable, and _____.

- a. repeatable**
- b. technical
- c. natural
- d. understandable

5. What concept, among others, do scientists use to ensure that processes are able to be compared?

- a. objectivity
- b. peer-review
- c. categorization
- d. scale**

* More questions will be developed and added to this exam to further address CORE Outcomes 1 and 2.

6. Hypotheses must be
- provable
 - falsifiable**
 - exhaustive
 - subjective
7. Why is science considered to be the best way to understand the world?
- Scientists are smarter than other citizens.
 - Meaningful scientific results can be replicated by others.**
 - Science requires total objectivity.
 - Tools used by scientists are more reliable.
8. Which of the following likely describes pseudoscience rather than science?
- Developing a hypothesis based on limited observations.
 - Collecting more data/observations
 - Collecting data to support a hypothesis**
 - Changing the hypothesis based on analysis of more data

True or False?

- TRUE** Testable questions can be answered through experiments.
- TRUE** Scientific laws describe and summarize observed phenomena.
- TRUE** Most people use the scientific method in their everyday lives.
- FALSE** The purpose of an experiment is to prove the hypothesis is true.
- FALSE** There should be only two independent variables in an experiment.
- FALSE** A scientist measuring the total area of mold spores is collecting qualitative data.
- FALSE** Scientific theories are guesses about cause-and-effect relationships.

16. Match the letter to the correct element of the scientific method.

<p>F. ___ Gather information/ Research</p> <p>E. ___ Ask a testable question</p> <p>C. ___ Form a hypothesis</p> <p>B. ___ Conduct an experiment</p> <p>D. ___ Analyze the results</p> <p>A. ___ Draw conclusions</p>	<p>A. Adding salt to distilled water increased the time it takes for the salt-water to freeze. The hypothesis is supported.</p> <p>B. Procedure:</p> <ol style="list-style-type: none"> 1. Find two identical ice trays and fill one with distilled water and the other with the same amount of distilled water with 2 teaspoons of table salt dissolved. 2. Place the ice trays side by side in the freezer. 3. Observe every 10 min and record the time it takes for the liquids to start freezing. <p>C. If table salt is added to distilled water, then it will take longer time to freeze because table salt depresses the freezing point of water and it takes longer time to reach this point.</p> <p>D.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Time to freezing</th> </tr> </thead> <tbody> <tr> <td>Distilled water</td> <td>20 min</td> </tr> <tr> <td>Distilled water + Table salt</td> <td>30 min</td> </tr> </tbody> </table> <p>E. Does adding table salt to distilled water increase its freezing time?</p> <p>F. Notes: (WebMD)</p> <ol style="list-style-type: none"> I. The freezing point of a solution is lower than the pure solvent. II. A solution must be cooled to a lower temperature for the freezing to occur. 	Time to freezing		Distilled water	20 min	Distilled water + Table salt	30 min
Time to freezing							
Distilled water	20 min						
Distilled water + Table salt	30 min						

17. Which of the following is a formulated scientific law?

- A. Conservation of mass and energy**
- B. Quantum theory
- C. Heisenberg Uncertainty principle
- D. Valence bond and molecular orbital theory

Group 2 Questions

Outcome 2.1-D2: Evaluate the merits of examples of natural scientific research at the level of an informed citizen.

18. Which of the following headlines from a popular science magazine is most likely an accurate representation of valid natural-science research?

- a. Scientists predict rare earthquake in the year 2065.
- b. Science proves that tight clothing causes cancer.
- c. Tornado-preventing towers called "Success" after first year
- d. **Multi-year research project strengthens scientists' understanding of subatomic particles.**

19. Which of the following is the best example of a testable question?

- a. What kind of cleaning product cleans the best?
- b. **Does the concentration of a reactant affect reaction rate?**
- c. Should people drink purified water?
- d. Why are acids sour?

20. "Consensus" is commonly used to describe research on potentially controversial topics like vaccines, climate change, and energy policies. Why is a consensus relevant in such contexts?

- a. **It means there is increased confidence in conclusions that have been reached by numerous independent scientists using a variety of data and methods.**
- b. Research grants are awarded based on majority votes, so the most popular gets the most funding.
- c. Scientific findings are not reliable if any researchers disagree with them.
- d. Support from the general public enables scientists to study topics with less concern of criticism from non-scientists.

21. When evaluating the merit of natural science research, which of the following is of least importance?

- a. Contribution of results to society
- b. Contribution of results to scientific field of study
- c. **Age of researcher**
- d. Journal in which research is published

22. When research is reviewed by experts before it is published, it is said to have been

- a. **peer-reviewed**
- b. expert- reviewed
- c. colleague-reviewed
- d. information-reviewed

23. Why are research projects that are designed to exactly repeat a previous project important?

- a. They add precision
- b. They provide another perspective
- c. **They illustrate that an experiment can be replicated**
- d. They show another way to test a question

24. Why is it important to learn about counting significant figures when reporting measured quantifiable data?

- a. **To preserve the precision of a measurement when reproducing data**
- b. To preserve the accuracy of a measurement when reproducing data
- c. To conserve percent error during statistical analysis
- d. To conserve mass during sampling

25. Why is it essential to calibrate measuring devices/instruments used in a scientific experiment periodically?

- a. **To ensure reliability of data obtained through scientific research**
- b. To lengthen the scientific process
- c. To promote the quality of instrumentation
- d. To perform statistical analysis all the time

26. Why is education in the area of the natural sciences vital despite of a person's professional/career background?

- a. To retain scientific literacy and deal with global issues such as the COVID-19 pandemic
- b. To appreciate technological advances in our society, such as cellphone development and advances in medicine, as a result of scientific inquiry
- c. To better understand the nature and dynamics of the physical universe we exist in and how it affects our everyday lives
- d. **All of the above**