# LIBE120 Foundations and Frontiers of Science Course

# Pre-Test Results

**February 20, 2024**

The main objective of this course is to provide students with knowledge of the scientific methodology and critical thinking approach as applied by the scientists in their study of natural phenomena and through the analysis of their use in real life examples from different scientific disciplines. The course further aims to introduce students a general knowledge of the basic ideas and methodologies of some of the major theories in physics, biology, geology, neuroscience/psychology, and inculcate the scientific habits of mind. In this context, Pre-Test Survey evaluated students enrolled in the LIBE120 course as presented in Table 1.

The survey was conducted with 37 respondents from different faculties. The majority of the participants were freshmen (89.19%), with most coming from the Faculty of Engineering (43.24%) and the Faculty of Architecture and Design (35.14%). Gender distribution consisted of 23 female (62.16%) and 14 male (37.84%) participants.

Table 1. Evaluation of Pre-Test in LIBE120 Foundations and Frontiers of Science Course

| Item | Yes (%) | Partially (%) | No (%) | Mean (M) |
|---|---|---|---|---|
| I can state what domains of knowledge are science and what are not. | 51.94 | 41.09 | 6.98 | 1.45 |
| I know that any research should have a research question, methodology, and evidence-based conclusions. | 65.12 | 30.23 | 4.65 | 1.60 |
| I know the difference between hypotheses, theories, laws, facts, and beliefs. | 50.39 | 44.96 | 4.65 | 1.46 |
| I can provide examples for hypotheses, theories, laws, facts, and beliefs from various scientific areas. | 30.23 | 58.91 | 10.85 | 1.19 |
| I know that scientific theories are tentative. | 60.47 | 29.46 | 10.08 | 1.50 |

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|---|---|---|---|---|
| I can tell whether a variable is categorical or numerical. | 41.09 | 32.56 | 26.36 | 1.15 |
| I can explain what is meant by operationalizing a variable. | 13.95 | 38.76 | 47.29 | 0.67 |
| I can differentiate between accuracy and precision in measurements. | 47.29 | 32.56 | 20.16 | 1.27 |
| I can differentiate between validity and reliability of a measurement. | 40.31 | 39.53 | 20.16 | 1.20 |
| I know that any measurement is accompanied by a measurement error. | 44.19 | 29.46 | 26.36 | 1.18 |
| I can differentiate and identify random and systematic errors in measurements. | 32.56 | 43.41 | 24.03 | 1.09 |
| I know how significant digits reflect the precision of a measuring tool. | 38.76 | 38.76 | 22.48 | 1.16 |
| I know which graphical representation to choose for representing a set of data. | 40.31 | 36.43 | 23.26 | 1.17 |
| I can distinguish symmetric, right-skewed, and left-skewed distributions. | 24.81 | 40.31 | 34.88 | 0.90 |
| I know that mean, median, and mode are measures of center, while variance and standard deviation are measures of spread. | 49.61 | 27.91 | 22.48 | 1.27 |
| I know how to construct a five-number summary and represent it as a boxplot. | 16.28 | 34.88 | 48.84 | 0.67 |
| I know when to use various measures of center and spread based on data distribution. | 23.26 | 37.98 | 38.76 | 0.84 |
| I can identify the premises and conclusion of an argument. | 43.41 | 39.53 | 17.05 | 1.26 |
| I can classify major fallacies and identify good arguments. | 30.23 | 46.51 | 23.26 | 1.07 |
| I can differentiate between deductive, inductive, and abductive arguments. | 28.68 | 37.98 | 33.33 | 0.95 |
| I can evaluate statistical tests of significance and hypothesis testing. | 29.46 | 34.11 | 36.43 | 0.93 |
| I can analyze experimental setups for issues of validity and reliability. | 25.58 | 44.19 | 30.23 | 0.95 |
| I know how protein is coded by mRNA. | 48.84 | 25.58 | 25.58 | 1.23 |
| I know that mutations are errors in DNA. | 69.77 | 15.50 | 14.73 | 1.55 |
| I can explain how mutations lead to variation in traits. | 46.51 | 33.33 | 20.16 | 1.26 |
| I can explain and provide examples of natural selection. | 54.26 | 30.23 | 15.50 | 1.39 |
| I can explain the theory of evolution as accepted by scientists. | 32.56 | 41.86 | 25.58 | 1.07 |
| I can explain why earthquakes happen. | 61.24 | 31.78 | 6.98 | 1.54 |
| I can differentiate between science, pseudoscience, and non-science. | 34.88 | 32.56 | 32.56 | 1.02 |

The LIBE120 pre-test results suggest that students have a moderate understanding of scientific literacy, particularly in fundamental concepts such as hypothesis testing, experimental design, and measurement accuracy. However, there is notable uncertainty and knowledge gaps in areas like statistical significance, logical reasoning, and distinguishing between pseudoscience and science.

To address these gaps, the course should emphasize critical thinking exercises, hands-on experiments, and case studies to improve students' confidence in scientific methodologies and reasoning. A post-test will be conducted to measure progress in these areas.