Texas CTE

Project Lead The Way [PLTW] Biomedical Innovation

Knowledge and Skills BIOINN

1 **Experimental Design. The student independently designs an experiment which investigates a unique research question and analyzes self-collected data to draw a conclusion. The student is expected to:** BIOINN.1

- a develop an experimental protocol that includes a testable hypothesis; BIOINN.1A
- b distinguish between the independent and dependent variables within the experimental design; BIOINN.1B
- c identify and explain the purpose and importance of experimental controls; BIOINN.1C
- d maintain a detailed repeatable account of the experiment in a physical or digital laboratory notebook; BIOINN.1D
- e conduct background research using credible sources to support the development of a research question, hypothesis and experimental design; BIOINN.1E
- f select and use appropriate equipment to conduct experiments; BIOINN.1F
- g identify source of errors, then redesign and repeat the experiment when appropriate; BIOINN.1G
- h communicate the findings of an experiment in oral and written (including digital) form; BIOINN.1H
- i collaborate with a mentor who is an expert in their field to inform the development of a research question, hypothesis and experimental design; BIOINN.1I
- j build a model, prototype, or schematic of proposed experimental design; BIOINN.1J
- k describe why experimental design is a continual process; BIOINN.1K
- l read and follow established experiment protocols and instructions; BIOINN.1L
- m display experiment data appropriately and accurately in multiple formats (graphs, tables, diagrams); BIOINN.1M
- n determine and perform appropriate calculations to analyze data based on the experiment; and BIOINN.1N
- o communicate logical conclusions from experimental data. BIOINN.1O

2 **Critical and Analytical Thinking. The student investigates and solves a problem using analytical and critical thinking skills, explains the value of diverse perspectives and applies them to the problem-solving process, and explains why**

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scientists must have the courage to take a calculated risk. The student is expected to: BIOINN.2

- a create and execute a plan using analytical and critical thinking skills to solve a problem, for example, students will investigate health care delivery and propose innovations in clinical medicine; BIOINN.2A
- b point out the importance of collecting data from multiple sources to solve a problem; BIOINN.2B
- c explain how persistence is a key mindset when identifying problems and/or pursuing solutions; BIOINN.2C
- d illustrate how iterative processes inform biomedical science decisions, improve solutions, and inspire new ideas; BIOINN.2D
- e evaluate the reliability and credibility of sources when gathering information to solve problems; BIOINN.2E
- f explain how solutions for complex problems can require interdisciplinary collaboration to incorporate a wide range of perspectives and skills; BIOINN.2F
- g explain the importance of risk taking in performing experiments and developing solutions; BIOINN.2G
- h classify the pros and cons associated with decisions made in biomedical science; BIOINN.2H
- i describe how failure or unexpected results can produce positive outcomes by improving understanding; and BIOINN.2I
- j explain how creativity can lead to scientific discovery. BIOINN.2J

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3 **Biotechnology Tools and Technology. The student selects and uses appropriate tools, technology, and software for experimental and clinical data collection and analysis. The student is expected to:** BIOINN.3

- a select appropriate technology and software for data collection; BIOINN.3A
- b describe and identify cell and tissue features using a microscope; BIOINN.3B
- 3c. describe and demonstrate aseptic techniques for handling, culturing, and analyzing bacteria colonies; BIOINN.3C
- 3d. conduct investigations and analyze data using probes and software; BIOINN.3D
- e conduct gel electrophoresis to separate deoxyribonucleic acid (DNA) fragments; and BIOINN.3E
- f explain and apply results of gel electrophoresis. BIOINN.3F

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4 **Efficient Systems. The student designs a medical space that is conducive to patient wellness and improves patient outcomes. The student is expected to:** BIOINN.4

- a describe how medical innovations can reduce wait time in the emergency room; BIOINN.4A
- b design an efficient emergency room to reduce patient wait time; and BIOINN.4B

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c evaluate scenarios to determine how patient health issues are prioritized in an emergency room. BIOINN.4C

5 Medical Innovations. The student creates or improves a medical innovation using a design process. The student is expected to: BIOINN.5

a describe the impact of various medical innovations on human health; and BIOINN.5A

b explain the process of inventing and improving medical innovations. BIOINN.5B

6 Statistics. The student uses statistics to solve biomedical science problems. The student is expected to: BIOINN.6

a analyze data from two sample t-tests; BIOINN.6A

b explain how data can be manipulated in scientific studies; BIOINN.6B

c describe how scientific data is presented in the media and in scientific journals; and BIOINN.6C

d describe how statistics can be used inappropriately to manipulate data and/or mislead readers. BIOINN.6D

7 Environmental Health and Safety. The student evaluates the impact of environmental factors on human health. The student is expected to: BIOINN.7

a identify environmental concerns that are potentially harmful to health; BIOINN.7A

b explain how a range of factors affect how individuals respond to a given toxin; BIOINN.7B

c design and conduct water quality testing for the presence of contaminants; BIOINN.7C

d create an environmental health profile and action plan for the local area; and BIOINN.7D

e create and analyze a dose response model for the exposure of toxic chemicals. BIOINN.7E

8 Public Health. The student analyzes health and disease data to inform public health decisions. The student is expected to: BIOINN.8

8a. analyze medical evidence to diagnose a patient's health condition; BIOINN.8A

b analyze data from epidemiological studies to investigate the symptoms, pathogen, and transmission pattern of a mystery illness; BIOINN.8B

8c. identify medical interventions that can address global health issues; BIOINN.8C

d calculate measures of risk used to demonstrate an association between a risk factor and a disease; and BIOINN.8D

e describe how to set up case-control and cohort studies. BIOINN.8E

Microbiology. The student uses proper techniques to identify strains of bacteria. The student is expected to: BIOINN.9

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a conduct water quality testing for the presence of coliforms and E. coli; and BIOINN.9A

b analyze bacterial deoxyribonucleic acid (DNA) using polymerase chain reaction (PCR) and gel electrophoresis to identify the strains of bacteria. BIOINN.9B

10 Career Awareness. The student demonstrates awareness of the education and skills required for biomedical science professionals and of the societal impacts of biomedical science professionals. The student is expected to: BIOINN.10

a identify and describe careers of professionals who research, diagnose, and treat medical conditions; BIOINN.10A

b describe the education requirements, salary ranges, professional licensure, skills, and responsibilities of biomedical science professionals; BIOINN.10B

c explain the importance of life-long learning for biomedical science professionals; BIOINN.10C

d apply professional standards as they relate to the habits and characteristics of a biomedical science professional; BIOINN.10D

e describe the impact that biomedical science research and interventions have on disease prevention and treatment; BIOINN.10E

f describe the unique solutions to the health and medical problems of this century; and BIOINN.10F

g describe the global impact of biomedical science solutions. BIOINN.10G

11 Career Awareness: The student demonstrates the use of project management to successfully and efficiently complete tasks as scheduled. The student is expected to: BIOINN.11

a write a proposal for an independent project; including the elements “identify problem, literature review, methodology, materials, project schedule, and proposed product”; BIOINN.11A

b establish a protocol, timeline, and a means to measure progress toward completion of a project; BIOINN.11B

c explain project timelines and progress of a project using a Gantt chart; BIOINN.11C

d research and compile information about a chosen topic within the scope of a managed project; and BIOINN.11D

e explain how breaking a large project into smaller tasks allows modifications to be made as necessary and serves to monitor progress toward completion of the project. BIOINN.11E

12 Professionalism and Ethics. The student applies professional standards as they apply to the habits and characteristics of a biomedical science professional. The student is expected to: BIOINN.12

a demonstrate the importance of honesty, integrity, and accountability for biomedical professionals; BIOINN.12A

b explain the importance of privacy for all individuals; BIOINN.12B

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c create and support an environment that fosters teamwork, emphasizes quality, and promotes learning; BIOINN.12C

d describe the importance of ethical considerations when making biomedical science decisions; BIOINN.12D

e describe the ethics of human experimentation and the importance of informed consent; and BIOINN.12E

f explain the importance of punctuality and meeting deadlines. BIOINN.12F

13 Communication. The student creates and delivers effective communication with specific audiences. The student is expected to: BIOINN.13

a use acceptable formats for writing assignments and professional presentations; BIOINN.13A

b modify communications to meet the needs of the audience and be appropriate to the situation; BIOINN.13B

c properly cite references for all reports in an accepted format; BIOINN.13C

d use proper elements of written communication such as spelling, grammar, and formatting; BIOINN.13D

e write a mini grant to fund a proposal using a specified format such as the format utilized by National Institutes of Health; BIOINN.13E

f explain the advantages and disadvantages of using online resources; and BIOINN.13F

g prepare and present a poster displaying key information from a scientific study. BIOINN.13G

14 Collaboration. The student creates an effective team environment to support successful goal attainment. The student is expected to: BIOINN.14

a demonstrate respect for others' viewpoints; BIOINN.14A

b describe the importance of each team member's contribution to the project; BIOINN.14B

c apply basic conflict resolution strategies and employ those strategies as necessary and appropriate; and BIOINN.14C

d employ a peer review process to give effective and constructive feedback to meet given outcomes. BIOINN.14D