Scientific Research and Design (IMRA26)

Subject: Career Development and Career and Technical Education
Grade: 12
Expectations: 58
Breakouts: 254

Employability Skills

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. These standards may not be offered as a standalone course. These standards shall be offered together with the essential knowledge and skills for career and technical education (CTE) courses in this chapter.

(c) Introduction.

(1) CTE instruction provides content aligned with challenging academic standards, industry-relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions.

(2) The goal of the employability skills standards is to ensure that students develop essential skills for effective performance in the workplace, regardless of the occupation.

(3) These standards are required to be addressed in their entirety as part of each CTE course based on the level of the course in a CTE program of study.

(A) CTE courses identified as Level 1 or Level 2 courses in a CTE program of study must address the employability skills standards identified in subsection (d)(1) of this section.

(B) CTE courses identified as Level 3 or Level 4 courses in a CTE program of study must address the employability skills standards identified in subsection (d)(2) of this section.

(4) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

Scientific Research and Design

(a) Implementation.

(1) The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(2) School districts shall implement the employability skills student expectations listed in §127.15(d)(2) of this chapter (relating to Career and Technical Education Employability Skills) as an integral part of this course.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Biology, and one credit of the following: Physics for Engineering, Chemistry, Integrated Physics and Chemistry (IPC), or Physics. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course. Students may take this course with different course content for a maximum of three credits.

(c) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) Scientific Research and Design allows districts and schools flexibility to develop local curriculum to supplement a program of study or coherent sequence. The course has the components of any rigorous scientific or career and technical education (CTE) program of study, including problem identification, investigation design, data collection, data analysis, formulation, and presentation of conclusions. These components are integrated with the CTE emphasis of helping students gain entry-level employment in high-skill, high-wage jobs and/or continue their education.

(3) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(4) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.

(5) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(6) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(7) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide tools for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(8) Students are encouraged to participate in extended learning experiences such as career and technical student organizations, other organizations that foster leadership and career development in the profession such as student

chapters of related professional associations, or practical, hands-on activities or experiences through which a learner interacts with industry professionals in a workplace, which may be an in-person, virtual, or simulated setting. Learners prepare for employment or advancement along a career pathway by completing purposeful tasks that develop academic, technical, and employability skills.

(9) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and Skills Statements

(0) Employability skills--Levels 3 and 4. In a CTE course identified as a Level 3 or Level 4 course in a CTE program of study, the student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) demonstrate dressing appropriately, speaking politely, and conducting oneself in a manner appropriate for the profession and work site

(i) demonstrate dressing appropriately for the profession

(ii) demonstrate speaking politely for the profession

(iii) demonstrate conducting oneself in a manner appropriate for the profession

(iv) demonstrate dressing appropriately for the work site

(v) demonstrate speaking politely for the work site

(vi) demonstrate conducting oneself in a manner appropriate for the work site

(B) analyze how teams can produce better outcomes through cooperation, contribution, and collaboration from members of the team;

(i) analyze how teams can produce better outcomes through cooperation from members of the team

(ii) analyze how teams can produce better outcomes through contribution from members of the team

(iii) analyze how teams can produce better outcomes through collaboration from members of the team

(C) present written and oral technical communication in a clear, concise, and effective manner for a variety of purposes and audiences, including explaining and justifying decisions;

(i) present written technical communication in a clear manner for a variety of purposes, including explaining decisions

(ii) present written technical communication in a concise manner for a variety of purposes, including explaining decisions

(iii) present written technical communication in a[n] effective manner for a variety of purposes, including explaining decisions

(iv) present written technical communication in a clear manner for a variety of audiences, including explaining decisions

(v) present written technical communication in a concise manner for a variety of audiences, including explaining decisions

(vi) present written technical communication in a[n] effective manner for a variety of audiences, including explaining decisions

(vii) present written technical communication in a clear manner for a variety of purposes, including justifying decisions

(viii) present written technical communication in a concise manner for a variety of purposes, including justifying decisions

(ix) present written technical communication in a[n] effective manner for a variety of purposes, including justifying decisions

(x) present written technical communication in a clear manner for a variety of audiences, including justifying decisions

(xi) present written technical communication in a concise manner for a variety of audiences, including justifying decisions

(xii) present written technical communication in a[n] effective manner for a variety of audiences, including justifying decisions

(xiii) present written oral communication in a clear manner for a variety of purposes, including explaining decisions

(xiv) present written oral communication in a concise manner for a variety of purposes, including explaining decisions

(xv) present written oral communication in a[n] effective manner for a variety of audiences, including justifying decisions

(xvi) present written oral communication in a[n] effective manner for a variety of purposes, including explaining decisions

(xvii) present written oral communication in a clear manner for a variety of audiences, including explaining decisions

(xviii) present written oral communication in a concise manner for a variety of audiences, including explaining decisions

(xix) present written oral communication in a[n] effective manner for a variety of audiences, including explaining decisions

(xx) present written oral communication in a clear manner for a variety of purposes, including justifying decisions

(xxi) present written oral communication in a concise manner for a variety of purposes, including justifying decisions

(xxii) present written oral communication in a[n] effective manner for a variety of purposes, including justifying decisions

(xxiii) present written oral communication in a clear manner for a variety of audiences, including justifying decisions

(xxiv) present written oral communication in a concise manner for a variety of audiences, including justifying decisions

(D) use time-management skills independently and in groups to prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that optimizes efficiency and results;

(i) use time-management skills independently to prioritize tasks in a way that optimizes efficiency

(ii) use time-management skills independently to prioritize tasks in a way that optimizes results

(iii) use time-management skills independently to follow schedules in a way that optimizes efficiency

(iv) use time-management skills independently to follow schedules in a way that optimizes results

(v) use time-management skills independently tend to goal-relevant activities in a way that optimizes efficiency

(vi) use time-management skills independently tend to goal-relevant activities in a way that optimizes results

(vii) use time-management skills in groups to prioritize tasks in a way that optimizes efficiency

(viii) use time-management skills in groups to prioritize tasks in a way that optimizes results

(ix) use time-management skills in groups to follow schedules in a way that optimizes efficiency

(x) use time-management skills in groups to follow schedules in a way that optimizes results

(xi) use time-management skills in groups tend to goal-relevant activities in a way that optimizes efficiency

(xii) use time-management skills in groups tend to goal-relevant activities in a way that optimizes results

(E) describe the importance of and demonstrate punctuality, dependability, reliability, and responsibility in reporting for duty and performing assigned tasks as directed;

(i) describe the importance of punctuality in reporting for duty

(ii) describe the importance of dependability in reporting for duty

(iii) describe the importance of reliability in reporting for duty

(iv) describe the importance of responsibility in reporting for duty

(v) describe the importance of punctuality in performing assigned tasks as directed

(vi) describe the importance of dependability in performing assigned tasks as directed

(vii) describe the importance of reliability in performing assigned tasks as directed

(viii) describe the importance of responsibility in performing assigned tasks as directed

(F) demonstrate respect for differences in the workplace;

(i) demonstrate respect for differences in the workplace

(G) identify the importance and benefits of meritocracy, a hard work ethic, and equal opportunity in the workplace;

(i) identify the importance of meritocracy in the workplace

(ii) identify the importance of a hard work ethic in the workplace

(iii) identify the importance of equal opportunity in the workplace

(iv) identify the benefits of meritocracy in the workplace

(v) identify the benefits of a hard work ethic in the workplace

(vi) identify the benefits of equal opportunity in the workplace

(H) identify consequences relating to discrimination and harassment;

(i) identify consequences relating to discrimination

(ii) identify consequences relating to harassment

(I) demonstrate knowledge of personal and occupational health and safety, applicable regulations, and first aid in the workplace and discuss why it is critical for employees and employers to maintain a safe work environment;

(i) demonstrate knowledge of personal health in the workplace

(ii) demonstrate knowledge of personal safety in the workplace

(iii) demonstrate knowledge of occupational health in the workplace

(iv) demonstrate knowledge of occupational safety in the workplace

(v) demonstrate knowledge of applicable regulations in the workplace

(vi) demonstrate knowledge of first aid in the workplace

(vii) discuss why it is critical for employees to maintain a safe work environment

(viii) discuss why it is critical for employers to maintain a safe work environment

(J) compare skills and characteristics of managers and leaders in the workplace; and

(i) compare skills and characteristics of managers in the workplace

(ii) compare skills and characteristics of leaders in the workplace

(K) identify career development opportunities in the field: (i) education and training; (ii) credentialing; (iii) internships and apprenticeships; and (iv) entrepreneurship opportunities;

(i) identify career development opportunities in the field: education

(ii) identify career development opportunities in the field: training

(iii) identify career development opportunities in the field: credentialing

(iv) identify career development opportunities in the field: internships

(v) identify career development opportunities in the field: apprenticeships

(vi) identify career development opportunities in the field: entrepreneurship opportunities

(L) demonstrate an understanding of legal and ethical responsibilities in relation to the field.

(i) demonstrate an understanding of legal responsibilities in relation to the field

(ii) demonstrate an understanding of ethical responsibilities in relation to the field

(1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(i) ask questions based on observations or information from text, phenomena, models, or investigations

(ii) define problems based on observations or information from text, phenomena, models, or investigations

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(i) apply scientific practices to plan descriptive investigations

(ii) apply scientific practices to plan comparative investigations

(iii) apply scientific practices to plan experimental investigations

(iv) apply scientific practices to conduct descriptive investigations

(v) apply scientific practices to conduct comparative investigations

(vi) apply scientific practices to conduct experimental investigations

(vii) use engineering practices to design solutions to problems

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(i) use appropriate safety equipment during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(ii) use appropriate safety equipment during classroom investigations as outlined in Texas Education Agency-approved safety standards

(iii) use appropriate safety equipment during field investigations as outlined in Texas Education Agency-approved safety standards

(iv) use appropriate practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate practices during field investigations as outlined in Texas Education Agency-approved safety standards

(D) use appropriate tools such as measurement and data collection tools, software, sensors, probes, microscopes, cameras, and glassware;

(i) use appropriate tools

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(i) collect quantitative data using the International System of Units (SI) as evidence

(ii) collect qualitative data as evidence

(F) organize quantitative and qualitative data using notebooks, journals, graphs, charts, tables, spreadsheets, and drawings and models;

(i) organize quantitative data using notebooks

(ii) organize qualitative data using graphs

(iii) organize quantitative data using journals

(iv) organize qualitative data using charts

(v) organize quantitative data using graphs

(vi) organize qualitative data using tables

(vii) organize quantitative data using charts

(viii) organize qualitative data using spreadsheets

(ix) organize quantitative data using tables

(x) organize qualitative data using drawings

(xi) organize quantitative data using spreadsheets

(xii) organize qualitative data using models

(xiii) organize quantitative data using drawings

(xiv) organize quantitative data using models

(xv) organize qualitative data using notebooks

(xvi) organize qualitative data using journals

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

(i) distinguish between scientific hypotheses, theories, and laws

(2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying patterns

(iii) analyze data by identifying sources of error

(iv) analyze data by identifying limitations

(C) use mathematical calculations to assess quantitative relationships in data; and

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

(i) evaluate experimental designs

(ii) evaluate engineering designs

(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(i) develop explanations supported by data

(ii) develop explanations supported by models

(iii) develop explanations consistent with scientific ideas

(iv) develop explanations consistent with scientific principles

(v) develop explanations consistent with scientific theories

(vi) propose solutions supported by data

(vii) propose solutions supported by models

(viii) propose solutions consistent with scientific ideas

(ix) propose solutions consistent with scientific principles

(x) propose solutions consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(i) analyze scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations by using observational testing so as to encourage critical thinking by the student

(v) evaluate scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(vi) evaluate scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(vii) evaluate scientific explanations by using experimental testing so as to encourage critical thinking by the student

(viii) evaluate scientific explanations by using observational testing so as to encourage critical thinking by the student

(ix) critique scientific explanations by using empirical evidence so as to encourage critical thinking by the student

(x) critique scientific explanations by using logical reasoning so as to encourage critical thinking by the student

(xi) critique scientific explanations by using experimental testing so as to encourage critical thinking by the student

(xii) critique scientific explanations by using observational testing so as to encourage critical thinking by the student

(xiii) analyze scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(xiv) analyze scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(xv) analyze scientific solutions by using experimental testing so as to encourage critical thinking by the student

(xvi) analyze scientific solutions by using observational testing so as to encourage critical thinking by the student

(xvii) evaluate scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(xviii) evaluate scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(xix) evaluate scientific solutions by using experimental testing so as to encourage critical thinking by the student

(xx) evaluate scientific solutions by using observational testing so as to encourage critical thinking by the student

(xxi) critique scientific solutions by using empirical evidence so as to encourage critical thinking by the student

(xxii) critique scientific solutions by using logical reasoning so as to encourage critical thinking by the student

(xxiii) critique scientific solutions by using experimental testing so as to encourage critical thinking by the student

(xxiv) critique scientific solutions by using observational testing so as to encourage critical thinking by the student

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(i) relate the impact of past research on scientific thought, including research methodology as related to the content

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis, as related to the content

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) relate the impact of current research on scientific thought, including research methodology as related to the content

(v) relate the impact of current research on scientific thought, including cost-benefit analysis, as related to the content

(vi) relate the impact of current research on scientific thought, including contributions of diverse scientists as related to the content

(vii) relate the impact of past research on society, including research methodology as related to the content

(viii) relate the impact of past research on society, including cost-benefit analysis, as related to the content

(ix) relate the impact of past research on society, including contributions of diverse scientists as related to the content

(x) relate the impact of current research on society, including research methodology as related to the content

(xi) relate the impact of current research on society, including cost-benefit analysis, as related to the content

(xii) relate the impact of current research on society, including contributions of diverse scientists as related to the content

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors to investigate science, technology, engineering, and mathematics careers.

(i) research resources to investigate science careers

(ii) research resources to investigate technology careers

(iii) research resources to investigate engineering careers

(iv) research resources to investigate mathematics careers

(v) explore resources to investigate science careers

(vi) explore resources to investigate technology careers

(vii) explore resources to investigate engineering careers

(viii) explore resources to investigate mathematics careers

(5) The student develops a proposal that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) establish a rationale and preliminary set of ideas for a research question or questions using organizational tools, collaboration, or research;

(i) establish a rationale set of ideas for a research question or questions using organizational tools, collaboration, or research

(ii) establish a preliminary set of ideas for a research question or questions using organizational tools, collaboration, or research

(B) perform a literature review and evaluate several examples related to the project;

(i) perform a literature review related to the project

(ii) evaluate several examples [of literature] related to the project

(C) refine a research question by interacting with professionals in the field of study and document the conversations;

(i) refine a research question by interacting with professionals in the field of study

(ii) document the conversations [related to a research question in the field of study]

(D) distinguish between descriptive, comparative, or experimental research design methodologies;

(i) distinguish between descriptive, comparative, or experimental research design methodologies

(E) develop a research question or questions that are testable and measurable;

(i) develop a research question or questions that are testable

(ii) develop a research question or questions that are measurable

(F) justify in writing the significance and feasibility of the project;

(i) justify in writing the significance of the project

(ii) justify in writing the feasibility of the project

(G) generate a materials list and propose a cost analysis; and

(i) generate a materials list [for a proposal that centers around a scientific or engineering topic or problem within a specific program of study or area of interest]

(ii) propose a cost analysis [for a proposal that centers around a scientific or engineering topic or problem within a specific program of study or area of interest]

(H) use the citation style appropriate to the field of study throughout the documentation.

(i) use the citation style appropriate to the field of study throughout the documentation

(6) The student formulates hypotheses to guide experimentation and data collection independently or in a team that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) perform background research on the selected investigative problem;

(i) perform background research on the selected investigative problem

(B) examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses; and

(i) examine hypotheses generated to guide a research process by evaluating the merits of the hypotheses

(ii) examine hypotheses generated to guide a research process by evaluating the feasibility of the hypotheses

(C) identify the control, independent variable, and dependent variables within the research and justify the purpose of each.

(i) identify the control within the research

(ii) identify the independent variable within the research

(iii) identify the dependent variables within the research

(iv) justify the purpose of [the control]

(v) justify the purpose of [the independent variable]

(vi) justify the purpose of [the dependent variables]

(7) The student develops, implements, and collects data for their investigative designs that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) write the procedure of the experimental design, including a schematic of the lab, materials, set up, ethical considerations, and safety protocols;

(i) write the procedure of the experimental design, including a schematic of the lab

(ii) write the procedure of the experimental design, including [the] materials

(iii) write the procedure of the experimental design, including set up

(iv) write the procedure of the experimental design, including ethical considerations

(v) write the procedure of the experimental design, including safety protocols

(B) conduct the experiment with the independent and dependent variables;

(i) conduct the experiment with the independent variables

(ii) conduct the experiment with dependent variables

(C) acquire data using appropriate equipment and technology; and

(i) acquire data using appropriate equipment

(ii) acquire data using appropriate technology

(D) record observations as they occur within an investigation, including qualitative and quantitative observations such as journals, photographic evidence, logs, tables, and charts.

(i) record observations as they occur within an investigation, including qualitative observations

(ii) record observations as they occur within an investigation, including quantitative observations

(8) The student organizes and evaluates qualitative and quantitative data obtained through experimentation that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) manipulate data by constructing charts, data tables, or graphs using technology to organize information collected in an experiment;

(i) manipulate data by constructing charts, data tables, or graphs using technology to organize information collected in an experiment

(B) identify sources of random error and systematic error and differentiate between both types of error;

(i) identify sources of random error

(ii) identify sources of systematic error

(iii) differentiate between both types [random and systematic] of error

(C) report error of a set of measured data in various formats such as standard deviation and percent error; and

(i) report error of a set of measured data in various formats

(D) analyze data using statistical methods to recognize patterns, trends, and proportional relationships.

(i) analyze data using statistical methods to recognize patterns

(ii) analyze data using statistical methods to recognize trends

(iii) analyze data using statistical methods to recognize proportional relationships

(9) The student knows how to synthesize valid conclusions from qualitative and quantitative data that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) justify conclusions that are supported by research data;

(i) justify conclusions that are supported by research data

(B) consider and summarize alternative explanations for observations and results; and

(i) consider alternative explanations for observations

(ii) consider alternative explanations for results

(iii) summarize alternative explanations for observations

(iv) summarize alternative explanations for results

(C) identify limitations within the research process and provide recommendations for additional research.

(i) identify limitations within the research process

(ii) provide recommendations for additional research

(10) The student communicates clearly and concisely to an audience of professionals conclusions that center around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) develop a plan of action on how to present to a target audience;

(i) develop a plan of action on how to present to a target audience

(B) review artifacts used in the communication of the presentation for errors, grammar, professional standards, and citations;

(i) review artifacts used in the communication of the presentation for errors

(ii) review artifacts used in the communication of the presentation for grammar

(iii) review artifacts used in the communication of the presentation for professional standards

(iv) review artifacts used in the communication of the presentation for citations

(C) develop a professional collection or portfolio of work that includes artifacts such as a journal, proposal, written procedures, methodology, iterations, interviews and check ins with professionals, changes within the experiment, and photographic evidence;

(i) develop a professional collection or portfolio of work that includes artifacts

(D) practice a professional presentation with peers and educators using a rubric to measure content, skill, and performance;

(i) practice a professional presentation with peers using a rubric to measure content

(ii) practice a professional presentation with peers using a rubric to measure skill

(iii) practice a professional presentation with peers using a rubric to measure performance

(iv) practice a professional presentation with educators using a rubric to measure content

(v) practice a professional presentation with educators using a rubric to measure skill

(vi) practice a professional presentation with educators using a rubric to measure performance

(E) incorporate feedback provided by a review panel to document for future improvements or changes; and

(i) incorporate feedback provided by a review panel to document for future improvements or changes

(F) communicate data analysis and experimental results of original findings of a research project clearly to an audience of professionals.

(i) communicate data analysis of original findings of a research project clearly to an audience of professionals

(ii) communicate experimental results of original findings of a research project clearly to an audience of professionals