

Technical Science

SWTC - Southwest Wisconsin Technical College

Information

Course Number	10-806-106
Credits	2
Contact Hours	54
Instructional Area	Science
Instructional Level	Associate Degree
Division	General Education
Developer(s)	John Pluemer

Description

Technical Science is divided into three units: 1. Scientific Tools and Methods, 2. Introduction to Chemistry, 3. Introduction to Physics. Upon completion of unit 1, students convert measurements, design tables and graphs, create models, and use the scientific method. In unit 2, students interpret a model of the atom and use the periodic table. They distinguish physical, chemical, and nuclear changes and identify properties of common compounds. They analyze chemical equations and relate technical applications to chemical properties. In unit 3, students determine the effect of force on linear motion, analyze various physical phenomena, and analyze the various forms of energy.

Goals

1. Convert measurements
2. Create tables and graphs to organize and present data
3. Create a model to illustrate a complex event or object
4. Use the Scientific Method to investigate a problem
5. Interpret a model of an atom
6. Use the Periodic Table to identify atomic, physical, and chemical properties of elements
7. Distinguish between physical, chemical, and nuclear changes
8. Determine chemical properties of basic compounds
9. Analyze a chemical equation
10. Relate technical applications to chemical or physical properties
11. Interpret types of rates
12. Determine the effect of force on linear motion
13. Analyze the relationship of physical phenomena
14. Analyze forms of energy (nuclear, electromagnetic, chemical)
15. Analyze forms of energy (thermal, mechanical, electric)

Prerequisites

1. None

Textbooks

John Pluemer. *Technical Science*. Publisher: Southwest Wisconsin Technical College

Supplies

Scientific Calculator

Core Abilities

- A. Communicate Clearly

Competencies and Performance Standards

1. Convert measurements to required accuracy

Performance Standards

Conditions - Competence will be demonstrated:

- o using a table of conversion factors
- o Using a scientific calculator
- o by completion of a quiz

Criteria - Performance will be satisfactory when:

- o Definitions match text and/or lecture
- o learner shows work using conversion factor method for English - Metric and English - English conversions
- o calculation includes correct units
- o calculation show cancellation of units
- o calculation shows correct numerical value

Learning objectives

What you will learn as you master the competency:

- a. Define qualitative and quantitative observations
- b. Distinguish between accuracy and precision
- c. Identify appropriate unit for desired measurement
- d. Make basic measurements of length, mass, and capacity
- e. identify relative sizes of various units
- f. Move decimal point to convert within metric system
- g. Use conversion factor method to convert English to metric or English to English
- h. Convert numbers from standard form to scientific notation and vice versa
- i. Interpret appropriate multidimensional units (Area, Volume, Density, etc.)

- j. Convert multidimensional units using conversion factor method

2. Create tables and graphs

Performance Standards

Conditions - Competence will be demonstrated:

- o by creation of a graph and/ or table
- o given a set of data to organize
- o on a quiz

Criteria - Performance will be satisfactory when:

- o Table or graph has a title
- o Table or graph has appropriate categories
- o Table or graph has relevant data in appropriate categories
- o Table or graph fits purpose of the presentation
- o Table or graph is labeled
- o learner can make inferences based on given table or graph

Learning objectives

What you will learn as you master the competency:

- a. Organize data into a classification scheme
- b. List the purpose of a table
- c. List the purpose of a graph
- d. Identify the best uses of a circle, bar, and line graph
- e. extract information from a table or graph (literal and inferential)
- f. Create tables and graphs

3. Create a model

Performance Standards

Conditions - Competence will be demonstrated:

- o by the creation of a model
- o given a scenario containing several variables
- o in a quiz

Criteria - Performance will be satisfactory when:

- o Model is consistent with the given information
- o Model can be used to make predictions about the event or object
- o Model is clearly presented (labeled, diagrammed, etc)

Learning objectives

What you will learn as you master the competency:

- a. Define the purpose of a model
- b. Identify examples of models
- c. Use a model to make predictions about an object or event

- d. Create a model

4. Use the scientific method

Performance Standards

Conditions - Competence will be demonstrated:

- o given an initial description of a problem
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner defines the problem
- o learner develops a hypothesis consistent with the problem
- o learner explains experimental and control procedure (for one variable)
- o learner draws valid conclusions
- o learner collects, organizes, and presents data so it can be easily interpreted

Learning objectives

What you will learn as you master the competency:

- a. Define the purpose of the scientific method
- b. Explain the steps of the scientific method
- c. Describe the reasons for working with only one variable at a time
- d. Explain the importance of a control procedure

5. Interpret a model of an atom

Performance Standards

Conditions - Competence will be demonstrated:

- o using appropriate models of an atom
- o without the use of notes
- o on a quiz

Criteria - Performance will be satisfactory when:

- o learner identifies three subatomic particles (protons, neutrons, and electrons)
- o learner accurately determines the charge, mass, and location of the subatomic particles
- o learner accurately relates relative number of particles in an unreacted atom
- o learner differentiates between an electron's energy level and orbital according to the text
- o learner accurately relates number of particles to atomic number, atomic mass, element, isotope, and ion

Learning objectives

What you will learn as you master the competency:

- a. Identify subatomic particles
- b. Determine charge, mass, and location of the subatomic particles
- c. Relate relative numbers of particles in an unreacted atom
- d. Define atomic number, atomic mass, element, isotope, and ion

- e. Differentiate between an electron's energy level and orbital

6. Use the Periodic Table

Performance Standards

Conditions - Competence will be demonstrated:

- o using a periodic table
- o without the use of notes
- o on a quiz

Criteria - Performance will be satisfactory when:

- o learner identifies at least three metals, nonmetals, and noble gases
- o learner lists numbers of subatomic particles for any atom
- o learner writes an electron configuration for elements 1 - 20
- o learner accurately describes how atoms in groups 1,2,6,7,8 generally react
- o learner identifies relative reactivity of groups 1,2,6,7,8

Learning objectives

What you will learn as you master the competency:

- Identify elements by symbol, atomic number, atomic mass
- Compare electron configuration to the structure of the Periodic Table
- Explain why atoms gain or lose electrons
- Identify metal, nonmetals, and noble gases
- Explain relationship between chemical properties and electron configuration.

7. Distinguish between physical, nuclear, and chemical changes

Performance Standards

Conditions - Competence will be demonstrated:

- o Without the use of notes
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner correctly classifies changes as physical, chemical, or nuclear
- o learner identifies at least two examples of physical, chemical, and nuclear changes
- o learner explains what happens to the structure of the atom during a physical, chemical, or nuclear change according to the text
- o learner accurately differentiates between a compound and a mixture

Learning objectives

What you will learn as you master the competency:

- Identify types of physical changes
- Identify types of chemical changes
- Identify types of nuclear changes
- explain what happens to the structure of the atom during a physical, chemical or nuclear change

8. Determine chemical properties of basic compounds

Performance Standards

Conditions - Competence will be demonstrated:

- o with the use of a periodic table
- o with the use of a table of electronegativities
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner describes the formation of an ionic and a covalent bond according to text and/or lecture
- o learner correctly determines which compounds are ionic and which are covalent using electronegativity
- o learner accurately determines charge of ions within a compound
- o learner accurately classifies compounds as acids, bases, salts, and nonmetal compounds
- o learner determines the correct formula of a compound given the name

Learning objectives

What you will learn as you master the competency:

- a. Define ionic bonds
- b. Define covalent bonds
- c. Define electronegativity
- d. Determine which type of bond will form
- e. Explain why compounds form in specific ratios
- f. Write the formula for a compound
- g. Determine the charge on ions that compose a compound

9. Analyze a chemical equation

Performance Standards

Conditions - Competence will be demonstrated:

- o using a periodic table
- o given the amount in grams of one reactant or product in the equation
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner clearly differentiates between coefficients and subscripts
- o learner determines if an equation is balanced
- o learner explains one reason for balancing equations

Learning objectives

What you will learn as you master the competency:

- a. Describe the meaning of subscripts and coefficients in a chemical equation.
- b. Determine if an equation is balanced
- c. Explain the purpose of balancing an equation

10. Relate technical applications to chemical or physical properties

Performance Standards

Conditions - Competence will be demonstrated:

- o in a 2 page report

Criteria - Performance will be satisfactory when:

- o learner explains the common function and/or use of a chemical compound
- o learner explains the chemical properties responsible for the compounds function and/or use
- o report contains correct grammar and spelling
- o report contains at least two references
- o report is original

Learning objectives

What you will learn as you master the competency:

- a. describe some chemical properties of water
- b. describe some chemical properties of metals
- c. describe some chemical properties of salts
- d. describe some chemical properties of nonmetals
- e. describe some chemical properties of acids and bases
- f. describe some chemical properties of organic compounds

11. Interpret types of rates

Performance Standards

Conditions - Competence will be demonstrated:

- o with the use of conversion factor table
- o using a scientific calculator
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner defines speed, velocity and acceleration according to text and/or lecture
- o learner chooses appropriate formula
- o learner shows steps used to solve the problem
- o learner shows cancellation of units
- o answer includes correct units of measure
- o answer is accurate within 1% of actual value

Learning objectives

What you will learn as you master the competency:

- a. Define verbally physical phenomena of rate (ie speed, velocity, and acceleration)
- b. Calculate speed and acceleration
- c. Manipulate mathematical formulas of rate, speed, acceleration to solve for another variable
- d. Use cancellation of units to identify correct units

- e. Use formulas for rate to solve application problems

12. Determine the effect of force on linear motion

Performance Standards

Conditions for assessment:

- o using a scientific calculator
- o in a quiz

Criteria - Performance will be satisfactory when:

- o definitions match the text and/or lecture
- o learner chooses appropriate formula
- o learner shows steps used to solve the problem
- o learner shows cancelation of units
- o answer includes correct units of measure
- o answer is accurate within 1% of actual value

Learning objectives

What you will learn as you master the competency:

- a. Explain Newton's First Law of Motion
- b. Define momentum and inertia
- c. Determine the factors that effect momentum and inertia
- d. Explain Newton's Second Law of Motion
- e. Define force
- f. Differentiate among mass, force, and weight
- g. Calculate force given mass and acceleration
- h. Manipulate the formula $F = MA$ to solve for other variables
- i. Use the formulas for force and rate to solve application problems
- j. Explain Newton's Third Law of Motion

13. Analyze the relationship of physical phenomena

Performance Standards

Conditions for assessment:

- o using a scientific calculator
- o in a quiz

Criteria - Performance will be satisfactory when:

- o definitions match the text and/or lecture
- o learner chooses appropriate formula
- o learner shows steps used to solve the problem
- o learner shows cancelation of units
- o answer includes correct units of measure
- o answer is accurate within 1% of actual value

Learning objectives

What you will learn as you master the competency:

- a. Define work including appropriate units
- b. Use the work formula ($W = F \cdot D$) to solve for any variable
- c. Define resistance
- d. Identify the components of frictional resistance
- e. Calculate resistance due to gravity
- f. Define power including appropriate units
- g. Use the power formula ($P = W/T$) to solve for any variable
- h. Define energy
- i. Relate the calculation of work to energy
- j. Distinguish between potential and kinetic energy
- k. Solve application problems involving work, power, resistance, and energy

14. Analyze forms of energy (nuclear, electromagnetic, chemical)

Performance Standards

Conditions - Competence will be demonstrated:

- o given various reference charts and graphs
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner identifies types of energy
- o learner identifies appropriate uses for types of energy
- o definitions match text and/or lecture
- o learner clearly explains that energy is conserved in quantity but not in quality
- o learner clearly explains that energy flows and matter cycles

Learning objectives

What you will learn as you master the competency:

- a. Describe six forms of energy (nuclear, electromagnetic, chemical, thermal, mechanical, and electrical)
- b. Explain the Law of Conservation of Energy and Matter
- c. Define entropy
- d. Describe the properties of electromagnetic waves
- e. Explain the flow of energy from plants to animals
- f. Describe uses for chemical energy
- g. Apply entropy and Law of Conservation of Matter and Energy to transformations between the six forms of energy

15. Analyze forms of energy (thermal, mechanical, electrical)

Performance Standards

Conditions for assessment:

- o given various reference charts and graphs
- o in a quiz

Criteria - Performance will be satisfactory when:

- o learner identifies types of energy
- o learner identifies appropriate uses for types of energy
- o definitions match text and/or lecture
- o learner chooses an appropriate formula
- o learner shows steps used to solve a problem
- o calculation is accurate to within 1%
- o calculations include appropriate units

Learning objectives

What you will learn as you master the competency:

- a. Review conversions of Celsius, Fahrenheit, and Kelvin temperatures
- b. Differentiate between temperature and thermal energy
- c. Describe specific heat
- d. Describe factors that effect heat transfer
- e. Calculate heat transfer
- f. Explain uses of machines (change direction of force, modify the work equation, or do work faster)
- g. Solve application problems involving simple machines
- h. Define properties of electrical energy (voltage, amperage, resistance, power, and energy)
- i. Distinguish between direct and alternating current
- j. Distinguish between series and parallel circuits
- k. Solve simple problems involving the formulas $E = I \cdot R$ and $P = E \cdot I$