Massachusetts Career Technical Education

Biotechnology Framework

2014

DESE is in the process of updating all CTE Frameworks. This framework was adopted in 2014. More information about the process to update frameworks will be provided in DESE’s CCTE Newsletter.

# [Strand 2: Technical Knowledge and Skills](#_bookmark0)

###### Safety in the Biotechnology Laboratory

* + 1. Complete and obtain a 10-hour OSHA certification
			1. Complete the requirements of OSHA 10 hour certification course and receive a course completion card.
		2. Performance Example:
			- Complete 10hr OSHA certification course.
		3. Complete and obtain a CPR and First Aid Training card/credential.
			1. Complete American Red Cross or American Heart Association Heart saver First Aid and CPR AED certification and receive a course completion card.

2.A.02 Performance Example:

* Complete First Aid and CPR AED Training
	+ 1. Follow safety and emergency procedures according to OSHA standards.
			1. Practice work habits that provide personal safety, safety for others, and protect the safety and security of the external environment.
			2. Select and use appropriate personal protective equipment at all times.
			3. Maintain a sanitary and clutter-free work environment.
			4. Monitor, use, store, and dispose of materials according to established procedures.

2.A.03 Performance Example:

* Students will use PPE at all times when working in the lab .according to OSHA standards.
* Students will wipe down work areas with 70% ethanol or a freshly prepared 1/10 dilution of bleach prior to and after working with bacteria.

###### Basic Biotechnology Knowledge and Skills

* + 1. Demonstrate knowledge of biotechnology industry fundamentals.
			1. Describe the major application areas of biotechnology and their products.
			2. Describe the life cycle of products (e.g., research and development to production).
			3. Describe the organizational structures of biotechnology companies.
			4. Summarize the historical development of biotechnology.
			5. Describe the social, legal, and ethical issues that affect the application of biotechnology.
			6. Use and interpret information resources relevant to biotechnology (e.g., journals, databases, website, etc.).
			7. Explain the different career paths in biotechnology and the jobs associated with them.

Demonstrate knowledge of regulatory affairs.

* + 1. Performance Example:
			- Student will analyze a teacher provided case study which addresses the moral, ethical, and medical issues surrounding the treatment of a young child suffering from a rare genetic disorder.
			- Student teams will debate the bioethical concerns surrounding the use of genetic diagnosis, stem cells, and in-vitro fertilization.
			1. Explain good documentation practices (e.g., signatures, dating, use of indelible ink, witnessing requirements).
			2. Explain the history of pharmaceutical regulations and the Food and Drug Administration (FDA).
			3. Explain the organization of the FDA (e.g., the roles of Center for Drug Evaluation and Research (CDER) and Center for Biologics Evaluation and Research (CBER)).
			4. Explain the life cycle of medical products (e.g., discovery through clinical trials, New Drug Application (NDAs), Investigational New Drug (INDs).
			5. Explain current Good Manufacturing Practice (cGMP) and Good Laboratory Practice (GLP) regulations.
			6. Explain the regulatory agencies at the local, state and federal levels.
			7. Document assay procedures and results.
			8. Evaluate results of assays (e.g., determine amount of analyte in quantitative assay).
			9. Prepare results in written technical reports (e.g., designated report format is used, all resources are referenced, graphs and tables are clearly labeled and explained, data is accurately analyzed) and present orally.
			10. Explain the roles of the IBC and IUCAC.
			11. Explain United States Department of Agriculture (USDA) an Public Health Service (PHS) Policy on the humane care and use of laboratory animals and the roles of the American Association for Laboratory Animal Science (AALAS) and Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC).

2.B.02 Performance Example:

* Prepare a PowerPoint presentation to explain the history of the FDA.
* Document assay procedure and results in a laboratory notebook
	+ 1. Demonstrate basic lab management skills.
			1. Inventory supplies according to established procedures.
			2. Obtain required materials.
			3. Schedule work functions in an organized manner.
			4. Clean and sterilize glassware and counters according to preestablished procedures.
			5. Ensure that equipment is cleaned and maintained according to established preventative maintenance procedures.
			6. Document lab support functions using logbooks, computer systems, forms, and other methods, according to established procedures (e.g., autoclave, pH meter, incubators and freezers).

Biomanufacturing Fundamentals

2.B.03 Performance Example:

* An instructor designated student will act as a lab supervisor for the day.

The student supervisor will assign lab maintenance duties (inventorying supplies, cleaning glassware, and equipment, media prep, et cetera), verify they are completed properly and review logbook entries that document all completed tasks for the day.

* Use a logbook to document use of equipment (i.e., autoclave).
	+ 1. Demonstrate and apply manufacturing process management techniques.
			1. Identify, create and use standard operating procedures (SOPs).
			2. Explain how process control data is used to monitor processes.
			3. Test product to verify that it meets specifications and regulations.
			4. Explain biomanufacturing lean techniques as they pertain to improved efficiency, reduction of waste and increased productivity.
			5. Identify and apply the concepts of total quality management appropriate to the field.
			6. Develop a comprehensive product development plan for a biotechnology product.
		2. Performance Example:
			- Create an SOP for the operation of a piece of lab equipment.
			- Choose a biotechnology product and develop a CPDP.

###### Solution Preparation

* + 1. Perform basic calculations.
			1. Perform calculations relating to measurements.
			2. Perform calculations relating to reagent and media formulation and dilution.
			3. Perform calculations relating to data acquisition and analysis.
			4. Perform calculations relating to products, processing and quality control monitoring.
			5. Perform calculations relating to growing cells and analyzing their growth rate.
			6. Determine concentrations of solutions.
			7. Graph and interpret data using electronic spreadsheet programs.
			8. Perform calculations relating to dosage levels for animal studies (e.g., mg/kg, ml/kg).
		2. Performance Example:
			- Calculate the concentration of a copper sulfate solution.
			- Create a standard curve graph using an Excel spreadsheet.
		3. Prepare solutions.
			1. Prepare percent, molar and molal solutions.
			2. Perform dilutions and calculate resulting concentrations.
			3. Perform serial dilutions.
			4. Prepare agar plates and broths using appropriate techniques (filtration or autoclave).
			5. Label and store reagents, solutions, and media according to established procedures

2.D.02 Performance Example:

* Students will prepare 15mL of a 7.5% Copper sulfate solution.
* Students will perform four 1:10 serial dilutions of copper sulfate solutions.

###### Instrumentation and Lab Assays

* + 1. Metrology: Use measurement instrumentation.
			1. Calibrate and maintain measuring instruments (e.g., balances, pH meters, thermometers, pipettes, spectrophotometers).
			2. Make weight measurements with acceptable accuracy and precision.
			3. Make volume measurements with acceptable accuracy and precision.
			4. Make pH measurements with acceptable accuracy and precision.
			5. Make temperature measurements with acceptable accuracy and precision.
			6. Make spectrophotometric measurements with acceptable accuracy and precision.
		2. Performance Example:
			- Students will demonstrate the ability to choose and use equipment for the measurement of weight, volume, pH, temperature, wavelength and concentration.
			- Students will demonstrate the ability to calibrate and maintain equipment such as pH meters, balances, thermometers, pipettes and spectrophotometers.
		3. Use microscopes.
			1. Identify microscope parts.
			2. Demonstrate use and care of microscopes.
			3. Differentiate between the different types of microscopes and describe their uses (compound, inverted, scanning electron, fluorescent, and stereo).
			4. Prepare a wet mount slide.
			5. Prepare a slide with a cross section.
			6. Demonstrate cleaning of the microscope and lenses.
			7. Demonstrate basic cell staining techniques to observe cell morphology.
			8. Count cells using a hemocytometer.
			9. Identify and describe functions of cellular organelles.

2.E.02 Performance Example:

* Students will demonstrate how to prepare a wet mount slide.
* Students will determine the number of cells using a hemocytometer when given a prepared slide.
	+ 1. Perform standard lab assays/techniques.
			1. Isolate DNA.
			2. Determine DNA concentration and purity.
			3. Perform enzyme-linked immunoabsorbant assay (ELISA).
			4. Perform western blotting.
			5. Perform DNA fingerprinting.
			6. Perform Polymerase Chain Reaction (PCR).
			7. Perform gram staining.
			8. Determine protein concentration.
			9. Determine enzyme activity.

2.E.03 Performance Example:

* Isolate plasmid DNA from transformed bacteria and determine DNA concentration and purity using a spectrophotometer set to absorbance 260 nm for concentration and a 260/280 nm ratio to determine purity.
* Separate Bovine Serum Albumin (BSA) from a mixture of proteins using SDS polyacrylamide gel electrophoresis (SDS PAGE).
	+ 1. Perform separation techniques.
			1. Operate centrifuges.
			2. Use filtration devices and systems.
			3. Use electrophoresis systems (e.g., SDS PAGE and agarose gel electrophoresis).
			4. Use chromatography (e.g., size exclusion, affinity, HIC, ion exchange).Compare and contrast various chromatography methods. (including size exclusion, HPLC, reverse phase, affinity, HIC, ion exchange, etc.).

2.E.04 Performance Example:

* Assemble and pour size exclusion columns of various column bed depths.
* Compare and contrast various separation techniques.

###### Cell techniques

* + 1. Perform aseptic technique.
			1. Decontaminate work area prior to and after use.
			2. Dispose of waste following appropriate decontamination procedures.
			3. Maintain a sterile environment using a biological safety cabinet.
			4. Operate an autoclave and explain its use in sterile technique.
			5. Sterilize reagents, solutions, and media properly according to established procedures.
		2. Performance Example:
			- Students will decontaminate the biological safety cabinet prior to use.
			- Students will autoclave prepared media.
			- Students will filter sterilize heat–labile solutions.
		3. Maintain microorganisms.
			1. Establish clonal cultures from a colony isolation.
			2. Culture bacteria using nutrient media on sterile agar plates and in fermentation flasks and test tubes.
			3. Identify bacteria using staining techniques, growth on selective media, and DNA analysis.

2.F.02 Performance Example:

* Isolate a single colony from a plate and streak for isolation on another plate.
* Prepare a slide from an isolated bacterial colony and perform a gram stain to determine if the bacteria are Gram negative or positive.
	+ 1. Transform cells.
			1. Transform bacteria with a plasmid.
			2. Explain transformation protocols for plant, mammalian and other cells.

2.F.03 Performance Example:

* Transform Eschericia coli JM109 with a plasmid containing a gene that codes for kanamycin resistance. Plate on LB agar plates containing kanamycin.
* Write a paper (or prepare a PowerPoint) that describes techniques for transformation of plant, bacterial and mammalian cells.
	+ 1. Maintain animal cells in tissue culture.
			1. Maintain suspension and/or attached cells.
		2. Preserve cells using cryopreservation.

2.F.04 Performance Example:

* Students will prepare media for growing animal cells.
* Students will grow and maintain cells (contamination free) in culture and passage those cells as necessary.
	+ 1. Clone plants.
			1. Prepare and sterilize explants containing meristematic tissues.
			2. Place explants in appropriate growth agar.
			3. Monitor daily and record amount of time to callus, shoot, root and leaf formation; document stages of development photographically.
			4. Transfer to new media, if appropriate.
			5. Transfer the plantlet to solid potting mixture when it is large enough.

2.F.05 Performance Example:

* Cut a young leaf off an African violet plant. Sterilize the leaf by serial passage through 70% ethanol, then bleach solutions and then rinse in sterile water. Excise a piece of leaf, 0.5 cm square, that includes a portion of the vein.
* Insert the explant in sterile, shoot elongation agar such that a cut edge is wedged approximately

¼ of the way into the media.

* + 1. Use inverted microscopes to view cell cultures.

2.F.06 Performance Example:

* Use an inverted microscope to view attached and suspension tissue culture cells.
* Use an inverted microscope to count cells on a hemocytometer.
	+ 1. Determine the viability of cells in culture.

2.F.07 Performance Example:

* Treat cells with trypan blue and count live and dead cells on a hemocytometer. If cells take up the trypan blue, they are non-viable.. Determine the % of dead cells..
* Treat attached cells on a plate with trypan blue and locate non-viable areas.
	+ 1. Describe the use of cells in biotechnology (e.g., use of cells in cancer research, as factories to produce enzymes and drugs, and for regenerative medicine therapies).

2.F.08 Performance Example:

* Explain the differences between the use of bacteria and mammalian cells to produce recombinant proteins.
* Explain the use of skin grafts in burn victims.

# [Embedded Academic Crosswalks](#_bookmark0)

### [Embedded English Language Arts and Literacy](#_bookmark0)

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| CTELearning Standard Number | Strand Coding Designation Grades ELAsLearning Standard Number | Text of English Language Arts Learning Standard |
| 2.C.01.02 | W.2 | Writing—Text Types and PurposesPerformance Example:Open response/Quiz grade: Explain how process control data is used to monitor processes. |
| 2.C.01.04 | SL.4, SL.5 | Speaking and Listening-- Presentation of Knowledge and Ideas(findings), Speaking and Listening-- Presentation of Knowledge and Ideas (digital media)Performance Example:PowerPoint presentation or project |
| 2.C.01.05 | SL.5 | Speaking and Listening-- Presentation of Knowledge and Ideas (digital media).Performance Example:In a small group, create a video which demonstrates applying the concepts of total quality management appropriate to the field. |
| 2.C.01.06 | SL.5 | Speaking and Listening-- Presentation of Knowledge and Ideas (digital media).Performance Example:Choose a product and develop a comprehensive development plan for it. Present it to class, using visual aids (PowerPoint presentation, posters, etc.) |
| 2.B.02.01 | SL.1 | Speaking and Listening—Comprehension and CollaborationPerformance Example: Class discussion |
| 2.B.02.02 | W.7, SL.4 | Writing—Research to Build and Present Knowledge, Speaking and Listening-- Presentation of Knowledge and Ideas (findings),Performance Example:Research the history of pharmaceutical regulations and the FDA and share out findings. |
| 2.B.02.03 | W.7, SL.4 | Writing—Research to Build and Present Knowledge, Speaking and Listening-- Presentation of Knowledge and Ideas (findings),Performance Example:Students will research the FDA and its specific roles. Students will then role play as the different parts (ex: CDER and CBER) demonstrating how the FDA functions. |
| 2.B.02.04 | W.2, W.4 | Writing—Text Types and Purposes, Writing—Production and Distribution of WritingPerformance Example:Write an essay, which explains the life cycle of medical products |
| 2.B.02.05 | SL.4 | Speaking and Listening-- Presentation of Knowledge and Ideas (findings)Performance Example:Work with a partner and present cGMP and GLP regulations to each other. Compare and contrast with your partner and share results in class discussion. |
| 2.B.02.06 | W.2 | Writing—Text Types and PurposesPerformance Example:Write a five paragraph essay explaining the regulatory agencies at the local, state and federal levels. |
| 2.B.02.09 | W.4, SL.5 | Writing—Production and Distribution of Writing, Speaking and Listening-- Presentation of Knowledge and Ideas (digital media).Performance Example:Via PowerPoint presentation, students demonstrate accuracy in reporting results in written technical reports and orally. |
| 2.E.02.03 | W.2, W.4, SL.4 | Writing—Text Types and Purposes, Writing—Production and Distribution of Writing, Speaking and Listening-- Presentation of Knowledge and Ideas (findings).Performance Example: Short answer quiz; hands-on presentation of microscopes. |
| 2.E.02.09 | W.2, W4 | Writing—Text Types and Purposes, Writing—Production and Distribution of WritingPerformance Example:Open response writing assignment. |
| 2.F.08 | W.7, SL4 | Writing— Research to Build and Present Knowledge , Speaking and Listening-- Presentation of Knowledge and Ideas (findings),Performance Example: Research use of cells in biotechnology and create a PowerPoint presentation to share with class |

### [Embedded Mathematics](#_bookmark0)

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| CTELearningStandardNumber | Math Content Conceptual Category and Domain Code Learning Standard Number | Text of Mathematics Learning Standard |
| 2.E.02.08 | 7.RP.3 | Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase anddecrease, percent errorPerformance Example:Count the number of tissue culture cells in the four large corner squares and the middle squares combined of a hemocytometer. Take the total number of cells counted in the 5 squares and multiply by 2 to determine the total number of cells per mm^3. Multiply by 10^3 to determine the cell count/ml. Example, count 100 cells inthe 5 squares. 2 X 100 = 200 cells per mm^3 = 2 x 10^5 cells/ml. Remember to take into account any dilution performed prior to loading the hemocytometer. |
| 2.E.03.02 | 7.RP.3 | 7.RP.3 Use proportional relationships to solve multistep ratio and percentproblems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent ErrorPerformance Example:Determine the concentration of DNA using the following relationship: 1 OD 260 = 50 ug/ml double stranded DNA. Read the absorbance 280 nm to determine the amount of protein present in the sample. A ratio of OD260/OD 280 of 1.8 to 2.0 indicates the preparation is pure. If the ratio is less than 1.8 the DNA is contaminated and may require further purification. |

### [Embedded Science and Technology/Engineering](#_bookmark0)

#### [Life Science (Biology)](#_bookmark0)

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| CTELearning Standard Number | Subject Area, Topic Heading andLearning Standard Number | Text of Biology Learning Standard |
| 2.A.03.012.B.03.042.E.01.01 | SIS2: Conduct and Design Scientific Investigations | Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.Follow safety guidelines.Performance Example:Students will be able to follow lab safety guidelines and maintain safety in the laboratory area. |
| 2.E.03.09 | 1.3 The Chemistry of Life | Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, that have an effect on enzymesPerformance Example:Students will be able to determine the role of enzymes using pH and temperature as variables. |
| 2.E.01.02 | 5.NBT.4 | 5.NBT.4 Use place value understanding to round decimals to any place.Performance Example:Round weight measurement to significant digit. Example, 1.0039 grams = 1.00 g rounded to 100ths |

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| 2.E.01.03 | 5.NBT.4 | 5.NBT.4 Use place value understanding to round decimals to any place.Performance Example:Round volume measurement to significant digit. Example, 1.52 ml = 1.5 ml rounded to nearest 10th |
| 2.E.01.04 | 5.NBT.4, F-BF.5 | 5.NBT.4 Use place value understanding to round decimals to any place.F-BF.5 (+) Understand the inverse relationship between exponentsand logarithms and use this relationship to solve problems involving logarithms and exponents.Performance Example:Round PH measurement to the nearest 10th. Students will show knowledge of PH scale versus concentration of hydrogen ions in a solution. |
| 2.E.01.05 | 5.NBT.4 | 5.NBT.4 Use place value understanding to round decimals to any place.Performance Example:Measure temperature in Celsius plus or minus 1 degree |
| 2.E.01.06 | 5.NBT.4 | 5.NBT.4 Use place value understanding to round decimals to any place. Performance Example:Measure absorbance to the 10th position |
| 2.F.02.02 | F-BF.5 , F-IF.7.b | F-BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.F-IF.7.b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.Performance Example:Inoculate 5.0 ml of a bacterial overnight culture into 500 ml of nutrient media. Incubate on a shaker at the appropriate temperature. Record absorbance at OD 600 at 30 minute intervals (include 0 minute time point).Graph the result. Identify lag, log, stationary and death phases. Determine cell doubling time using the graph. |
| 2.D.01.01 | 6.RP.3.c, 7.RP.3, F-LE.1.c,4.MD.1 | 6.RP.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. |
|  |  | 7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent errorF-LE-1.c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in.Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Determine the population doubling time of an animal cell in tissue culture. |
| 2.D.01.02 | 6.RP.3.c, 7.RP.3, 4.MD.1 | 6.RP.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in.Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Change a solution concentration reported as mass per volume to a percentage. |
| 2.D.01.03 | 8.EE.5, 8.SP.3, S-ID.7 | 8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. |
|  |  | 4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in.Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Perform a bacterial growth curve and report the equation for the linear relationship of log phase growth. Determine rate of change. |
| 2.D.01.04 | 4.MD.1 | 4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Express product concentration in ug/ul, mg/ml, kg/l and choose the appropriate units for your product. |
| 2.D.01.05 | 8.EE.4 | 8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very smallquantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.Performance Example:Report seeding of animal cells and absolute numbers of cells at various times using scientific notation. |
| 2.D.01.06 | 4.MD.1 | 4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in.Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Perform a protein assay and report concentration using appropriate units. |
| 2.D.02.01 | 6.RP.3.c, 7.RP.3, 4.MD.1 | 6.RP.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error4.MD.1 Know relative sizes of measurement units within one systemof units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger |
|  |  | unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in.Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3,36), …Performance Example:Prepare 100 ml of 0.5 M sodium chloride. |
| 2.E.02.08 | 2.8 Cell Biology | Compare and contrast a virus and a cell in terms of genetic material and reproductionPerformance Example:Students will be able to compare and contrast viruses and cells in relation to their use in Biotechnology. |
| 2.E.03.02 | 3.1 Genetics | Describe the basic structure (double helix, sugar/phosphate backbone, linked by complementary nucleotide pairs) of DNA, and describe its function in genetic inheritance.Performance Example:Students will be able to determine the various components of DNA. |

#### [Physical Science (Chemistry)](#_bookmark0)

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| CTELearning Standard Number | Subject Area, Topic Heading andLearning Standard Number | Text of Chemistry Learning Standard |
| 2.D.01.062.D.02.02 | 7.2 Solutions, Rates of Reaction and Equilibrium | Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometryPerformance Example:Students will be able to perform calculations using solution concentration, molarity and molality. |
| 2.A.03.022.B.03.042.E.01.01 | SIS2 | Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.Follow safety guidelinesPerformance Example:Students will be able to follow lab safety guidelines and maintain safety in the laboratory area |

[Industry Recognized Credentials](#_bookmark0) (Licenses and Certifications/Specialty Programs)

OSHA 10hr [www.osha10hourtraining.com](http://www.osha10hourtraining.com/) CPR AED certification