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| CENTRAL FLORIDA ASSESSMENT COLLABORATIVE |
| Individual Test Item Specifications |
| Forensic Science 2 |
| 2014 |

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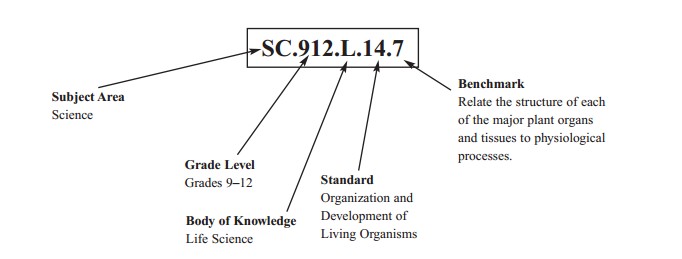
I. Guide to the Individual Benchmark Specifications

Content specific guidelines are given in the *Individual Benchmark Specifications* for each course. The *Specifications* contains specific information about the alignment of items with the NGSSS and the Florida Standards. It identifies the manner in which each benchmark is assessed, provides content limits and stimulus attributes for each benchmark, and gives specific information about content, item types, and response attributes.

## Benchmark Classification System

Each NGSSS benchmark is labeled with a system of letters and numbers.

* The two letters in the *first position* of the label identify the **Subject Area**.
* The number(s) in the *second position* represents the **Grade Level**.
* The letter in the *third position* represents the **Strand** or **Body of Knowledge.**
* The number in the *fourth position* represents the **Standard**.
* The number in the *last position* identifies the specific **Benchmark**.



Each MAFS benchmark is labeled with a system of letters and numbers.

* The four letters in the *first position* of the label identify the **Subject**.
* The number(s) in the *second position* represents the **Grade Level**.
* The letter(s) in the *third position* represents the **Category**.
* The number in the *fourth position* shows the **Domain**.
* The number in the *fifth position* identifies the **Cluster**.
* The number in the *last position* identifies the specific **Benchmark**.



**Definitions of Benchmark Specifications**

The *Individual Benchmark Specifications* provides standard-specific guidance for assessment item development for CFAC item banks. The following information is provided for each benchmark assessed.

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| **Reporting Category** | is a grouping of related benchmarks that can be used to summarize and report achievement. |
| **Standard** | refers to the standard statement presented in the NGSSS or in the Florida Standards. |
| **Benchmark**  **Also Assesses** | refers to the benchmark statement presented in the NGSSS or standard statement in the Florida Standards. In some cases, two or more related benchmarks are grouped together because the assessment of one benchmark addresses another benchmark. Such groupings are indicated in the Also Assesses statement.  refers to the benchmarks that are closely related to the benchmark (see description above) |
| **Item Types**  **Cognitive**  **Complexity** | are used to assess the benchmark or group of benchmark.  ideal level at which item should be assessed. |
| **Benchmark Clarifications** | explain how achievement of the benchmark will be demonstrated by students. In other words, the clarification statements explain what the student will do when responding to questions. |
| **Content Limits** | define the range of content knowledge and that should be assessed in the items for the benchmark. |
| **Stimulus Attributes** | define the types of stimulus materials that should be used in the items, including the appropriate use of graphic materials and item context or content. |
| **Response Attributes**  **Content Focus** | define the characteristics of the answers that a student must choose or provide.  defines the content measured by each test item. Content focus addresses the broad content and skills associated with the examples found in the standards, benchmarks, or benchmark clarifications. |
| **Sample Items** | are provided for each type of question assessed. The Correct Answer for all sample items is provided. |

# II. Individual Benchmark Specifications

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| **Reporting Category** | Physics |
| **Standard** | Earth in Space & Time |
| **Benchmark Number** | SC.912.E.5.8 |
| **Benchmark** | Connect the concepts of radiation and the electromagnetic spectrum to the use of historical and newly-developed observational tools. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | The student will be able to demonstrate knowledge of applications and the development of forensic techniques based on concepts of radiation and electromagnetic properties. |
| **Content Limits** | Specific technical details of methodologies are not assessed.  The appropriate applications of said methods are assessed. |
| **Stimulus Attributes** | Forensic case scenario, data table, graph, chart |
| **Response Attributes** | Answer choices may include how electromagnetic radiation (EM spectrum) can be used to locate, collect, observe and analyze forensic evidence. Metric units are used for wavelength (m, cm, etc.) and frequency (Hz). |
| **Sample Item** | A forensic scientist needs to determine whether or not a fragment of a bullet  recovered from the body of a victim matches a spent bullet found near the crime scene.  Which of the following methods would be best to accomplish this task?   1. Carbon-14 dating 2. Neutron activation analysis 3. Positron emission tomography analysis 4. X-ray diffraction analysis   Correct Answer: D |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.6 |
| **Benchmark** | Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to explain/identify how genetic factors, environmental factors or pathogenic agents cause diseases. |
| **Content Limits** | This item does not require students to identify specific modes of communication between the cells of the immune system.  This item does not require students to identify or explain detailed methods of immunity development. |
| **Stimulus Attributes** | Graphics, illustrations, diagrams |
| **Response Attributes** | Genetic factors, environmental factors, and/or pathogenic agents answer choices are applicable to forensic science. |
| **Sample Item** | For which of the following conditions would an individual **not** have a heterozygous advantage?  A) Cystic fibrosis  B) Down Syndrome  C) Sickle-cell disease  D) Tay-Sachs disease  Correct Answer: B |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.13 |
| **Benchmark** | Distinguish between bones of the axial skeleton and the appendicular skeleton. |
| **Also Assesses** | SC.912.L.14.14 |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | The student will be able to identify bones of the axial skeleton and appendicular skeleton. |
| **Content Limits** | Items will assess the major bones of the axial skeleton and the appendicular  skeleton. |
| **Stimulus Attributes** | Graph, diagram, illustration, chart |
| **Response Attributes** | Correct answer choice reveals that the student can distinguish between the axial\  and appendicular skeleton. |
| **Sample Item** | The coroner is examining a human bone that contains an impression. She  describes the bone as being part of the axial skeletal system.  Which of the following bones could you conclude the coroner is examining?    A)  clavicle  B)  femur  C)  skull  D)  tibia  Correct Answer: C |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.15 |
| **Benchmark** | Identify major markings (such as foramina, fossae, tubercles, etc.) on a skeleton.  Explain why these markings are important. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to identify major markings on a skeleton.  Students will be able to explain why these marking are important, such as  foramen allowing blood vessels and nerves to pass, projections allowing for  muscle attachment, and various shapes allowing for articulation such as condyles  fitting into fossae. |
| **Content Limits** | Items will assess the major markings relevant to the skeleton. |
| **Stimulus Attributes** | Drawings, illustrations |
| **Response Attributes** | Answer choices will allow students to demonstrate their ability to identify and  explain markings on normal human bone. |

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| **Sample Item** | Skeletal remains recovered from a shallow grave were sent to the forensic  pathology lab for examination. According to the report, the epiphysis of the  femur was completely fused.  What can be concluded about the victim?   1. The victim is a male. 2. The victim was most likely an adult. 3. The victim died of blunt force trauma. 4. The victim’s body was subjected to high temperatures.   Correct answer: B |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.16 |
| **Benchmark** | Describe the anatomy and histology, including ultrastructure, of muscle tissue. |
| **Also Assesses** | SC.912.L.14.11 |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to describe the infrastructure, anatomy and histology of  muscle tissue. |
| **Content Limits** | This item is limited to anatomy and histology used in forensics. |
| **Stimulus Attributes** | Diagram, model |
| **Response Attributes** | Answer choices will reveal that the student can explain/describe anatomy and/or  histology as applied to forensic science. |
| **Sample Item** | A tissue sample was submitted to the lab for microscopic examination. The  forensic pathologist noted the following characteristics: 1) the cells are striated  and 2) the cells are multinucleated.  What is the tissue sample?   1. Cardiac muscle 2. Involuntary muscle 3. Skeletal muscle 4. Smooth muscle   Correct Answer: C |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.36 |
| **Benchmark** | Describe the factors affecting blood flow through the cardiovascular system. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to identify factors that affect blood flow and/or describe how these factors affect blood flow through the cardiovascular system. |
| **Content Limits** | Items may address factors such as blood pressure, blood volume, resistance, disease, and exercise. |
| **Stimulus Attributes** | Diagram, model, narrative stem |
| **Response Attributes** | Specific heart disease scenarios will be presented.  Students will describe in short response how blood flow is affected. |

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| **Sample Item** | A medical examiner determines upon autopsy that the deceased suffered from atherosclerosis, a condition that occurs when fats, especially cholesterol, accumulate in the lining of arteries. Explain the relationship between too much cholesterol, plaque and how blood flow is eventually affected.  **Sample Answer:**  Too much cholesterol produces fatty deposits called plaque. As plaque increase in size, it fills more and more of the artery, eventually affecting blood flow.  **Rubric:**   |  | | --- | | **2 Points:**   * The response indicates that the student has a **complete understanding** of the concept embodied in the task. * The student has provided a response that is accurate, complete, and fulfills all the requirements of the task. * Necessary support and/or examples are included, and the information given is clearly text-based. | | **1 Point:**   * The response indicates that the student has a **partial understanding** of the concept embodied in the task. * The student has provided a response that includes information that is essentially correct and text-based but the information is too general or too simplistic. * Some of the support and/or examples may be incomplete or omitted. | | **0 Points:**   * The response indicates that the student **does not demonstrate** and understanding of the reading concept embodied in the task. * The student has provided a response that is inaccurate or contains only irrelevant text-based information. * The response has an insufficient amount of information to determine the student’s understanding of the task or the student has failed to respond to the task. | |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.43 |
| **Benchmark** | Describe the histology of the respiratory system. |
| **Also Assesses** | SC.912.L.14.44 |
| **Item Types** | Multiple choice, short answer |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to explain the histology of the human respiratory system. |
| **Content Limits** | Items should assess the microscopic anatomy of cells and tissues in the  respiratory system. |
| **Stimulus Attributes** | Diagrams, illustrations |
| **Response Attributes** | Answer choices will involve the microscopic identity and description of  respiratory cells and/or tissue as applied to forensic science. |

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| **Sample Item** | A charred body is discovered during the investigation of a house fire. An  anonymous tip to the police suggested the victim had been murdered and the fire  set to conceal the crime. Upon examination, the pathologist noted black deposits  on the lining of the trachea and the lung mucosa. Explain the significance of  these findings.  **Sample Answer:**  The victim inhaled smoke from the fire. Had the victim been killed and a fire  started to cover up the crime, there would have been no black deposits in the  lungs.  **Rubric:**   |  | | --- | | **2 Points:**   * The response indicates that the student has a **complete understanding** of the concept embodied in the task. * The student has provided a response that is accurate, complete, and fulfills all the requirements of the task. * Necessary support and/or examples are included, and the information given is clearly text-based. | | **1 Point:**   * The response indicates that the student has a **partial understanding** of the concept embodied in the task. * The student has provided a response that includes information that is essentially correct and text-based but the information is too general or too simplistic. * Some of the support and/or examples may be incomplete or omitted. | | **0 Points:**   * The response indicates that the student **does not demonstrate** and understanding of the reading concept embodied in the task. * The student has provided a response that is inaccurate or contains only irrelevant text-based information. * The response has an insufficient amount of information to determine the student’s understanding of the task or the student has failed to respond to the task. | |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.44 |
| **Benchmark** | Describe the physiology of the respiratory system including the mechanisms of  ventilation, gas exchange, gas transport and the mechanisms that control the rate  of ventilation. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to identify parts of the respiratory system, either  structurally or functionally.  Students will be able to describe the process of ventilation (breathing). |
| **Content Limits** | Identification items are limited to nose, pharynx, larynx, trachea, bronchi, lungs, bronchi, bronchioles, alveolar ducts, alveolar sacs, and alveoli.    Items addressing ventilation may reference Boyle's law but may not assess Boyle's law in isolation.  Items addressing gas exchange may reference Dalton's Law and Henry's Law but may not address those items in isolation.  Items identifying structure may be diagram-based.  Items identifying function may or may not be diagram-based. |
| **Stimulus Attributes** | Diagram, model |
| **Response Attributes** | Answer choices refer to different methods of ventilation seen among the  different animal groups. Only one choice refers to the animal group in question. |

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| **Sample Item** | When carbon dioxide levels in the blood rise, how does the brain of a mammal  initiate pulmonary ventilation?   1. Stimulate alveoli to grow larger. 2. Stimulating the air sacs to compress decreasing blood volume. 3. Stimulating the diaphragm to contract increasing lung volume. 4. Stimulating the muscles of the pharynx to create a positive pressure.     Correct Answer: C |

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| **Reporting Category** | Life Science |
| **Standard** | Organization & Development of Living Organisms |
| **Benchmark Number** | SC.912.L.14.46 |
| **Benchmark** | Describe the physiology of the digestive system, including mechanical digestion,  chemical digestion, absorption and the neural and hormonal mechanisms of  control. |
| **Also Assesses** | SC.912.L.18.6; SC.912.L.18.8; SC.912.L.18.11; SC.912.L.18.2; SC.912.L.18.3 |
| **Item Types** | Multiple choice, short answer |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to describe how (honors: and why) mechanical and  chemical digestion takes place within the organs of the digestive system.  Students will be able to describe how (honors: add why) absorption takes place  within the organs of the digestive system. Honors: this description will include  when/where major macromolecules are extracted. This description will include  when/where nutrients are absorbed. This benchmark will also include the  anatomy of the digestive system. |
| **Content Limits** | Items may assess mechanical digestion, chemical digestion, absorption, and/or  neural and hormonal mechanisms of control. The physiology of the digestive  system will be applied to forensic scenarios. |
| **Stimulus Attributes** | Diagrams and illustrations may be used. |
| **Response Attributes** | Students answer choices will require knowledge of digestive system physiology  as applied to forensic science scenarios. |

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| **Sample Item** | The stomach contents of a victim consisted of partially undigested lettuce and  pork. The police report states witnesses saw the victim alive in the local diner at  5:00pm the night the body was discovered.  Based on statements and stomach contents, what can be determined about the  death of this victim?   1. The death was accidental 2. The death was a result of choking. 3. The victim was murdered sometime after 5:00 p.m. 4. The victim died within a couple of hours after dinner.   Correct Answer: A |

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| **Reporting Category** | Life Science |
| **Standard** | Heredity & Reproduction |
| **Benchmark Number** | SC.912.L.16.11 |
| **Benchmark** | Discuss the technologies associated with forensic medicine and DNA identification, including restriction fragment length polymorphism (RFLP) analysis. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Low, moderate, high |
| **Benchmark Clarification** | Students will be able to describe and discuss the processes of preparing specimens for electrophoresis using restriction enzymes.    Students will be able to describe and discuss the process of conducting electrophoresis.  Students will be able to interpret the results of electrophoresis testing. |
| **Content Limits** | The test item is limited to those technologies and associated legal and ethical issues addressed in the normal content of forensic science. |
| **Stimulus Attributes** | Diagrams, scenarios |
| **Response Attributes** | Answer choices will test student knowledge in identifying and describing new and old technology associated with forensic medicine. |
| **Sample Item** | DNA fingerprinting has many applications in the legal world. Which of the following explains the banding pattern of a DNA fingerprint?   1. DNA is positively charged. 2. Restriction enzymes will cut DNA at restriction site. 3. Larger DNA fragments travel farther on an electrophoresis gel. 4. Smaller DNA fragments migrate farther on an electrophoresis gel.   Correct Answer: D |

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| Reporting Category | Life Science |
| Standard | Heredity & Reproduction |
| Benchmark Number | SC.912.L.16.12 |
| Benchmark | Describe how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules (DNA cloning). |
| Also Assesses | N/A |
| Item Types | Multiple Choice |
| Complexity Level | Low, moderate |
| Benchmark Clarification | The student will be able to describe how recombinant DNA is constructed using the technologies of restriction digestion, gel electrophoresis, polymerase chain reaction, ligation, and transformation.  Students will be able to recognize examples of where rDNA is used in our society. |
| Content Limits | Test items do not require specific knowledge of the apparatus used in these technologies.  Items assessing the various technologies used are limited to a conceptual understanding. |
| Stimulus Attributes | Diagram, chart, text |
| Response Attributes | Answer choices will reveal student’s ability to explain basic recombinant DNA technology. |
| Sample Item | Recombinant DNA technology is used for all of the following **except** which one?   1. Growing cultures of unknown organism. 2. Human insulin production by bacterial cells. 3. Amplification of DNA for microbe identification. 4. Inserting genes from humans or plants into bacteria or viruses.   Correct Answer: A |

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| **Reporting Category** | Life Science |
| **Standard** | Heredity & Reproduction |
| **Benchmark Number** | SC.912.L.16.3 |
| **Benchmark** | Describe the basic process of DNA replication and how it relates to the  transmission and conservation of the genetic information. |
| **Also Assesses** | SC.912.L.16.5; SC.912.L.16.4; SC.912.L.16.9 |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | The student will be able to describe the basic process of DNA replication and  how it results in a duplication and exact copy of the existing genetic  information.  Students will be able to explain DNA replication in the semi-conservative  model. Students should be able to explain the antiparallel nature of DNA. |
| **Content Limits** | The item does not require naming enzymes involved in this process or factors  that interfere with DNA replication. |
| **Stimulus Attributes** | Picture, diagram, chart, text |
| **Response Attributes** | Answer choices will reveal student’s ability to describe basic DNA replication. |
| **Sample Item** | If a specific DNA sequence is 5 'ATGCTAGAT 3' the matching DNA sequence  would be which of the following?   1. 3 ‘TACGATCTA 5’ 2. 3 ‘UACGAUCUA 5’ 3. 5 ‘ATGCTAGT 3’ 4. 5 ‘UACGAUCUA 3’   Correct Answer: A |

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| **Reporting Category** | Life Science |
| **Standard** | Interdependence |
| **Benchmark Number** | SC.912.L.17.6 |
| **Benchmark** | Compare and contrast the relationships among organisms, including predation,  parasitism, competition, commensalism, and mutualism. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | The student will be able to understand the relationship of both partners in each  relationship and be able to recognize both direct and indirect relationships.  Students will be able to determine relationships given a food web. |
| **Content Limits** | Items will not ask students to define the terms predation, parasitism,  competition, commensalism, and mutualism.  Item content may include co-evolution and symbiosis. |
| **Stimulus Attributes** | Food web / chain |
| **Response Attributes** | Student answer choices will include ways to assess student’s ability to compare  and contrast relationships in a food web/chain. |

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| **Sample Item** | The organ-pipe flowering cactus depends on bats for pollination. The bats  pollinate the cactus as they eat the fruit of the cactus. Recent studies show that  the cacti are not producing as much fruit as they used to. Bats living near these  cacti have been driven from their cave homes by local villagers.  What is the relationship between the bats and the cactus?   1. Commensalism 2. Competition 3. Mutualism 4. Predation   Correct Answer: A |

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| **Reporting Category** | Life Science |
| **Standard** | Matter & Energy Transformations |
| **Benchmark Number** | SC.912.L.18.4 |
| **Benchmark** | Describe the structures of proteins and amino acids. Explain the functions of  proteins in living organisms. Identify some reactions that amino acids  undergo. Relate the structure and function of enzymes. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice, short answer |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to understand the fundamental similarities and  differences among the major biological organic compounds, including their  basic relationships to each other in living organisms. |
| **Content Limits** | The items will not require higher level understanding of chemical principles involved with structure and properties of the organic compounds being  Assessed.  Assessment will be limited only to fundamental properties that distinguish among the various compounds. |
| **Stimulus Attributes** | Molecular structure table of properties, chart |
| **Response Attributes** | Student answer choices will include structures/functions of proteins,  enzymes and/or amino acids or chemical reactions of enzymes as applied to  forensics. |
| **Sample Item** | Explain how a mistake during transcription at the embryonic stage could  lead to a mutation, death or no change in an individual.  **Sample Answer:**  If there is a mistake during transcription, a different codon is produced. A change from UAU (tyrosine) to UAC (also tyrosine) would result in no change to the individual because both codons code for the same amino acid. If the mistake results in a change from UAU to UUU, a completely new amino acid (phenylalanine) is coded for and will change the protein formed. This would likely change the individual’s phenotype (outward appearance) and could even be a fatal mistake. A change from UAU to UAG would codes for a stop codon which would halt further protein synthesis. Depending on where in the protein strand this occurs, the result could be a phenotype change or death.  **Rubric:**   |  | | --- | | **2 Points:**   * The response indicates that the student has a **complete understanding**   of the concept embodied in the task.   * The student has provided a response that is accurate, complete,   and fulfills all the requirements of the task.   * Necessary support and/or examples are included, and the information   given is clearly text-based. | | **1 Point:**   * The response indicates that the student has a **partial understanding**   of the concept embodied in the task.   * The student has provided a response that includes information that is   essentially correct and text-based but the information is too general or too simplistic.   * Some of the support and/or examples may be incomplete or omitted. | | **0 Points:**   * The response indicates that the student **does not demonstrate** an   understanding of the reading concept embodied in the task.   * The student has provided a response that is inaccurate or contains only   irrelevant text-based information.   * The response has an insufficient amount of information to determine   the student’s understanding of the task or the student has failed to  respond to the task. | |

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| **Reporting Category** | Chemistry |
| **Standard** | Matter & Energy Transformations |
| **Benchmark Number** | SC.912.L.18.11 |
| **Benchmark** | Explain the role of enzymes as catalysts that lower the activation energy of  biochemical reactions.  Identify factors, such as pH and temperature, and their effect on enzyme  activity. |
| **Also Assesses** | SC.912.P.12.12 |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Moderate, high |
| **Benchmark Clarification** | The student will able to define an enzyme as a catalyst and is able to\  explain how it functions in biochemical reactions by lowering the activation  energy of the reaction.  The student will able to identify how the enzymes activity is dependent on  such factors as pH and temperature. Enzyme activity should be addressed  as a consequence of DNA transcription and translation, specifically,  primary protein structure that is dependent on DNA sequences. Items may  assess how these factors affect enzymatic processes in DNA replication,  RNA processing and DNA technology. |
| **Content Limits** | The test item should relate to only biochemical reactions in living  organisms.  The test item should not require students to identify the enzyme substrate  complex, enzyme specificity or include other factors of enzyme kinetics  such as saturation, inhibitors, or positive / negative feedback controls. |
| **Stimulus Attributes** | Illustrations, drawings, graphs |
| **Response Attributes** | Answer choices will assess enzyme activity and its dependence on other  factors. |
| **Sample Item** | Question 1: A geneticist is assisting in a project to develop a bacterium to  break down biofuels such as wood chips and straw into smaller molecules  that can be converted into ethanol. Certain varieties of bacteria produce an  enzyme that will cleave cellulose into smaller molecules that can be  converted into ethanol. However, the process is very slow.  Which of the following factors could be changed that would possibly  increase the rate at which cellulose is broken down by this enzyme?     1. Keep pH levels neutral and the temperature about 28° Celsius. 2. Add acid to the wood biofuel first to help break down the cellulose. 3. Lower the levels of bacteria to reduce competition for food resources. 4. Increase the temperature to increase available energy for the reaction rate.   Correct Answer: A |

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| **Reporting Category** | Chemistry |
| **Standard** | Matter & Energy Transformations |
| **Benchmark Number** | SC.912.L.18.12 |
| **Benchmark** | Discuss the special properties of water that contribute to Earth's suitability  as an environment for life: cohesive behavior, ability to moderate  temperature, expansion upon freezing, and versatility as a solvent. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | The student will be able to identify that water is a unique molecule and  necessary for life because of it specific and unique properties.  The student will be able to relate how the cohesive behavior of water gives  it unique and special properties that contribute to its usefulness in plant life  and animal life.  The student will be able to relate how the density change in freezing is  essential to life on this planet.  The student will be able to explain how water is able to dissolve many  substances making it an essential molecule for life.  The student will be able to understand the polar nature of a water molecule  and how it relates to its special properties. |
| **Content Limits** | The item will not assess hydrogen bonding, the freezing point of water, or  other specific conceptual or numerical values of water. |
| **Stimulus Attributes** | Illustrations, diagrams |
| **Response Attributes** | Answer choices will relate water’s special properties to forensic science. |

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| **Sample Item** | Why is water often referred to as the universal solvent?   1. Water is called the universal solvent because it is polar and nonpolar. 2. Water is called the universal solvent because all substances (polar and nonpolar) dissolve in water. 3. Water is called the universal solvent because more substances dissolve in water than in any other chemical. This is because water is everywhere. 4. Water is called the universal solvent because more substances dissolve in water than in any other chemical. This is because water (H20) isa polar molecule. However, nonpolar chemicals will not dissolve in water.   Correct Answer: D |

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| **Reporting Category** | Nature of Science |
| **Standard** | Practice of Science |
| **Benchmark Number** | SC.912.N.1.1 |
| **Benchmark** | Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1. pose questions about the natural world, 2. conduct systematic observations, 3. examine books and other sources of information to see what is already known, 4. review what is known in light of empirical evidence, 5. plan investigations, 6. use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), 7. pose answers, explanations, or descriptions of events, 8. generate explanations that explicate or describe natural phenomena (inferences), 9. use appropriate evidence and reasoning to justify these explanations to others, 10. communicate results of scientific investigations, and 11. evaluate the merits of the explanations produced by others. |
| **Also Assesses** | SC.912.N.1.4; SC.912.N.1.6 |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate, high |
| **Benchmark Clarification** | Students will be able to design and/or evaluate a scientific investigation using evidence of scientific thinking and/or problem solving.    Students will be able to interpret and analyze data to make predictions and or defend conclusions.  Students will be able to evaluate the merits of scientific explanations produced by others.    Students will be able to assess the reliability of sources of information according to scientific standards.  Students will be able to describe how scientific inferences are made from observations/evidence/tests performed and identify examples in forensic science. |
| **Content Limits** | Items will test a forensic style scenario. |
| **Response Attributes** | Diagrams |
| **Sample Item** | Blow fly development:    A body is discovered in a ditch along the turnpike in June. Forensic investigators collected third instar maggots as well as some blow fly pupae. Referring to the chart above, which statement concerning the post mortem interval (PMI) is accurate?   1. The PMI is about a month ago. 2. The PMI is exactly 20 days ago. 3. The PMI is less than 20 days ago. 4. The PMI is more than a month ago.   Correct Answer: C  (Diagram from scienceinschool.org) |

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| **Reporting Category** | Nature of Science |
| **Standard** | Practice of Science |
| **Benchmark Number** | SC.912.N.1.3 |
| **Benchmark** | Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented. |
| **Also Assesses** | SC.912.N.2.4 |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | The student will be able to identify and explain the value of continuous testing of theories to determine validity and value of challenges to advance scientific understanding.  The student will be able to recognize and understand that data is not conclusive, comprehensive, and is interpreted.  The student will be able to explain how this leads to competing theories in science. |
| **Content Limits** | Student will not be required to provide an example of advancement from previous interpretation. |
| **Stimulus Attributes** | Scenarios will be placed in the context of experimental design. |
| **Response Attributes** | Diagrams |
| **Sample Item** | A researcher states that there is a link between cell phone radiation and cancer. Another researcher contends another factor is responsible. What is the best method for resolving the issue?     1. Accept both as scientifically correct. 2. Accept the original findings because they were first. 3. Decide based on which researcher has the best credentials. 4. Collaborate and gather additional data to find a factual conclusion.   Correct Answer: D |

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| **Reporting Category** | Nature of Science |
| **Standard** | Practice of Science |
| **Benchmark Number** | SC.912.N.1.5 |
| **Benchmark** | Describe and provide examples of how similar investigations conducted in  many parts of the world result in the same outcome. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice, Short Answer |
| **Complexity Level** | Low, moderate, high |
| **Benchmark Clarification** | Students will be able to describe with examples how similar experiments  can be conducted around the world with the same results. |
| **Content Limits** | Content should be limited to material covered within the scope of a forensic  science course. |
| **Stimulus Attributes** | Graphs, illustrations, diagrams |
| **Response Attributes** | Questions and answer choices will include investigations related to forensic  science and will ideally relate similar investigations in different areas. |
| **Sample Item** | Blowfly larvae are collected from a crime scene. Which of the following is  not important in determining the Post Mortem Interval?   1. The temperature of the maggot mass. 2. The relative size and sex of the victim. 3. The weather data for several days prior to the discovery. 4. The environment in which the body is discovered (i.e. buried, covered).   Correct Answer: B |

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| **Reporting Category** | Nature of Science |
| **Standard** | Role of Theories, Laws, Hypotheses, and Models |
| **Benchmark Number** | SC.912.N.3.5 |
| **Benchmark** | Describe the function of models in science, and identify the wide range of models used in science. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice, short answer |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | The student will be able to understand why science uses models to study a variety of phenomenon and appreciate the inherent weaknesses and limitations of such models. |
| **Content Limits** | The student will be assessed on recognizing when a model can be used and distinguishing this method from other scientific processes. |
| **Stimulus Attributes** | Scenarios, models, diagrams, charts |
| **Response Attributes** | Answer choices will include functions or identity of models in forensic science. |
| **Sample Item** | For various reasons, scientists sometimes find that it is impractical to directly observe or test a particular phenomenon, such as a black hole. For a forensic scientist who is investigating the ballistics of a crime scene after the fact, which one of the following alternative methods is best to use?   1. Develop a hypothesis that fits the known facts. 2. Recreate the ballistics of the crime scene with computer models. 3. Apply well-established theories that best explains the known facts. 4. Return to the actual crime scene and recreate the ballistics of the crime using the actual weapon(s).   Correct Answer: B |

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| **Reporting Category** | Nature of Science |
| **Standard** | Science & Society |
| **Benchmark Number** | SC.912.N.4.2 |
| **Benchmark** | Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental. |
| **Also Assesses** | N/A |
| **Item Types** | Extended response |
| **Benchmark Clarification** | The student will be able to choose a strategy for solving a societal problem by analyzing its costs and benefits. |
| **Content Limits** | Content should be limited to material covered within the scope of a forensic science course. |
| **Stimulus Attributes** | A specific scenario may be described to allow the student to assess the costs and benefits of the problem-solving strategy. |
| **Response Attributes** | Critical thinking skills will be assessed by allowing student to compare and contrast a number of problem solving strategy costs/benefits. |

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| **Sample Item** | A police department in a small town in Florida would like to expand their crime lab. The current facilities allow only the basic fingerprinting and presumptive testing; major cases requiring sophisticated tests are contracted out to either private companies or neighboring law enforcement agency labs. Write a convincing argument for adding additional facilities to the small PD.  Answers will vary, but should include points comparing the current cost of contracting tests, the time lapse in awaiting results, the benefit of being able to conduct tests ‘in house’, etc. Arguments should be logical and clearly stated.  **Rubric:**   |  | | --- | | **4 Points**:   * The response indicates that the student has a **thorough understanding** of the concept embodied in the task. * The student has provided a response that is accurate, complete, and fulfills all the requirements of the task. * Necessary support and/or examples are included, and the information is clearly text-based. | | **3 Points:**   * The response indicates that the student has an **understanding** of the concept embodied in the task. * The student response has provided a response that is accurate and fulfills all the requirements of the task. * The required support and/or details are not complete or clearly text-based. | | **2 Points:**   * The response indicates that the student has a **partial understanding** of the concept embodied in the task. * The student has provided a response that includes information that is essentially correct and text-based, but the information is too general or too simplistic. * Some of the support and/or examples and requirements of the task may be incomplete or omitted. | | **1 Point:**   * The response indicates that the student has a **very limited understanding** of the concept embodied in the task. * The response is incomplete, may exhibit many flaws, and may not address all requirements of the task. | |

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| **Reporting Category** | Chemistry |
| **Standard** | Matter |
| **Benchmark Number** | SC.912.P.8.7 |
| **Benchmark** | Interpret formula representations of molecules and compounds in terms of composition and structure. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | The student will be able to read a formula representation of a molecule or compound and describe the elements in that compound, and the number of each atom in that compound. |
| **Content Limits** | The item does not require the formula weight or and knowledge of the molecule to solve the problem.  The item does not require the student to distinguish the type of bonding between the atoms in a molecule or compound.  The item does not require the student to predict what elements would bond to other elements and in what ratios. |
| **Stimulus Attributes** | Chemical formula and test |
| **Response Attributes** | Answer choices will allow interpretation of chemical formulas, element identification and counting atoms. |
| **Sample Item** | How many carbon atoms are in a single molecule of butane (C4H10)?  A) 4  B) 6  C) 10  D) 14  Correct Answer: A |

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| **Reporting Category** | Physics |
| **Standard** | Energy |
| **Benchmark Number** | SC.912.P.10.4 |
| **Benchmark** | Describe heat as the energy transferred by convection, conduction, and  radiation, and explain the connection of heat to change in temperature or  states of matter. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate, high |
| **Benchmark Clarification** | Students will be able to describe energy transference through convection,  conduction, and radiation.  The student will be able to identify that heat is the energy that is responsible  for changing the temperature of matter.  The student will be able to identify that the addition of heat or the release of  heat from matter is what is responsible for changing its state from one form to  another. |
| **Content Limits** | The item should not address the kinetic theory of matter or the relationship  between kinetic energy and heat. |
| **Stimulus Attributes** | Scenarios |
| **Response Attributes** | Answer choices will allow students to demonstrate ability to describe heat  energy transfer and its relation to states of matter changes. |

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| **Sample Item** | A student decides to do a science fair project on clouds. Through research, he  learns that energy from the sun warms the water at the surface causing it to  evaporate. This evaporated water rises with warm rising air. As it rises, cold  air above it flows down to fill the space left behind by the warmer rising air  generating wind. The rising air begins to cool causing the water vapor to  condense and clouds are formed. This cyclical process results in both wind and  cloud formation.  What processes are taking place to make this happen?   1. Conduction and convection 2. Conduction and radiation 3. Conduction and thermal expansion 4. Convection and radiation   Correct Answer: D |

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| **Reporting Category** | Chemistry |
| **Standard** | Energy |
| **Benchmark Number** | SC.912.P.10.7 |
| **Benchmark** | Distinguish between endothermic and exothermic chemical processes. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to distinguish between an endothermic and an exothermic  reaction. |
| **Content Limits** | The item should only focus on the classification of a chemical reaction related  to endothermic or exothermic processes. The item does not have to involve  catalysts in the reaction. |
| **Stimulus Attributes** | Energy diagram, chemical formula, chemical reaction |
| **Response Attributes** | Answer choices will allow students to demonstrate their ability to identify and  distinguish between exothermic and endothermic reactions. |
| **Sample Item** | How is this reaction classified?  CH4 + 2O2 -> CO2 + H2O + Heat   1. Decomposition 2. Double replacement 3. Endothermic 4. Exothermic   Correct Answer: D |

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| **Reporting Category** | Physics |
| **Standard** | Motion |
| **Benchmark Number** | SC.912.P.12.1 |
| **Benchmark** | Distinguish between scalar and vector quantities and assess which should be used to describe an event. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to properly use and identify examples of scalar and vector quantities. |
| **Content Limits** | Items can include math computations derived from given information. |
| **Stimulus Attributes** | Crime scene diagram, blood spatter pattern. |
| **Response Attributes** | Answer choices will allow students to demonstrate ability to distinguish between scalar and vector quantities and assess which one will be used to describe an event related to forensic science. |
| **Sample Item** | Which of the following would not be considered a vector measurement?   1. The mass of the bullet. 2. The momentum of a bullet. 3. The force applied to a bullet while shooting it. 4. The velocity of a bullet as it travels through the air.   Correct Answer: A |

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| **Reporting Category** | Physics |
| **Standard** | Motion |
| **Benchmark Number** | SC.912.P.12.2 |
| **Benchmark** | Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Moderate |
| **Benchmark Clarification** | Student will be able to properly use and identify examples of position, velocity, acceleration and frames of reference.  Student will be able to analyze the motion of an object and interpret the relationship between position, velocity, and acceleration as it relates to the time interval involved. |
| **Content Limits** | Items may include scenarios that describe or compare the motion of objects. Items can require simple calculations for velocity, position or acceleration.  . |
| **Stimulus Attributes** | Formula/reference sheet, graphs, illustrations, diagrams |
| **Response Attributes** | Answer choices will allow students to demonstrate ability to determine/analyze position, velocity, and acceleration as functions of time. |
| **Sample Item** | A motorcycle accelerates from a stop at a rate of 4m/s2 for 20 seconds. It then continues at a constant speed for 40 seconds. You may use the blank graph below to plot the speed vs. time of the motorcycle.    What is the motorcycle’s speed at 15 seconds? Answer: 60m/s  What is the motorcycle’s speed at 45 seconds? Answer: 80 m/s  **Rubric:**   |  | | --- | | **2 Points:**   * The response indicates that the student has a **complete understanding** of the concept embodied in the task. * The student has provided a response that is accurate, complete, and fulfills all the requirements of the task. * Necessary support and/or examples are included, and the information given is clearly text-based. | | **1 Point:**   * The response indicates that the student has a **partial understanding** of the concept embodied in the task. * The student has provided a response that includes information that is essentially correct and text-based but the information is too general or too simplistic. * Some of the support and/or examples may be incomplete or omitted. | | **0 Points:**   * The response indicates that the student **does not demonstrate** and understanding of the reading concept embodied in the task. * The student has provided a response that is inaccurate or contains only irrelevant text-based information. * The response has an insufficient amount of information to determine the student’s understanding of the task or the student has failed to respond to the task. | |

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| **Reporting Category** | Physics |
| **Standard** | Motion |
| **Benchmark Number** | SC.912.P.12.3 |
| **Benchmark** | Interpret and apply Newton's three laws of motion. |
| **Also Accesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Moderate, high |
| **Benchmark Clarification** | The student will be able to explain Newton's three laws of motion.  Students will be able to relate terms such as force, mass, acceleration, velocity, and momentum.  Students will be able to recognize that Newton’s three laws govern an object's behavior in a given scenario. |
| **Content Limits** | Items may include scenarios that describe or compare the motion of objects.  Items can require simple calculations to determine force, mass, acceleration, velocity, or momentum. |
| **Stimulus Attributes** | Formula/reference, graphs, illustrations, drawings |
| **Response Attributes** | Answer choices will allow students to demonstrate ability to interpret and apply Newton’s laws of motion as related to forensic science. |

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| **Sample Item** | **Question 1 (MC):** A diagram shows a balloon that is moving in one direction while escaping air is moving in the opposite direction.  Which best explains what causes the balloon to move?   1. Action reaction forces 2. Friction forces 3. Gravitational forces 4. Inertia   Correct Answer: A |

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| **Reporting Category** | Physics |
| **Standard** | Motion |
| **Benchmark Number** | SC.912.P.12.5 |
| **Benchmark** | Apply the law of conservation of linear momentum to interactions, such as collisions between objects. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice; Short Answer |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | Students will be able to recognize that linear momentum is conserved only in collisions between objects.  Students will be able to recognize this is Newton's third law. |
| **Content Limits** | Items include simple calculations of mass and velocity.  Items may include the mass and velocity of objects before and after collisions. |
| **Stimulus Attributes** | Reference/formula, diagrams, visual cues. |
| **Response Attributes** | Answer choices will allow students to demonstrate ability apply the law of conservation of linear momentum to interactions that may be involved in forensic investigations. |
| **Sample Item** | A bullet is fired into a 3 kg wood block that is sitting on top of the ice of a frozen lake. The bullet has a momentum of 450kg m/s. The bullet enters the wood block and stops.  If we assume the ice is a frictionless surface, what should happen to the momentum of the wood block after the bullet enters it?   1. The block will not change its momentum at all and will not move. 2. The wood block would have a much smaller momentum then the bullet had and will barely move. 3. The block will have nearly the same momentum as the bullet did and move in the same direction the bullet was moving. 4. The wood block will have a larger momentum than the bullet did and move in the same direction as the bullet was moving.   Correct Answer: C |

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| **Reporting Category** | Physics |
| **Standard** | Motion |
| **Benchmark Number** | SC.912.P.12.6 |
| **Benchmark** | Qualitatively apply the concept of angular momentum. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Low, moderate |
| **Benchmark Clarification** | The student will be able to define angular momentum.  The student will be able to describe with words or with diagrams the momentums and velocities involved with an object traveling in a circular path. |
| **Content Limits** | The item should not require any mathematical computations regarding this concept. The item does not extend to planetary bodies. The item does not require knowledge of centrifugal or centripetal forces. |
| **Stimulus Attributes** | Illustrations, diagrams, text |
| **Response Attributes** | Answer choices will allow students to demonstrate ability to apply the concept of angular momentum qualitatively to situations related to forensic science. |
| **Sample Item** | A motorcycle is traveling due south. What is the angular momentum vector of the front wheel of the motorcycle?   1. East 2. North 3. South 4. West   Correct Answer: C |

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| **Reporting Category** | Chemistry |
| **Standard** | Matter |
| **Benchmark Number** | SC.912.P.12.12 |
| **Benchmark** | Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction. |
| **Also Assesses** | N/A |
| **Item Types** | Multiple Choice |
| **Complexity Level** | Moderate , high |
| **Benchmark Clarification** | The student will be able to explain how the concentration of reactants affects the rate of a reaction.  The student will be able to explain how the temperature affects the rate of a chemical reaction.  The student will be able to explain how the presence of a catalyst lowers the activation energy of a reaction and thus increases the rate of the reaction. |
| **Content Limits** | The student will not be required to quantify relationships. |
| **Stimulus Attributes** | Case study scenario, graphs, data tables, charts. |
| **Response Attributes** | Answers will allow students to use critical thinking skills to choose the correct reaction and how its rate is affected during forensic investigations. |
| **Sample Item** | A driver is pulled over by law enforcement on suspicion of drunk-driving. The driver fails the field sobriety test and is arrested. A few hours later the suspect is transported to a hospital for blood alcohol content testing.  Are the results from the blood alcohol test valid even though it was done several hours after the time of arrest?   1. No: The blood alcohol content has since decreased due to the oxidation of alcohol to carbon dioxide. 2. Yes: Since the rate of alcohol oxidation is known, the original blood alcohol content can be determined at the time of arrest. 3. Yes: The blood alcohol content remains constant for several hours since the temperature of the blood has also remained constant. 4. No: The blood alcohol content has since decreased because the alcohol has had more time to spread throughout the bloodstream, thus being diluted.   Correct Answer: B |