Vermont Comprehensive Assessment Program (VTCAP)

VERMONT AGENCY OF EDUCATION

Practice Test Alignment Document

Science | Grade 11

Sequence Number	Standard	Learning Target
Session 1		
1	**SEP**: Planning and Carrying Out Investigations, **DCI**: ESS2.C: The Roles of Water in Earth's Surface Processes, **CCC**: Structure and Function, **PE: HS-ESS2-5**: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Use diagrams from an investigation to select an action that would freeze water and cause it to expand and explain how the investigation provides evidence of the natural process that caused changes in a mountain rock.
2	**SEP**: Using Mathematical and Computational Thinking, **DCI**: PS2.B: Types of Interactions, **CCC**: Patterns, **PE: HS-PS2-4**: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	Describe how the gravitational force in the models is supported by the equation and use the equation to describe the gravitational force in the models.
3	**SEP**: Asking Questions and Defining Problems, **DCI**: LS3.A: Inheritance of Traits, **CCC**: Cause and Effect, **PE: HS-LS3-1**: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	Describe a question that could be answered by the investigation shown in a diagram and select which question a comparison between the original leaf cells to the new leaves would answer.
4*	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: **PS1.B**: Chemical Reactions, ETS1.C: Optimizing the Design Solution, **CCC**: Stability and Change, **PE: HS-PS1-6**: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	Describe how to change the amount of carbon dioxide in ocean water by applying Le Chatelier's principle and describe a constraint on implementing a change to the system.
5	**SEP**: Developing and Using Models, **DCI**: ESS2.D: Weather and Climate, **CCC**: Energy and Matter, **PE: HS-ESS2-6**: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	Use a model to explain how burning fossil fuels affects Earth's spheres.

*This is a hand-scored question. The rubric can be found at the end of this document for reference.
Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

Sequence Number	Standard	Learning Target
6	**SEP**: Using Mathematical and Computational Thinking, **DCI**: ESS3.D: Global Climate Change, **CCC**: Systems and System Models, **PE: HS-ESS3-6**: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	Evaluate a model and graphs to describe a claim about how Earth's oceans will change in acidity due to changing levels of carbon in Earth's atmosphere.
7	**DCI**: ESS3.D: Global Climate Change, **CCC**: Systems and System Models, **PE: HS-ESS3-6**: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	Use a graph to identify which ecosystems in Earth's oceans are most likely to be damaged as a result of a change in acidity of Earth's oceans.
8	**DCI**: ESS2.D: Weather and Climate, **CCC**: Energy and Matter, **PE: HS-ESS2-6**: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	Use a model to explain how an organism in an ecosystem can contribute to storing more carbon, and also how that population of organisms indirectly affects the amount of carbon in ocean water.
9	**SEP**: Analyzing and Interpreting Data, **DCI**: ESS2.A: Earth Materials and Systems, **PE: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Use a data table to describe the effect of land use on erosion.
10	**SEP**: Analyzing and Interpreting Data, **DCI**: ESS2.A: Earth Materials and Systems, **CCC**: Stability and Change, **PE: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Use a data table to support a claim about which action causes the most disturbance and describe a feedback loop between the biosphere and geosphere.
11	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ESS3.C: Human Impacts on Earth Systems, **CCC**: Stability and Change, **PE: HS-ESS3-4**: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	Use a data table to select a method that will reduce human impact on the environment and stabilize the amount of erosion in an area.
12	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ESS3.C: Human Impacts on Earth Systems, **CCC**: Stability and Change, **PE: HS-ESS3-4**: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	Use a data table to select the method that would most likely reduce the human impact on the environment and explain why.

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Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

Session 2		
1	**SEP**: Obtaining, Evaluating, and Communicating Information, **DCI**: LS4.A: Evidence of Common Ancestry and Diversity, **CCC**: Patterns, **PE: HS-LS4-1**: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	Use a cladogram to identify and explain which animals have the most similar DNA sequences.
2	**SEP**: Developing and Using Models, **DCI**: PS1.C: Nuclear Processes, **CCC**: Energy and Matter, **PE: HS-PS1-8**: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	Select the model of nuclear fusion to show the process that occurs inside bombs and explain that during nuclear processes, the total number of neutrons and protons is conserved.
3	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ESS3.B: Natural Hazards, **CCC**: Cause and Effect, **PE: HS-ESS3-1**: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Explain a trend about natural disasters shown in graphs and support a claim that the graphs show migration increases after natural disasters due to people no longer having access to resources.
4*	**SEP**: Developing and Using Models, **DCI**: LS1.C: Organization for Matter and Energy Flow in Organisms, **CCC**: Energy and Matter, **PE: HS-LS1-7**: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.	Use a model to describe differences between the air flowing in and out of the room, identify an input and output of cellular respiration and add it to the model, and explain that cellular respiration releases stored energy to power the human body.
5	**SEP**: Planning and Carrying Out Investigations, **DCI**: PS3.B: Conservation of Energy and Energy Transfer, **CCC**: Systems and System Models, **PE: HS-PS3-4**: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	Explain that an investigation produced low-quality data because many variables were changed at the same time.
6	**DCI**: PS3.B: Conservation of Energy and Energy Transfer, **CCC**: Systems and System Models, **PE: HS-PS3-1**: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	Explain why a person outside on a hot day would feel cooler in a pool because the water has a higher specific heat than air, so thermal energy flows out of the person's body.

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Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

7	**SEP**: Planning and Carrying Out Investigations, **DCI**: PS3.B: Conservation of Energy and Energy Transfer, **CCC**: Systems and System Models, **PE: HS-PS3-4**: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	Identify a change to the investigation procedure that will improve the quality of the data collected and identify a variable that should be controlled during the investigation.
8	**SEP**: Using Mathematical and Computational Thinking, **DCI**: PS3.B: Conservation of Energy and Energy Transfer, **CCC**: Systems and System Models, **PE: HS-PS3-1**: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	Use an equation to calculate the amount of thermal energy transferred during an investigation.
9	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: PS2.A: Forces and Motion, **CCC**: Cause and Effect, **PE: HS-PS2-3**: Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	Explain what caused the damage during a collision investigation and how a design device decreases the force on an object during a collision.
10	**SEP**: Analyzing and Interpreting Data, **DCI**: PS2.A: Forces and Motion, **CCC**: Cause and Effect, **PE: HS-PS2-1**: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	Support a claim using evidence from a graph that increasing an object's time to stop affects the acceleration of the object and the amount of force on the object.
11	**SEP**: Analyzing and Interpreting Data, **DCI**: PS2.A: Forces and Motion, **CCC**: Cause and Effect, **PE: HS-PS2-1**: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	Support a claim using evidence from a graph that more force is needed to stop an object that has more speed, and that objects that were moving faster before the collision accelerated more during the collision.
12	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: PS2.A: Forces and Motion, **CCC**: Cause and Effect, **PE: HS-PS2-3**: Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	Explain how devices change the force on people during a collision by changing the time for the people to come to a stop.

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Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

Session 3		
1	**SEP**: Planning and Carrying Out Investigations, **DCI**: LS1.A: Structure and Function, **CCC**: Stability and Change, **PE: HS-LS1-3**: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	Identify a procedure that would provide evidence that a neurotransmitter and hormone has the effect shown in the diagram and identify the type of feedback shown in the diagram.
2	**SEP**: Using Mathematical and Computational Thinking, **DCI**: ESS1.B: Earth and the Solar System, **CCC**: Scale, Proportion, and Quantity, **PE: HS-ESS1-4**: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	Use a diagram to describe the speed of a satellite and explain why the satellite's speed changes during the orbit.
3	**SEP**: Using Mathematical and Computational Thinking, **DCI**: PS4.A: Wave Properties, **CCC**: Cause and Effect, **PE: HS-PS4-1**: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	Compare the wavelength and frequency of sound waves in metal versus air and explain the mathematical relationship: the speed of a wave equals wavelength times frequency.
4	**SEP**: Engaging in Argument from Evidence, **DCI**: LS4.C: Adaptation, **CCC**: Cause and Effect, **PE: HS-LS4-5**: Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.	Evaluate a claim about how changes in environmental conditions can cause changes to a population over several generations and provide evidence that the emergence of a new species is the inability to produce offspring.
5*	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ESS1.A: The Universe and Its Stars, **CCC**: Energy and Matter, **PE: HS-ESS1-2**: Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	Use evidence from a diagram to describe one way the universe is changing and describe how cosmic microwave background radiation is another piece of evidence that supports the change in the universe previously described.
6	**DCI**: LS3.A: Inheritance of Traits, **CCC**: Cause and Effect, **PE: HS-LS3-1**: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	Provide evidence to support a claim that inherited traits are the result of differences in inherited DNA.
7	**SEP**: Engaging in Argument from Evidence, **DCI**: LS3.B: Variation of Traits, **PE: HS-LS3-2**: Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.	Describe how genetic variation can occur during asexual reproduction.

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Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

8	**SEP**: Engaging in Argument from Evidence, **DCI**: LS3.B: Variation of Traits, **CCC**: Cause and Effect, **PE: HS-LS3-2**: Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.	Make and support a claim that over time different mutations occurred in different species using information from a data table.
9	**SEP**: Asking Questions and Defining Problems, **DCI**: LS1.A: Structure and Function, LS3.A: Inheritance of Traits, **CCC**: Cause and Effect, **PE: HS-LS3-1**: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	Identify a question to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits and describe that the order of nucleotides in a DNA molecule determines the structure of a protein.
10	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ETS1.B: Developing Possible Solutions, **PE: HS-ETS1-3**: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	Evaluate different solutions and select a solution that meets established criteria.
11	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ETS1.B: Developing Possible Solutions, **PE: HS-LS2-7**: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Describe a disadvantage of a design solution to problem caused by human activities.
12	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: LS2.C: Ecosystem Dynamics, Functioning, and Resilience, **PE: HS-LS2-7**: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Order the locations from highest to lowest biodiversity based on data from a survey and select the location that is farthest from the source of pollution.
13	**SEP**: Constructing Explanations and Designing Solutions, **DCI**: ETS1.B: Developing Possible Solutions, **PE: HS-ETS1-3**: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	Complete a table to show which proposed solutions best meet the needs of a city and describe reasons to use a different solution.

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Science and Engineering Practices (**SEP**), Disciplinary Core Ideas (**DCI**), Cross-Cutting Concepts (**CCC**)

Scoring Rubrics

Session 1

Question 4

Scoring Rubric

Score	Description
4	The response demonstrates thorough use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response describes one way students could decrease the amount of CO_2 in ocean water by applying Le Chatelier's principle and describes one constraint on implementing the change described in part (a). The response • clearly applies science and engineering practices to provide an explanation or solution; • provides a coherent and accurate explanation or solution based on disciplinary core ideas; • reflects thorough understanding of complex ideas and crosscutting concepts; and • effectively applies and demonstrates complete understanding of the three dimensions.
3	The response demonstrates sufficient use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack some detail or information, or the response may contain minor errors in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
2	The response demonstrates limited use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack multiple details or information, or the response may contain major error(s) in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
1	The response demonstrates minimal use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
0	The response is inaccurate, is irrelevant, or contains no evidence of use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
Blank	No response.

Sample Student Response:

$CO_2 + H_2O + CaCO_3 \rightleftarrows Ca^{2+} + 2\ H^+ + 2\ CO_3^{2-}$

a. They could solve the problem by removing calcium ions or adding calcium carbonate to ocean water. Either of these have the effect of shifting the reaction toward the products and decreasing the amount of CO_2 (while also increasing the amounts of calcium and carbonate ions available for shell/skeleton making).

b. The students would have to consider the costs of their solution, materials, energy requirements, and the reality of scaling up their design; the students would need to test their solution to see if it would work; OR any other plausible constraint.

Scoring Rubrics

Session 2

Question 4

Scoring Rubric

Score	Description
4	The response demonstrates thorough use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response describes two differences between the air flowing into the room and the air flowing out of the room and explains the reason for both differences. The response also identifies one input and one output of cellular respiration that are not described in part (a) and describes how to add these to the model. The response also explains how cellular respiration releases stored energy that powers the human body. The response • clearly applies science and engineering practices to provide an explanation or solution; • provides a coherent and accurate explanation or solution based on disciplinary core ideas; • reflects thorough understanding of complex ideas and crosscutting concepts; and • effectively applies and demonstrates complete understanding of the three dimensions.
3	The response demonstrates sufficient use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack some detail or information, or the response may contain minor errors in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
2	The response demonstrates limited use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack multiple details or information, or the response may contain major error(s) in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
1	The response demonstrates minimal use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
0	The response is inaccurate, is irrelevant, or contains no evidence of use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
Blank	No response.

Sample Student Response:

a. Air flowing into the room has more oxygen than air flowing out of the room. Air flowing into the room has less carbon dioxide/water than air flowing out of the room. This is because cellular respiration uses up oxygen and produces carbon dioxide/water.

Scoring Rubrics

b. Inputs: energy, glucose/sugar/food

Outputs: water (sweat)/carbon dioxide, energy (ATP)/thermal energy/heat

Inputs could be added with an arrow going toward the human.

Outputs could be shown with an arrow going away from the human.

c. Cellular respiration breaks bonds in food and oxygen molecules and forms bonds in carbon dioxide and water. The bonds in the output molecules have less energy than the bonds in the input molecules and that energy is used for life.

Scoring Rubrics

Session 3

Question 5

Scoring Rubric

Score	Description
4	The response demonstrates thorough use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response uses evidence from the diagram to describe one way the universe is changing and explains how the evidence supports the change. The response also describes how cosmic microwave background radiation is another piece of evidence that supports the change described in part (a). The response • clearly applies science and engineering practices to provide an explanation or solution; • provides a coherent and accurate explanation or solution based on disciplinary core ideas; • reflects thorough understanding of complex ideas and crosscutting concepts; and • effectively applies and demonstrates complete understanding of the three dimensions.
3	The response demonstrates sufficient use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack some detail or information, or the response may contain minor errors in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
2	The response demonstrates limited use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems. The response may lack multiple details or information, or the response may contain major error(s) in applying and demonstrating understanding of science and engineering practices, disciplinary core ideas, and crosscutting concepts.
1	The response demonstrates minimal use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
0	The response is inaccurate, is irrelevant, or contains no evidence of use of the three dimensions to make sense of scientific phenomena and/or to design solutions to problems.
Blank	No response.

Sample Student Response:

a. The universe is expanding/getting larger/full of objects that are becoming farther apart. The diagram shows that (all distant) galaxies are moving away from Earth. This is supported by the diagram, which shows that (all distant) galaxies are moving away from Earth/the light from all distant galaxies is shifted to longer wavelengths.

b. The universe was very hot, and the radiation shows that now the universe is very cold. The universe getting bigger explains this because the same amount of energy is spread over more space.