MCAS Grade 10 ELA, Grade 10 Math, and Grades 5 and 8 STE

Standard Setting Meeting Executive Summary

August 2019

This report summarizes the process and results of setting achievement levels for the Massachusetts Comprehensive Assessment System (MCAS) assessments for grade 10 English language arts (ELA), grade 10 mathematics, and grades 5 and 8 science and technology/engineering (STE). The Massachusetts Department of Elementary and Secondary Education (ESE) partnered with Measured Progress and Pearson (the MCAS assessment contractors) to collect recommendations for cut scores associated with the achievement levels for the MCAS assessments.

MCAS Standard Setting Process and Results

Achievement levels are used to classify student achievement on an assessment. In order to classify student achievement into the four different levels, the following components are required: 1) policy-level definitions, 2) Achievement Level Descriptors (ALDs), and 3) cut scores. Policy-level definitions provide general descriptions of the knowledge, skills, and abilities students must demonstrate to be classified into each achievement level and apply to all courses or subject areas. ALDs illustrate the achievement levels in terms that are specific to a course or subject area. Cut scores represent the lowest boundary of each achievement level on the scale.

The process of recommending performance standards for the MCAS tests was based on standard setting procedures that were used for the MCAS tests for grades 3 through 8 ELA and mathematics, are in line with national best practice, and with review and approval of the MCAS technical advisory committee (TAC). Results and details of that process are presented in the following sections.

Policy-level Definitions

Policy-level definitions for the MCAS achievement levels are shown in Table 1. The titles and descriptions of the achievement levels were defined to be part of a cohesive assessment system. The achievement levels indicate a student’s ability to demonstrate proficiency in relation to subject- and grade-specific expectations, as indicators of a student’s readiness for the next grade-level or college and career, as defined in the Massachusetts curriculum framework.

The Commissioner and the Board of Elementary and Secondary Education approved the final policy-level definitions for MCAS assessments in March 2017.

**Table 1. Policy-level definitions for MCAS Achievement Levels**

|  |  |
| --- | --- |
| **Achievement Level** | **Policy-level Definition** |
| **Exceeding Expectations** | A student who performed at this level exceeded grade-level expectations by demonstrating mastery of the subject matter. |
| **Meeting Expectations** | A student who performed at this level met grade-level expectations and is academically on track to succeed in the current grade in this subject. |
| **Partially Meeting Expectations** | A student who performed at this level partially met grade-level expectations in this subject. The school, in consultation with the student's parent/guardian, should consider whether the student needs additional academic assistance to succeed in this subject. |
| **Not Meeting Expectations** | A student who performed at this level did not meet grade-level expectations in this subject. The school, in consultation with the student's parent/guardian, should determine the coordinated academic assistance and/or additional instruction the student needs to succeed in this subject. |

Achievement Level Descriptors (ALDs)

Draft sets of ALDs for the grade 10 ELA, grade 10 math, and grades 5 and 8 STE, shown in [Appendix A](#AppendixA), indicate the knowledge and skills that students performing at a given achievement level should be able to demonstrate within each specific content area and at each grade-level. A multi-step process was used to develop, review, and approve the ALDs for each assessment. Prior to the standard setting meeting, the ESE content staff worked in cooperation with staff from the Center for Instructional Support (CIS) to create a draft set of ALDs for each content and grade-level specific course. Educators from the ESE’s Assessment Development Committees also reviewed the drafts. The set of ALDs for each grade within each subject was created, such that they represented a gradual increase in expectations across the achievement levels within a grade and across grades. Descriptors were developed for the *Partially Meeting Expectations, Meeting Expectations,* and *Exceeding Expectations* only. A student classified as *Not Meeting Expectations* has not demonstrated the knowledge, skills, and abilities necessary to achieve *Partially Meeting Expectations.*

Teachers who participated in the standard setting committees had the opportunity to provide suggestions and edits to the draft set of ALDs, based on their recommended cut score for each achievement level and the items they reviewed during the standard setting meeting. To produce the final set of ALDs, the ESE content staff will edit the set of draft ALDs based on suggestions generated by the participants in the standard setting meeting.

Cut Scores

The cut scores that were recommended for adoption for the MCAS assessments are based on a standardized set of procedures implemented during the standard setting meetings. Details pertaining to the general methods used during the meetings for obtaining the recommended cut scores and the resulting recommendations are provided below.

Standard Setting Meeting

From August 5 to August 7, 2019, after the first year of operational administration in spring 2019, a standard setting meeting was conducted to obtain cut score recommendations for each test. There were four committees, with each recommending cut scores for one assessment:

* ELA grade 10
* Math grade 10
* STE Committees
  + STE grade 5
  + STE grade 8

Each committee was composed of between 18 to 20 individuals, including teachers and non-teacher educators (e.g., administrators, curriculum specialists, professors of higher education). The participants were selected for the standard setting committee to provide content and grade-level expertise during the committee meeting and be representative of the state teaching population, including geographic region, gender, ethnicity, educational experience, community size, and community socioeconomic status.

The Extended Modified (Yes/No) Angoff standard setting method was used for the standard setting meeting (Davis & Moyer, 2015; Plake, Ferdous, Impara, & Buckendahl, 2005). This is a content- and item-based method that leads participants through a standardized process through which they consider student expectations, as defined by ALDs, and the individual items administered to students to recommend cut scores for each achievement level. The standardized process was used by the committees for each grade/subject.

The process started with participants experiencing the test from the spring 2019 administration within the online testing system. Based on their experience with the test items and a review of the draft ALDs, panelists created borderline descriptions. During this process, participants worked within their committees to modify the draft ALDs to create descriptors of the knowledge, skills, and abilities that “borderline” students, or those students who just barely enter an achievement level, would be expected to demonstrate.

During the judgment process, participants reviewed each item on the test, referencing the borderline descriptions, and answered the following question for each achievement level:

“How many points would a student with performance at the borderline of the [specific] achievement level likely earn if he or she answered the question?”

The cut score recommendation for each individual participant was the expected raw score a borderline student at the respective achievement level would likely earn, calculated as the sum of the individual item judgments. For the purposes of the standard setting, “likely” was defined as 2 out 3 students at the borderline level. Each recommended cut score from the standard setting committee was the median of the recommendations from the individual participants in the committee.

Additionally, the percentage of students who would be classified into each achievement level based on committee recommendations—also known as impact data—was calculated. The impact data were determined using student data from the spring 2019 online administration. As part of the discussion of the round 2 judgments, the impact were was presented, based on the round 2 recommendations, so the participants could see the resulting student achievement level classifications prior to making their round 3 recommendations. For the grade 10 ELA and math committees, the panelists were also presented the impact data for grades 7 and 8, from the 2017 standard setting process, to review the impact data from their recommendations in alignment with the impact data from those grades. This information was also presented at the end of the round 3 cut score recommendations.

The results (Round 3 recommendations) from the standard setting meeting for the STE and grade 10 committees are presented in Tables 2 and 3, respectively.

**Table 2. Standard Setting Recommendations for STE Tests (Grades 5 and 8)**

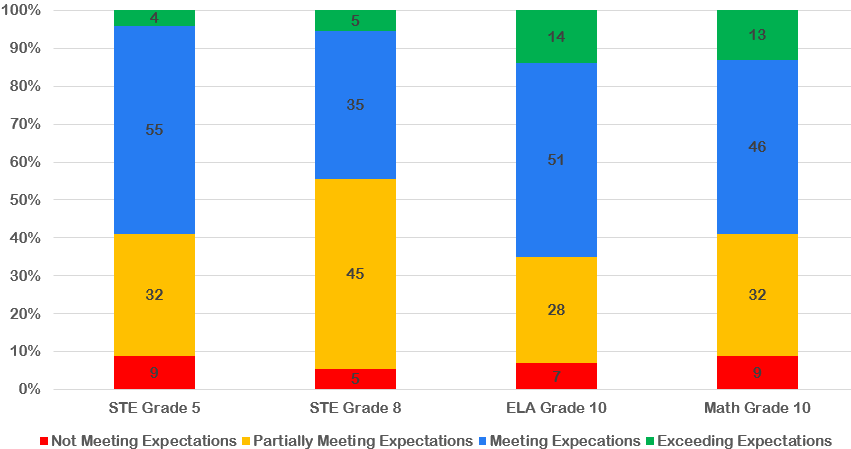
|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade** | **Achievement Level** | | | | | | | | |
| **Not Meeting Expectations** | | **Partially Meeting Expectations** | | **Meeting Expectations** | | **Exceeding Expectations** | | |
| **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** |
| 5 | 0 to 15 | 9 | 16 to 29 | 32 | 30 to 46 | 55 | 47 to 54 | 4 |
| 8 | 0 to 16 | 5 | 17 to 32 | 45 | 33 to 45 | 35 | 46 to 54 | 5 |

**Table 3. Standard Setting Recommendations for Grade 10 Tests (ELA and Mathematics)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject** | **Achievement Level** | | | | | | | |
| **Not Meeting Expectations** | | **Partially Meeting Expectations** | | **Meeting Expectations** | | **Exceeding Expectations** | |
| **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** |
| ELA | 0 to 20 | 7 | 21 to 36 | 28 | 37 to 46 | 51 | 47 to 51 | 14 |
| Math | 0 to 12 | 9 | 13 to 31 | 32 | 32 to 52 | 46 | 53 to 60 | 13 |

Figure 1 presents the impact data from the final recommendations from the standard setting meeting as stacked bar graphs.

**Figure 1. Impact Data for STE, ELA and Math Tests based on Standard Setting Recommendations**



Vertical Articulation Meeting

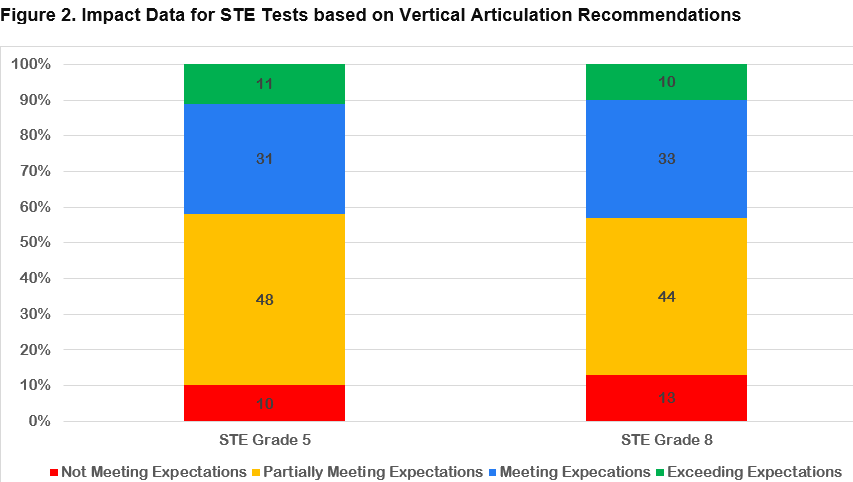
Subsequent to the standard setting meeting, on August 7, 2019, a vertical articulation meeting was convened. The meeting consisted of one committee that reviewed the STE cut score recommendations from both grades. The participants of the vertical articulation meeting consisted of table leaders from each of the standard setting committees and other committee members selected prior to the standard setting meeting. The focus of the vertical articulation meeting was to review the cut score recommendations from the standard setting meeting along with impact data to consider whether and to what extent adjustments to the recommended cut scores might be warranted based on both content and policy. The adjustments to the recommendations made by the vertical articulation committees were influenced by a desire to honor the content-based recommendations of the standard setting process, maintain high expectations for achievement across the MCAS assessments, and ensure the relationship among standards was coherent and defensible.

Tables 4 presents the results from the vertical articulation meeting for STE.

**Table 4. Vertical Articulation Recommendations for STE Tests (Grades 5 and 8)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade** | **Achievement Level** | | | | | | | | |
| **Not Meeting Expectations** | | **Partially Meeting Expectations** | | **Meeting Expectations** | | **Exceeding Expectations** | | |
| **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** |
| 5 | 0 to 16 | 10 | 17 to 34 | 48 | 35 to 43 | 31 | 44 to 54 | 11 |
| 8 | 0 to 15 | 13 | 16 to 31 | 44 | 32 to 42 | 33 | 43 to 54 | 10 |

Figure 2 presents the impact data from the final recommendations from the vertical articulation meeting as stacked bar graphs.



Reporting Scale

The process of determining the transformation rules from the Item Response Theory (IRT) scale to the final reporting scale was guided by several principals identified by ESE:

1. The final cut scores achieved through the scaling solution should respect the cut score recommendations from the standard setting and vertical articulation committees as closely as possible.
2. The impact data from the final scaling solution should reflect a coherent assessment system across the grades.
3. The reporting scaled scores for the three achievement level cuts should be the same across grades and tests.
4. The scaling solution should involve a single linear transformation, from the IRT scale to the reporting scale.
5. The reporting scaled score range should be the same across grades and tests.

An iterative process involving Pearson, Cognia, and ESE was used to determine a final reporting scale and transformation rules for each test. First, based on recommended raw score cuts for the three achievement levels, the IRT scale cuts were adjusted so that the differences between every two IRT scale cuts were the same, allowing for a single linear transformation rule. Based on the adjusted IRT cut scores, scaling constants for the linear transformation were determined. Using the scaling constants, look-up tables for each grade and test were created, displaying the relationship between the raw scores and reporting scaled scores. Based on the look-up tables, adjusted raw score cuts for each achievement level were determined. Finally, the resulting impact data based on the adjusted raw score cuts were calculated and reviewed to ensure a coherent system across grades. This process was repeated several times until a final scaling solution was determined.

The recommended reporting scale ranges from a lowest obtainable scale score (LOSS) of 440 to a highest obtainable scale score (HOSS) of 560. In order to create common points of reference across the assessments, the same scaled score cuts for each achievement level were defined, with a *Partially Meeting Expectations* cut of 470, a *Meeting Expectations* cut of 500, and an *Exceeding Expectations* cut of 530. While the cut scores were defined with the same scaled scores and descriptions across the grades, they are not identical, and direct comparisons through averaging and aggregation across grades should not be made without study and/or statistical adjustments. The scaled scores and distributions of students resulting from the cuts set for STE, ELA, and mathematics were not designed for direct comparison.

Tables 5 and 6 present the results from the final scaling solutions for the STE and grade 10 tests, respectively.

**Table 5. Final Recommendations for STE Tests (Grades 5 and 8)**

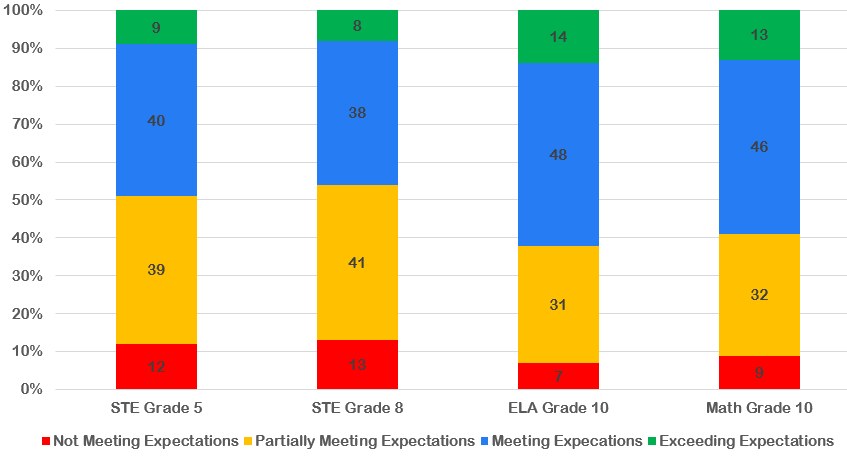
|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade** | **Achievement Level** | | | | | | | | |
| **Not Meeting Expectations** | | **Partially Meeting Expectations** | | **Meeting Expectations** | | **Exceeding Expectations** | | |
| **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** |
| 5 | 0 to 17 | 12 | 18 to 32 | 39 | 33 to 44 | 40 | 45 to 54 | 9 |
| 8 | 0 to 15 | 13 | 16 to 30 | 41 | 31 to 43 | 38 | 44 to 54 | 8 |

**Table 6. Final Recommendations for Grade 10 Tests (ELA and Mathematics)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject** | **Achievement Level** | | | | | | | |
| **Not Meeting Expectations** | | **Partially Meeting Expectations** | | **Meeting Expectations** | | **Exceeding Expectations** | |
| **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** | **Raw Score Range** | **% in Level** |
| ELA | 0 to 20 | 7 | 21 to 37 | 31 | 38 to 46 | 48 | 47 to 51 | 14 |
| Math | 0 to 12 | 9 | 13 to 31 | 32 | 32 to 52 | 46 | 53 to 60 | 13 |

Figure 3 presents the impact data from the final recommendations as stacked bar graphs.

**Figure 3. Impact Data for STE, ELA, and Math Tests based on Final Recommendations**



The final approved result from this standard setting will be used for future administrations of the MCAS grade 10 ELA and math tests, and grades 5 and 8 STE tests, to classify student results into achievement levels for reporting until it is determined that new standards need to be established for the MCAS by the ESE.

Interim Legacy Achievement Cut Score Validation

On the previous (“legacy”) version of the grade 10 MCAS tests, a student was required for graduation to earn a competency determination by receiving a score of 240 (Proficient) or receiving a score between 220 and 238 and fulfilling the requirements of an Educational Proficiency Plan (EPP). As part of the transition to the next-generation MCAS, the Board of Elementary and Secondary Education voted to establish an interim competency determination standard for school graduation. Interim standards would be defined as a similar level of achievement to the required standards on the legacy tests. Students taking the next-generation MCAS during 2019 and 2020 would be evaluated against the interim standards on each test.

The interim legacy achievement level standards were first identified through a statistical linking process. An equipercentile linking method was used to statistically establish an association between the raw scores from the spring 2018 and spring 2019 administrations of the MCAS tests. The statistically defined interim cuts on the next-generation MCAS would likely represent similar levels of achievement by establishing similar impact levels across assessments. This is accomplished through determining the raw scores on the spring 2019 administration of the next-generation MCAS which would result in percentiles equal to those associated with the raw scores for each of the achievement levels from the spring 2018 administration of the legacy MCAS tests. The equipercentile linking process was completed using a matched sample from the spring 2018 and spring 2019 populations, to ensure that the populations used in the process were similar across various categories, including ability, gender, ethnicity, and economic status. Recommended interim legacy achievement level cut scores were determined for each achievement level for both the grade 10 ELA and grade 10 math tests.

After the standard setting committees completed their cut score recommendations, a subset of panelists from the grade 10 committees were convened to review and validate the recommended interim legacy MCAS achievement level cut scores that were statistically established. The panelists reviewed the performance of students from the spring 2018 administration on the legacy MCAS to determine general descriptions of the achievement of students at the borderline of each legacy achievement level. The general descriptions were then used by the panelists to review the performance of students from the spring 2019 administration on the next-generation MCAS at the recommended interim legacy cut scores. Based on their review, the panelists completed a validation judgment survey where they answered the following question:

“Based on your review, does the recommended interim cut score on the spring 2019 next-generation MCAS for the achievement level represent similar expectations as on the spring 2018 legacy MCAS?”

If the panelist responded “no” to the question, they were provided the opportunity to select a raw score that they determined represented similar expectations. If half or more of the panelists responded “yes” to the question, the interim cut score was validated by the panelists. If less than half of the panelists responded “yes” to the question, the interim cut score recommendation was defined as the median of the panelist recommendations.

The result of the panelists’ recommendations was that each of the interim legacy cut scores were validated by the committees. Table 6 displays the interim cut score recommendations for the legacy achievement levels on the next-generation MCAS.

**Table 6. Validated Recommended Cut Scores for the Legacy Achievement Levels**

|  |  |  |  |
| --- | --- | --- | --- |
| **Subject** | **Legacy Achievement Levels** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Grade 10 ELA | 13 | 22 | 38 |
| Grade 10 Math | 12 | 21 | 35 |

References

Davis, L. L. & Moyer, E. L. (2015). PARCC performance level setting technical report. Available from Partnership for Assessment of Readiness for College and Careers (PARCC), Washington, D.C.

Plake, B. S., Ferdous, A. A., Impara, J. C., & Buckendahl, C. W. (2005). *Setting Multiple Performance Standards Using the Yes/No Method: An Alternative Item Mapping Method.* Meeting of the National Council on Measurement in Education*.* Montreal, Canada.

Appendix A – Achievement Level Descriptors

Grade 5 MCAS Science and Technology/Engineering Achievement Level Descriptors

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations,* and *Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Partially Meeting Expectations  *On MCAS, a student at this level:*** | **Meeting Expectations  *On MCAS, a student at this level:*** | **Exceeding Expectations  *On MCAS, a student at this level:*** |
| **Understanding and Application of Disciplinary Core Ideas** | Demonstrates a partial understanding of some scientific concepts and processes by identifying and sometimes describing or providing evidence for these concepts and processes.  Uses some basic scientific terms in common scientific examples. | Demonstrates a solid understanding of many scientific concepts and processes by mostly describing, explaining, and providing evidence for these concepts and processes.  Mostly applies appropriate scientific terms in a variety of applications, including common science examples and some novel situations. | Demonstrates a comprehensive, in-depth understanding of many scientific concepts and processes by consistently describing, explaining, and providing evidence for these concepts and processes.  Consistently applies scientific terms in appropriate contexts in both common science examples and many novel situations. |
| **Understanding and Application of Scientific and Engineering Practices** | Identifies a testable, scientific question for an investigation.  Completes a simple, commonly used model.  Uses simple graphs or data to draw general conclusions about a familiar scientific investigation or phenomena.  Identifies evidence to support a claim.  Describes a benefit or drawback of simple design features given a familiar device or prototype. | Develops some testable, scientific questions for an investigation.  Completes or uses a model and describes some strengths and weaknesses of the model.  Analyzes multiple sources of data, including graphs and tables, to draw conclusions about a familiar scientific investigation or phenomena.  Provides some evidence to support a claim and constructs basic explanations for scientific phenomena or results from an investigation.  Analyzes design features of a familiar device or prototype and describes a benefit or drawback of the design. | Consistently develops testable, scientific questions for an investigation.  Creates a model, consistently describes the strengths and weaknesses of the model, and provides information for how to improve the model.  Analyzes multiple sources of data, including graphs and tables, to draw conclusions about a novel or complex scientific investigation or phenomena.  Provides several pieces of evidence to support a claim and constructs thorough explanations for scientific phenomena or results from an investigation.  Analyzes design features of a novel device or prototype and constructs an explanation for how the design features meet criteria for success or are limited by constraints. |

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations,* and *Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

|  |  |  |  |
| --- | --- | --- | --- |
| **Earth and Space Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **ESS1. Earth’s Place in the Universe** | Identifies the Sun, the Moon, and Earth in a model.  Recognizes that the Sun is a star.  Recognizes that people at different locations on Earth may experience day and night at the same time.  Given a pattern of moon phases, selects the Moon phase that completes the pattern.  Recognizes that shadows change over the course of a day because of the apparent movement of the Sun.  Supports a claim with evidence that an environment has changed over time, such as a forested area that was once covered by water.  Classifies whether geologic structures were formed by erosion or deposition. | Completes a model of the Sun, the Moon, and Earth and mostly describes the movements of each.  Recognizes that the Sun is the only star in our solar system.  Constructs an explanation for why people on Earth experience day and night.  Describes how the Moon reflects the Sun’s light and makes a pattern over approximately one month.  Uses a model to show the pattern of the Moon over a week or a month.  Completes a model showing the relationship between a shadow’s length and the position of the Sun in the sky.  Generally describes the processes of erosion or deposition.  Identifies the relative age of rock layers based on the position of the rock layers. | Develops a model of the Sun, the Moon, and Earth and consistently describes the movements of each.  Explains why the Sun appears brighter than other stars.  Constructs an explanation with evidence for why people at one location on Earth are experiencing day while people at another location on Earth are experiencing night.  Explains how the Moon’s reflection of the Sun’s light and the orbit of the Moon are responsible for the phases of the Moon.  Constructs an explanation for why the length and direction of a shadow changes during a day.  Constructs an explanation with evidence of how erosion and deposition can change geologic structures or an area over time. |

|  |  |  |  |
| --- | --- | --- | --- |
| **ESS2. Earth’s Systems** | Uses weather data tables or simple graphs to describe one of the following: precipitation, wind speed, or temperature for an area.  Differentiates between two different types of climate.  Completes a simple model of the water cycle.  Identifies on a map where a volcano or earthquake is likely to occur.  Recognizes evidence of weathering or erosion in a diagram or simple description.  Interprets simple graphs to draw general conclusions about the relative amounts of fresh and salt water on Earth. | Analyzes simple weather data patterns to describe expected weather for an area.  Analyzes climate data for several different regions and describes differences in weather patterns. Recognizes that different regions can have different climate types.  Completes a model of the water cycle and describes what is happening in most of the water cycle stages.  Analyzes a map to locate where mountain ranges, ocean trenches, volcanoes, and earthquakes are likely to occur.  Describes the processes of weathering and erosion and applies them to common examples, such as landslides, canyons, valleys, etc.  Analyzes a map to identify water sources as fresh or salt water, including fresh water stored in glaciers and polar ice caps. | Analyzes and interprets graphs and tables to draw conclusions about various weather patterns.  Explains the difference between weather and climate and uses climate data to draw conclusions about the expected weather patterns of different climate types (e.g., desert, tropical, tundra).  Develops a model of the water cycle, including absorption and surface runoff, and describe how heat energy is needed for water to cycle.  Explains why mountain ranges, ocean trenches, volcanoes, and earthquakes occur at plate boundaries.  Explains how landscapes change due to weathering and erosion and provides examples of each process.  Describes different sources of fresh water and salt water and explains why it is important to understand the relative amounts of these types of water on Earth. |
| **ESS3. Earth and Human Activity** | Categorizes some common examples of renewable and nonrenewable energy resources.  Identifies one way to reduce human impact on the environment for a given situation.  Identifies one design solution to reduce the impact of a weather event, such as a hurricane, or other natural event, such as an earthquake, on humans.  Identifies a testable question about a filter to determine how well the filter will work. | Explains why some sources of energy are considered renewable and others are not.  Consistently categorizes energy sources as either renewable or nonrenewable.  Describes different ways to reduce human impact on the environment for a given situation.  Identifies multiple design solutions to reduce the impact of a weather event or other natural event on humans.  Develops a testable question about how to improve the design of a filtering system and provides information about how to answer the question. | Explains how humans have impacted the environment in different ways and constructs explanations for how to reduce those impacts on the environment.  Identifies multiple design solutions to reduce the impact of a weather event or other natural event on humans and explains how each design solution could reduce the impact.  Develops testable questions about how to make several improvements to the design of a filtering system and provides evidence for how the improvements will better filter the water. |

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| --- | --- | --- | --- |
| **Life Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **LS1. From Molecules to Organisms: Structures and Processes** | Completes a model of an organism’s life cycle and describes the importance of one stage of the life cycle.  Supports a claim with evidence about how the function of an animal or plant structure helps it to survive.  Recognizes that photosynthesis is important for the survival of a plant. | Compares the life cycles of two organisms and describes similarities between the two life cycles, including the importance of some of the stages.  Supports claims with evidence about how different functions of animal or plant structures helps the animal or plant to survive.  Completes a model showing some of the inputs (sunlight, air, water) or outputs (sugars) of photosynthesis. | Constructs an explanation for why each stage of the life cycle is important, using example of both plants and animals.  Supports claims with evidence about how several structures of animals and plants allow for the survival, growth, and reproduction of different organisms.  Develops a model showing the inputs and outputs of photosynthesis and explains the importance of photosynthesis for the survival and growth of a plant. |
| **LS2. Ecosystems: Interactions, Energy, and Dynamics** | Analyzes a simple food web or other model and identifies the ecological role of some of the organisms.  Recognizes that the energy organisms depend on originates from the Sun.  Describes one way animals and plants use energy.  Identifies the function of a composter and one design element of a composter.  Identifies a type of organism (bacteria or fungi) that breaks down dead organisms. | Analyzes a food web or other model, identifies the ecological roles of several of the organisms, and describes some of the roles of the organisms.  Analyzes a model and describes the flow of energy through a simple food web.  Analyzes several composter designs and describes some advantages and disadvantages of each design.  Describes the importance of decomposers in recycling matter back to the soil. | Analyzes food webs and other models and consistently describes the ecological roles of the organisms.  Completes a model to show energy transfer through a food web and describes how energy is transferred from one organism to another.  Analyzes several composter designs, describes several advantages and disadvantages of each, and explains which composter is best to use.  Explains what would happen to an ecosystem without decomposers, and explains how decomposers recycle matter back into both the soil and air. |
| **LS3. Heredity: Inheritance and Variation of Traits** | Provides observable evidence that traits are inherited from a parent.  Recognizes that some basic characteristics are inherited, while others are a result of the environment. | Analyzes data and draws some conclusions about familiar traits that are inherited and characteristics that are a result of the environment. | Analyzes novel data and draws conclusions about traits that are inherited and characteristics that are a result of the environment. |
| **LS4. Biological Evolution: Unity and Diversity** | Identifies the type of environment where an organism once lived based on fossilized remains.  Supports a claim with one piece of evidence for how some individuals within a population may have a survival advantage over other individuals in the population.  Uses evidence, such as an organism’s structure, to describe how an organism is well adapted to its environment.  Recognizes what may happen to an organism if its environment changes and it is unable to move away or adapt to the changing environment. | Classifies fossils based on their physical characteristics, including the type of environment where the fossilized organism once lived.  Supports a claim with several pieces of evidence for how some individuals within a population may have a survival advantage over other individuals in the population.  Identifies an example of how an organism is well adapted to its environment.  Describes what will happen to a population if individuals within that population are unable to reproduce. | Constructs an explanation for why the fossil record is incomplete due to many organisms not being fossilized.  Given data about the characteristics of a novel organism, draws conclusions and explains how the organism is well adapted to its environment.  Explains, with evidence, if an organism is likely to survive environmental changes.  Explains why reproduction is critical to the survival of a species. |

|  |  |  |  |
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| **Physical Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **PS1. Matter and Its Interactions** | Analyzes a simple particle model of matter and identifies the phase of the substance.  Completes a graph to show the masses of substances after a phase change or after a chemical reaction.  Analyzes a simple set of data to determine the best material to use in a common situation, based on the material’s characteristic properties.  Determines if a chemical reaction occurred or if a mixture was formed during an investigation and provides one piece of evidence to support the claim. | Analyzes a particle model of a substance before and after a phase change to determine phases of the substance and the phase change that occurred.  Constructs an explanation about how mass is conserved during a phase change or a chemical reaction.  Analyzes a set of data about materials, identifies the best material to use in a given situation, and provides evidence for the reasoning.  Develops a question to determine if a chemical reaction occurred or if a mixture was formed during an investigation and provides possible answers to the question with pieces of evidence to support the answers. | Analyzes particle models of substances before and after phase changes to determine the phase change that occurred and describes whether heat was added or removed.  Describes an investigation that could be used to show that mass is conserved during a phase change or chemical reaction.  Analyzes multiple sets of data to determine the best materials to use in a variety of different situations, based on the material’s characteristic properties. Supports the conclusions with evidence from the data.  Describes an investigation that could be used to determine if a chemical reaction will occur or if a mixture will be formed when two substances are combined and includes information about evidence that would be needed to make the determination. |
| **PS2. Motion and Stability: Forces and Interactions** | Interprets a diagram to determine if balanced forces are acting on an object.  Labels a model showing the direction of the gravitational force on an object on Earth.  Identifies if two magnets will be attracted to each other or repelled from each other based on the magnets’ orientations.  Recognizes that either an attractive or a repulsive force exists between two magnets. | Determines if the motion of an object will change, based on a diagram showing the forces acting on the object.  Describes how friction affects the motion of an object.  Completes a model showing the direction of the gravitational force on multiple objects that are on or near the surface of Earth.  Completes a model of the poles on several magnets based on whether the magnets attract each other or repel each other. | Completes a diagram of the forces acting on an object based on whether the object is at rest, moving at a constant speed, or changing speed and explains the reasoning.  Describes how different surface textures affect friction.  Constructs an explanation about the gravitational force exerted by Earth on objects always being toward the center of Earth.  Describes an investigation that could be used to determine the poles of magnets and explains what evidence could be used to make this determination. |
| **PS3. Energy** | Interprets a graph that shows the relationship between speed and kinetic energy.  Identifies one type of energy that is produced when a collision occurs.  Describes one way that energy can be moved from one place to another.  Interprets a familiar situation to describe one way that stored energy is converted to another type of energy. | Describes the relationship between the speed of an object and the kinetic energy of that object.  Describes the energy conversions that take place when two objects collide.  Interprets a given scenario and describe one way that energy is transferred in the scenario.  Describes two energy conversions in a given situation including kinetic energy being converted to electrical energy and/or stored energy being converted into another type of energy. | Completes a graph showing the kinetic energy of object as the speed of the object changes and explains why the graph should be completed in that way.  Constructs an explanation about the energy conversions that take place when two objects collide and supports the explanation with evidence.  Analyzes a novel scenario and describes multiple ways that energy is transferred from place to place and how energy is converted in multiple ways. |
| **PS4. Waves and Their Applications in Technologies for Information Transfer** | Recognizes that waves can cause an object to move.  Uses a simple model of a wave to show that the wave has a regular pattern.  Recognizes that light must be reflected off an object and enter the eye for the object to be seen.  Given a communication system, identifies one component (encoder, decoder, receiver, sender) of the system. | Generally describes that waves carry energy and can cause objects to move.  Completes a model showing that a wave has a regular pattern of motion.  Develops a model to show how light reflects off an object and enters the eye so the object can be seen.  Describes at least two components of a given communication system. | Constructs an explanation about how an object can be moved by the energy of a wave.  Explains how objects are seen by the eye, using evidence from a given scenario.  Consistently describes the components of a communication system for a given scenario. |

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| **Technology/ Engineering** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **ETS1. Engineering Design**  **and**  **ETS3. Technological Systems** | Identifies a criterion for success and a constraint when given a simple design problem.  Identifies one solution to a simple engineering design problem.  Analyzes different representations of a simple design solution and chooses the most appropriate one for a given situation.  Identifies the importance of a prototype.  Identifies the difference between an innovation and an invention. | Describes several criteria for success and constraints when given a design problem.  Generates a solution to an engineering design problem and generally explains how the solution could be successful based on evidence.  Analyzes different representations of a design solution, chooses the most appropriate representation for the given situation, and explains the reasoning.  Identifies several design features of a prototype and explains how these features are important to the design of the prototype.  Analyzes a design feature of a prototype and explains the importance of a prototype.  Describes one innovation to an existing technology.  Provides an example of an invention, including common examples and some novel examples. | Explains how certain criteria for success and constraints will impact the solution to a design problem.  Generates two or more solutions to an engineering design problem and explains in detail how the solutions could be successful, and identifies possible failure points for each solution.  Describes an appropriate representation for a design solution and explains the reasoning.  Describes several design features of prototypes and explains the benefits and possible limitations of each.  Explains why prototypes are constructed and explains the importance of redesigning a prototype.  Explains why a novel technology is an innovation or an invention, given a description of the technology. |

Grade 8 MCAS Science and Technology/Engineering Achievement Level Descriptors

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations,* and *Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

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|  | **Partially Meeting Expectations  *On MCAS, a student at this level:*** | **Meeting Expectations  *On MCAS, a student at this level:*** | **Exceeding Expectations  *On MCAS, a student at this level:*** |
| **Understanding and Application of Disciplinary Core Ideas** | Demonstrates a partial understanding of some scientific concepts and processes by identifying and sometimes describing or providing evidence for these concepts and processes.  Uses some basic scientific terms in common scientific examples. | Demonstrates a solid understanding of many scientific concepts and processes by mostly describing, explaining, and providing evidence for these concepts and processes.  Mostly applies appropriate scientific terms in a variety of applications, including common science examples and some novel situations. | Demonstrates a comprehensive, in-depth understanding of many scientific concepts and processes by consistently describing, explaining, and providing evidence for these concepts and processes.  Consistently applies scientific terms in appropriate contexts in both common science examples and many novel situations. |
| **Understanding and Application of Scientific and Engineering Practices** | Identifies a testable, scientific question for an investigation.  Completes a simple, commonly used model.  Uses simple graphs or data to draw general conclusions about a familiar scientific investigation or phenomena.  Identifies evidence to support a claim.  Describes a benefit or drawback of simple design features given a familiar device or prototype. | Develops some testable, scientific questions for an investigation.  Completes or uses a model and describes some strengths and weaknesses of the model.  Analyzes multiple sources of data, including graphs and tables, to draw conclusions about a familiar scientific investigation or phenomena.  Provides some evidence to support a claim and constructs basic explanations for scientific phenomena or results from an investigation.  Analyzes design features of a familiar device or prototype and describes a benefit or drawback of the design. | Consistently develops testable, scientific questions for an investigation.  Creates a model, consistently describes the strengths and weaknesses of the model, and provides information for how to improve the model.  Analyzes multiple sources of data, including graphs and tables, to draw conclusions about a novel or complex scientific investigation or phenomena.  Provides several pieces of evidence to support a claim and constructs thorough explanations for scientific phenomena or results from an investigation.  Analyzes design features of a novel device or prototype and constructs an explanation for how the design features meet criteria for success or are limited by constraints. |

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| **Earth and Space Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **ESS1. Earth’s Place in the Universe** | Completes a model of the Earth-Sun-Moon system to show either a solar or a lunar eclipse.  Identifies the basic pattern of the moon phases.  Recognizes that the tilt of Earth’s axis causes the seasons.  Recognizes that gravity affects high and low tides, Earth’s orbit, and the Moon’s orbit.  Recognizes that the Milky Way galaxy contains many solar systems and that Earth is one planet within our solar system.  Identifies the bottom layer of rock as the oldest and the top layer of rock as the youngest.  Identifies some of the processes that play a role in the formation of rock. | Develops a model showing the positions of the Sun, the Moon, and Earth during a solar or a lunar eclipse.  Completes a model of the moon phases.  Compares the intensity of sunlight at different locations on Earth during different seasons of the year.  Analyzes models to determine where high and low tides occur based on the position of the Moon.  Describes the role that gravity plays in orbital motions.  Orders the planets, our solar system, the Milky Way galaxy, and the universe by their relative sizes.  Analyzes a model showing several layers of rock and draws conclusions about the relative ages of the fossils found in the rock layers.  Uses rock layers and fossil evidence to describe how the geology of a particular area has changed over time, such as from a sea floor to a forest. | Constructs an explanation for why people see solar and lunar eclipses on Earth.  Constructs an explanation for why people on Earth observe the phases of the Moon.  Analyzes a graph to describe how changes in the duration and intensity of sunlight during a year determines the seasons. Supports conclusions with evidence from the graph.  Completes models showing where high and low tides occur and explains why there are high and low tides in these locations.  Compares and draws conclusions about the force of gravity on planets, moons, asteroids, comets, etc. in our solar system.  Analyzes a model showing several layers of rock containing a fault to draw a conclusion about the relative age of the fault.  Constructs an explanation for how rock layers and geologic structures, such as canyons, volcanoes, mountains, and beaches, are formed through weathering, erosion, heat, pressure, and/or deposition. |
| **ESS2. Earth’s Systems** | Uses a model to show that geologic structures, such as volcanoes and mountain ranges, are formed where plates are pushed together.  Recognizes that surface structures continue to change over time due to geologic processes, such as weathering, erosion, glaciation, and the movement of Earth’s plates.  Completes a model showing the primary steps of the water cycle.  Analyzes weather data and draws simple conclusions about the precipitation and temperature of an area.  Recognizes that temperatures near the ocean are more stable than temperatures of inland locations. | Uses a model to describe the role of convection currents in the movement of Earth’s plates and identifies where convection currents occur.  Describes how geologic processes form and shape geologic structures, such as mid-ocean ridges, mountains, and volcanoes, and cause geologic events, including earthquakes, landslides, and volcanic eruptions.  Analyzes maps and other evidence to draw conclusions about the movement of Earth’s plates.  Describes the role of solar energy and gravity in the water cycle.  Describes the weather conditions that typically occur when cool and warm air masses collide. | Constructs an explanation for how the movement of Earth’s plates causes various geologic events, such as earthquakes, volcanic eruptions, and tsunamis.  Uses data to explain the relative time scales different geologic structures form over.  Supports a claim about the movement of Earth’s plates using several pieces of evidence, such as the shapes of continents and the locations of specific fossils and types of rock.  Describes evidence that glaciers were once present in an area.  Constructs an explanation for how each stage of the water cycle is dependent upon energy from the Sun and/or the Earth’s gravity.  Describes how air masses move and how the movement of air masses affects the weather in an area. |
| **ESS3. Earth and Human Activity** | Analyzes a basic map to draw general conclusions about the distribution of minerals or fossil fuels on Earth.  Identifies one way that humans can mitigate the impact of increases in human population on natural resources and the environment.  Analyzes a simple graph or data table to draw conclusions about how climate change is affecting an area. | Provides a partial explanation for why some resources, such as fossil fuels, water, and mineral/ores, are unevenly distributed on Earth.  Describes various ways that humans can mitigate the overuse of Earth’s resources, such as using renewable energy sources, recycling, using public transportation, etc.  Analyzes data to describe how climate change is affecting an ecosystem and describes one way that humans can reduce the effects of climate change on the ecosystem. | Explains why natural resources are unevenly distributed on Earth.  Analyzes data, including graphs and maps, to draw conclusions about how humans use natural resources and identifies some ways human can mitigate the overuse of these resources.  Constructs an explanation using evidence that human activities, such as fossil fuel combustion, agriculture, and deforestation, have played a role in rising global temperatures over the past century.  Describes several ways humans can mitigate the effects of climate change. |

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| **Life Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **LS1. From Molecules to Organisms: Structures and Processes** | Recognizes that animal, plant, and bacterial cells have some shared characteristics and some different characteristics.  Recognizes some parts of a cell and the function of some cell parts.  Describes two body systems and how they work together.  Identifies some behaviors and structures of plants and animals that enables them to survive and successfully reproduce.  Identifies a characteristic that is inherited and a characteristic that is mostly a result of the environment.  Recognizes that all organisms need an energy source and nutrients to survive. | Uses the characteristics of cells to categorize an organism as an animal, plant, or bacteria.  Given a diagram of a cell, identifies the cell parts and describes most functions of the cell parts.  Generally describes how different body systems work together.  Provides evidence for how some organisms are able survive and reproduce more than other organisms.  Analyzes information about an organism to determine which characteristics are inherited and which characteristics are mostly a result of the environment.  Describes how carbohydrates, proteins, and fats are broken down to support cell growth and to release energy (cellular respiration). | Compares animal, plant, and bacterial cells and identifies both similarities and differences between them.  Consistently describes the functions of cell parts.  Describes how the interactions between body systems can be affected by a condition or disease based on the functions of the body systems.  Expalins how various structures and behaviors can provide survival and reproductive advantages to plants and animals.  Uses evidence to explain why some characteristics are inherited and other characteristics are a result of both inheritance and the environment.  Using a model, explains how food molecules are broken down and rearranged to provide nutrients for cell growth and energy for cellular processes. |
| **LS2. Ecosystems: Interactions, Energy, and Dynamics** | Interprets graphs to determine whether the size of a population increased, decreased, or stayed the same.  Identifies one ecological relationship (competitive, predator-prey, parasitic, or mutually beneficial) when given a description of the interaction of two organisms.  Recognizes that the biodiversity of a population is positively correlated with its size.  Identifies how an ecosystem and how an organism living in the ecosystem can be helped by a human action. | Analyzes population data, including graphs, to describe changes in the size a particular population over time.  Identifies several ecological relationships when given the interactions of organisms in an environment (including analyzing a food web).  Completes models to show the cycling of matter through photosynthesis, cellular respiration, and decomposition.  Uses a model of an ecosystem to describe how a disruption to the ecosystem can have an effect on an organism in the ecosystem.  Describes multiple ways how the biodiversity of a population can be increased.  Describes several ways an ecosystem and the organisms living in the ecosystem can be helped by human actions. | Constructs an explanation for the reasons why populations grow versus decline over time.  Analyzes a complex food web and describes the ecological roles of the organisms.  Consistently describes the roles of producers, primary, secondary, tertiary consumers, and decomposers in a model.  Develops a model to show the cycling of matter and energy through an ecosystem, including the role of photosynthesis, cellular respiration, and decomposition.  Uses a model of an ecosystem to construct an explanation with evidence for how a natural or manmade disruption to the environment can affect multiple populations in the ecosystem.  Evaluates competing designs for protecting an ecosystem and its inhabitants from threats such as climate change, habitat loss, pollution, or overharvesting of resources. |
| **LS3. Heredity: Inheritance and Variation of Traits** | Uses a model to show that chromosomes are made up of genetic information.  Identifies one benefit of sexual reproduction or one benefit of asexual reproduction.  Recognizes that offspring from sexual reproduction inherit genes and characteristics from two parents.  Analyzes a simple Punnett square to determine the expected percentage of offspring with a certain trait. | Completes a model to show that chromosomes hold genes and genes hold the instructions for proteins.  Describes mutations as changes to genes.Identifies examples of mutations that are harmful, beneficial, or neutral to changes in traits of an organism.  Describes some of the benefits and drawbacks of sexual versus asexual reproduction.  Completes a Punnett square to determine the expected percentage of offspring that will inherit certain genotypes (allele pairs) and phenotypes (traits). | Develops a model to show that chromosomes are made up of genes and that genes contain the instructions for proteins, which determine the inherited characteristics of an organism.  Describes how a mutation may be harmful, neutral, or beneficial to an organism depending on its interactions with the environment.  Constructs an explanation for why some organisms benefit from asexual reproduction while other organisms benefit from sexual reproduction.  Develops a model to show that sexual reproduction results in sets of chromosomes (found in the nucleus) from each parent, and therefore an allele for each gene is inherited from each parent. |
| **LS4. Biological Evolution: Unity and Diversity** | Analyzes fossil evidence to draw conclusions about different organisms living at different times.  Compares a structure in a living organism to a structure from a fossilized organism and draws a conclusion about their similarity.  Recognizes that individuals with certain inherited characteristics have a higher probability of surviving than individuals without those characteristics.  Identifies one difference between natural selection and artificial selection. | Analyzes fossil evidence to describe how the environment in an area has changed over geologic time.  Explains how living and fossilized organisms can have similar body structures with similar or different functions.  Identifies examples of natural selection and generally explains why they are examples of natural selection.  Compares examples of natural selection and artificial selection. | Constructs an explanation using fossil evidence for how similar structures can be used to infer whether two types of organism share a recent common ancestor.  Constructs an explanation for how a trait can become more common in a population over time due to natural selection.  Describes advantages and disadvantages of both natural and artificial selection. |

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| **Physical Science** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **PS1. Matter and Its Interactions** | Identifies that all living and non-living things are made-up of atoms.  Identifies that mixtures can be separated by physical means.  Using data, identifies one piece of evidence that a chemical reaction or a physical change occurred.  Interprets a particle model to determine the three states of matter shown in the model.  Recognizes that a new substance is formed when a chemical reaction occurs.  Given data, determines if energy is being absorbed or released in a chemical reaction.  Calculates the density of an object given its mass and volume. | Completes a model showing how atoms form compounds and molecules.  Describes how mixtures are made up of pure substances that can be separated by physical means.  Using data, identifies multiple pieces of evidence that a chemical reaction or a physical change occurred.  Partially describes how particle motion, spatial arrangement, or temperature of a substance change when thermal energy is added to or removed from the substance.  Completes a bar graph to show the conservation of mass in a chemical reaction or a physical change.  Given a chemical reaction, identifies if it is exothermic and endothermic based on whether or not thermal energy is released or absorbed.  Describes, compares, and calculates the densities of different materials. | Analyzes a chemical formula to determine the number of each type of atom that makes up a given molecule.  Analyzes data to determine which substances are pure substances.  Explains the difference between a chemical reaction and a physical change and provides multiple pieces of evidence to support the explanation.  Consistently describes how particle motion, spatial arrangement, and temperature of a substance change when thermal energy is added to or removed from the substance.  Relates temperature to a measure of average kinetic energy and recognizes that temperature/kinetic energy does not change as a substance is changing state.  Supports a claim that matter is not created or destroyed during a chemical reaction or a physical change, using evidence from an investigation.  Describes the difference between an endothermic and exothermic reaction. Supports the description with evidence from a chemical reaction.  Determines whether an object would float or sink in water due its density and supports the answer with evidence. |
| **PS2. Motion and Stability: Forces and Interactions** | Given a model, recognizes that an object that applies a force to another object will also experience a force acting on it.  Recognizes that the speed of an object will change if the mass of the object changes and the forces acting on the object are constant.  Recognizes that the speed of an object will change if the forces acting on the object are not balanced.  Recognizes that two positive charges or two negative charges will repel each other, and a negative charge and a positive charge will attract each other.  Completes a model, to show that gravitational forces are always attractive.  Using a model, describes how an object can exert forces on another object, even when the objects are not in contact with each other. | Analyzes models to draw conclusions about the forces acting on objects during a collision.  Completes a graph to show how the change in speed of an object, with a constant net force acting on it, depends on the mass of the object.  Completes a model to show whether the speed of an object will increase, decrease, or remain constant based on the forces acting on an object.  Completes a model to show how the distance between two electric charges or the magnitudes of the charges affects the strength of the forces between the charges.  Describes how the mass of objects affects the gravitational forces on the objects.  Completes a model of the electric, magnetic, or gravitational field around an object. | Develops models to show the forces acting on objects before, during, and after a collision.  Develops a model to show how the change in speed of an object depends on the mass of the object and the net force acting on the object.  Uses data to construct an explanation about how the distance between two electric charges or the magnitudes of the charges affects the strength of the force between the charges.  Develops a model showing the relative magnitudes of gravitational forces acting between two objects.  Completes a model of the electric, magnetic, or gravitational field between two objects. |
| **PS3. Energy** | Interprets a graph to show how the kinetic energy of an object relates to the speed of the object, or vice versa.  Interprets data to describe what will happen to an object’s kinetic energy as its potential energy decreases.  Identifies the flow of thermal energy from hot to cold.  Identifies an example of conduction, radiation, or convection.  Describes how it takes more time to heat an object that has more mass than an object (of the same material) with less mass.  Using a graph, determines how an increase in average kinetic energy of an object results in an increase in temperature. | Completes a graph to show how the kinetic energy of an object relates to the speed of the object, or vice versa.  Analyzes information, including graphics and data, and generally describes how the kinetic and potential energies of an object compare at different heights, when energy is conserved.  Analyzes the conversions of different types of potential energy into kinetic energy and vice versa to draw conclusions about energy conservation.  Generally describes how thermal energy is transferred through conduction, radiation, and convection and generally describes ways this heat flow can be increased or decreased in a given situation.  Analyzes data and draws conclusions to describe how certain materials will better conduct thermal energy compared to others.  Describes how average kinetic energy is related to temperature. | Uses a graph to show how the kinetic energy of an object relates to the speed of the object, or vice versa, and explains the reasoning.  Analyzes information, including graphics and data, and consistently describes how the kinetic and potential energies of an object compare at different heights, and is able to explain that energy is conserved.  Explains how different types of potential energies are converted to kinetic energy and vice versa.  Explains how thermal energy is transferred through conduction, radiation, and convection and fully describes ways the rate of this heat flow can be increased or decreased in a given situation.  Constructs an explanation to show the relationships among the amount of energy transferred between objects, how well materials of the objects retain or radiate heat, the masses of the objects, and the changes in the average kinetic energies of the object’s materials. |
| **PS4. Waves and Their Applications in Technologies for Information Transfer** | Completes a model of a wave to show its frequency, amplitude, or wavelength.  Given a model, sometimes identifies where waves are reflected, absorbed, or transmitted through a material.  Identifies when a signal is either encoded or transmitted. | Compares two waves’ frequencies, amplitudes, and wavelengths, and sometimes describes how these characteristics will affect the waves.  Completes a model showing reflection, absorption, and transmission of a wave, including how waves are refracted.  Describes the processes of encoding and transmitting. | Compares two or more waves’ frequencies, amplitudes, and wavelengths, and consistently describes how these characteristics will affect the pattern of a wave.  Develops a model to explain how waves are reflected, absorbed, or transmitted in a given situation, including how waves are refracted. |

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| **Technology/ Engineering** | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| **ETS1. Engineering Design** | Identifies criteria and constraints of a design problem. Identifies one solution to a simple problem.  Uses a simple design matrix to determine the best solution.  Sometimes solves simple scale problems, given the actual measurement or the scaled measurement.  Analyzes a design feature of a prototype and identifies the importance of a prototype. | Describes some criteria and constraints of a design problem. Describes a solution to a problem and explains how it could be successful based on evidence.  Uses a design matrix to draw conclusions about possible solutions.  Solves scale problems, given the actual measurement or the scaled measurement.  Generally describes appropriate design features of a prototype and describes the importance of a prototype. | Describes several criteria and constraints of a design problem. Describes several solutions to a problem and explains their limitations and benefits based on evidence.  Uses a design matrix to draw conclusions about possible solutions and explains the reasoning.  Explains when a scale drawing should be used, and determines an appropriate scale for a given situation.  Consistently describes appropriate design features of prototypes for a given situation. |
| **ETS2. Materials, Tools, and Manufacturing** | Recognizes basic properties of common materials (such as wood, metal, and plastic).  Given data, chooses a material for a design problem given its characteristics.  Given a set of tools, chooses the best tool for a given task.  Identifies and describes some of the manufacturing processes (forming, separating, conditioning, assembling, finishing, quality control, and safety).  Identifies an advantage or a disadvantage of using a computer or a human for a given task. | Describes properties (such as flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point) of common materials and generally uses the materials for appropriate design solutions.  Describes the best tools to use for a given situation.  Generally describes a few steps of the manufacturing process in a given situation.  Provides an advantage and a disadvantage of using a computer or a human for a given task. | Evaluates different materials and determines the best materials to use for a given design problem. Explains the reasoning, giving both drawbacks and benefits of the materials.  Consistently describes several steps of the manufacturing process in a given situation.  Provides multiple advantages and/or disadvantages of using a computer or a human for a given task. |
| **ETS3. Technological Systems** | Identifies and describes the functions of some components of a communication system (source, encoder, transmitter, receiver, decoder, and storage).  Given a diagram, identifies and describes some of the functions of some components of a vehicle (structural, propulsion, guidance, suspension, and control subsystems).  Given a diagram, identifies and describes some of the parts of a structural system (foundation, decking, wall, and roofing).  Given a diagram, identifies a force (tension, torsion, compression, and shear) acting on a structure.  Given a transportation, structural, or communication system, identifies some of the components of an engineering system: inputs, processes, outputs, and feedback. | Completes a model and describes the functions of several components of a communication system.  Completes a model and describes most of the functions of some components of a vehicle.  Identifies and describes most of the parts of a given structural system.  Identifies and describes two forces acting on a shown structure. Identifies live and dead loads for a given scenario.  Given a transportation, structural, or communication system, identifies and describes several components of an engineering system. | Develops a model and describes the functions of the components of a communication system.  Develops a model and describes most of the functions of the components of a transportation system.  Consistently identifies and describes the parts of a given structural system.  Consistently identifies and describes forces acting on a shown structure. Describes live and dead loads for a given scenario.    Given a transportation, structural, or communication system, consistently identifies and describes components of an engineering system. |

Grade 10 MCAS English Language Arts Achievement Level Descriptors

**General: Grades 3 through 8 and 10**

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations,* and *Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students’ work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

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|  | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| Reading | Demonstrates **partial** understanding of what a text implies and states explicitly; cites **limited** textual support for conclusions; **incompletely** summarizes key details and ideas; provides a **partial** analysis of a character, an event, or an idea in grade-appropriate texts  Demonstrates **partial** understanding of words and phrases used in a text; provides **limited** understanding of how structural elements, point of view, or purpose affects the content and style in text(s)  Makes **basic** comparisons between texts; shows **partial** understanding of content in diverse media; **partially** evaluates and analyzes claims and evidence in text(s) | Demonstrates **sufficient** understanding of what a text implies and states explicitly; cites **solid** textual support for conclusions; **appropriately** summarizes key details and ideas; provides a **mostly complete** analysis of a character, an event, or an idea in grade-appropriate texts  Demonstrates **general** understanding of words and phrases used in a text;provides **general understanding** of how structural elements, point of view, or purpose affects the content and style in text(s)  Makes **appropriate** comparisons between texts; shows **solid** understanding of content in diverse media; **appropriately** evaluates and analyzes claims and evidence in text(s) | Demonstrates **comprehensive** understanding of what a text implies and states explicitly; cites **in-depth** textual support for conclusions; **skillfully** summarizes key details and ideas; provides a **sophisticated** analysis of a character, an event, or an idea in grade-appropriate texts  Demonstrates **in-depth** understanding of words and phrases used in a text; provides **sophisticated** understanding of how structural elements, point of view, or purpose affects the content and style in text(s)  Makes **insightful** comparisons between texts; shows **sophisticated** understanding of content in diverse media; **insightfully** evaluates and analyzes claims and evidence in text(s) |
| Writing | Produces **basic** writing with **limited** selection and explanation of evidence and details related to grade-appropriate texts, topics, or subject areas  Produces writing with **little** development of a central idea or sequenced events, **limited** organization, and **basic** expression of ideas  Exhibits **partial** awareness of task, purpose, and audience | Produces **solid** writing with **appropriate** selection and explanation of evidence and details related to grade-appropriate texts, topics, or subject areas  Produces writing with **appropriate** development of a central idea or sequenced events, **moderate** organization, and **adequate** expression of ideas  Exhibits **sufficient** awareness of task, purpose, and audience | Produces **clear** writing with **skillful** selection and explanation of evidence and details related to grade-appropriate texts, topics, or subject areas  Produces writing with **full** development of a central idea or sequenced events, **effective** organization, and **clear** expression of ideas  Exhibits **full** awareness of task, purpose, and audience |
| Language | Demonstrates **limited** reading vocabulary of general academic and domain-specific words and phrases in grade-appropriate texts  Demonstrates **limited** understanding of unfamiliar words in text and shows **partial** understanding of word parts and word relationships in word meanings  Demonstrates **little** control of the standard English conventions of sentence structure, grammar, usage, and mechanics | Demonstrates **solid** reading vocabulary of general academic and domain-specific words and phrases in grade-appropriate texts  Demonstrates **solid** understanding of unfamiliar words in text and shows **sufficient** understanding of word parts and word relationships in word meanings  Demonstrates **mostly consistent** control of the standard English conventions of sentence structure, grammar, usage, and mechanics | Demonstrates **comprehensive** reading vocabulary of general academic and domain-specific words and phrases in grade-appropriate texts  Demonstrates **comprehensive** understanding of unfamiliar words in text and shows **full** understanding of word parts and word relationships in word meanings  Demonstrates **consistent** control of the standard English conventions of sentence structure, grammar, usage, and mechanics |

**DRAFT Grade 10**

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations,* and *Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students’ work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Partially Meeting Expectations**  ***On MCAS, a student at this level:*** | **Meeting Expectations**  ***On MCAS, a student at this level:*** | **Exceeding Expectations**  ***On MCAS, a student at this level:*** |
| Reading | **Partially** analyzes what a text implies and states explicitly; uses **little** evidence to support the analysis; **incompletely** identifies and analyzes the development of a central idea or theme of a text; provides a **limited** analysis of how characters, events or ideas are developed and interact across sufficiently complex texts    **Partially** determines meanings (e.g., figurative, connotative, technical) of words and phrases and analyzes how they impact meaning and tone; demonstrates **limited** understanding of how structural elements and point of view contribute to the overall development of ideas or purpose  Provides a **basic** analysis between texts; **partially** integrates information from different sources; **partially** analyzes and evaluates important claims, arguments, or themes in multiple texts | **Adequately** analyzes what a text implies and states explicitly; uses **sufficient** evidence to support the analysis; **appropriately** identifies and analyzes the development of a central idea or theme of a text; provides a **mostly complete** analysis of how characters, events or ideas are developed and interact across sufficiently complex texts  **Appropriately** determines meanings (e.g., figurative, connotative, technical) of words and phrases and analyzes how they impact meaning and tone; demonstrates **general** understanding of how structural elements and point of view contribute to the overall development of ideas or purpose  Providesan **appropriate** analysis between texts; **solidly** integrates information from different sources; **appropriately** analyzes and evaluates important claims, arguments, or themes in multiple texts | **Insightfully** analyzes what a text implies and states explicitly; uses **strong** and **thorough** evidence to support the analysis; **skillfully** identifies and analyzes the development of a central idea or theme of a text; provides a **sophisticated** analysis of how characters, events or ideas are developed and interact across sufficiently complex texts  **Skillfully** determines meanings (e.g., figurative, connotative, technical) of words and phrases and analyzes how they impact meaning and tone; demonstrates **sophisticated** understanding of how structural elements and point of view contribute to the overall development of ideas or purpose  Provides an **insightful** analysis between texts; **skillfully** integrates information from different sources; **insightfully** analyzes and evaluates important claims, arguments, or themes in multiple texts |
| Writing | Produces **basic** writing with **limited** selection and explanation of evidence and details related to sufficiently complex texts, topics, or subject areas  Produces writing with **little** development of a **basic** central idea, thesis, or sequenced events; **limited** organization; and **basic** expression of ideas  Exhibits **partial** awareness of task, purpose, and audience | Produces **solid** writing with **appropriate** selection and explanation of evidence and details related to sufficiently complex texts, topics, or subject areas  Produces writing with **adequate** development of a **solid** central idea, thesis, or sequenced events; **moderate** organization; and **appropriate** expression of ideas  Exhibits **sufficient** awareness of task, purpose, and audience | Produces **clear** and **sophisticated** writing with **skillful** selection and explanation of evidence and details related to sufficiently complex texts, topics, or subject areas  Produces writing with **full** development of an **insightful** central idea, thesis, or sequenced events; **skillful** organization; and **rich** expression of ideas  Exhibits **full** awareness of task, purpose, and audience |
| Language | Demonstrates **limited** reading vocabulary of sufficiently complex academic and domain-specific words and phrases  **Partially** determines the meaning of unfamiliar words in text using a variety of strategies; shows **partial** understanding of various grammatical rules and literary devices in a text  Demonstrates **little** control of the standard English conventions of sentence structure, grammar, usage, and mechanics | Demonstrates **solid** reading vocabulary of sufficiently complex academic and domain-specific words and phrases  **Sufficiently** determines the meaning of unfamiliar words in text using a variety of strategies; shows **sufficient** understanding of various grammatical rules and literary devices in a text  Demonstrates **mostly consistent** control of the standard English conventions of sentence structure, grammar, usage, and mechanics | Demonstrates **comprehensive** reading vocabulary of sufficiently complex academic and domain-specific words and phrases  **Skillfully** determines the meaning of unfamiliar words in text using a variety of strategies; shows **full** understanding of various grammatical rules and literary devices in a text  Demonstrates **consistent** control of the standard English conventions of sentence structure, grammar, usage, and mechanics |

Grade 10 MCAS Mathematics Achievement Level Descriptors

**Mathematics: Grades 3 through 8 and 10**

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations, and Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Partially Meeting Expectations  On MCAS, a student at this level:** | **Meeting Expectations  On MCAS, a student at this level:** | **Exceeding Expectations  On MCAS, a student at this level:** |
| **Conceptual Understanding and Procedural Knowledge** | * Demonstrates partial understanding of the grade appropriate numeration system * Performs some calculations and estimations * Identifies examples of basic math facts or mathematical concepts * Mostly reads and sometimes constructs graphs, tables and charts | * Applies understanding of the base-ten system and fractions to interpret numbers and solve problems * Performs most calculations and estimations * Describes mathematical concepts and generates examples and counterexamples of concepts * Represents data and mathematical relationships using equations, verbal descriptions, tables, and graphs | * Performs complex calculations and estimations * Selects the best representations for a given set of data * Explains relationships between models such as equations, verbal descriptions, tables, and graphs * Applies math facts and connects mathematical concepts from various areas of mathematics, and uses the concepts to develop generalizations * Recognizes and makes use of structure, discerning patterns by seeing complicated things as single objects |
| **Problem Solving** | * Applies learned procedures to solve routine problems * Uses concrete objects or pictures to help conceptualize and solve problems. | * Applies learned procedures and mathematical concepts to solve a variety of problems, including multi-step problems * Solves problems using multiple methods   Demonstrates the relationships between operations used to solve problems and the context of the problems | * Generates strategies and procedures to solve non-routine problems * Solves problems using multiple methods, evaluating reasonableness of intermediate steps leading to the standard algorithms * Draws connections between strategies * Analyzes givens, constraints, and relationships in problems, using multiple methods and appropriate tools |
| **Mathematical Reasoning** | * Applies some reasoning methods to solve routine problems | * Uses a variety of reasoning methods to solve routine and non-routine problems * Uses symbols to solve routine mathematical problems | * Reasons abstractly and quantitatively, using multiple reasoning methods to solve complex problems and provides justification for the reasoning * Decontextualizes situations and represents them symbolically |
| **Mathematical Communication** | * Identifies and uses basic terms | * Uses logical forms of representation (e.g., text, graphs, symbols) to illustrate steps to a solution | * Uses logical forms of representation (e.g., text, graphs, symbols) to justify solutions and solution strategies * Constructs viable arguments and critiques the reasoning of others, attending to precision |

**Mathematics: Grade 10**

Student results on the MCAS tests are reported according to four achievement levels: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations, and Not Meeting Expectations.* The descriptors below illustrate the knowledge and skills students demonstrate on MCAS at each level. Knowledge and skills are cumulative at each level. No descriptors are provided for the *Not Meeting Expectations* achievement level because students work at this level, by definition, does not meet the criteria of the *Partially Meeting Expectations* level.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Partially Meeting Expectations**  **On MCAS, a student at this level:** | **Meeting Expectations**  **On MCAS, a student at this level:** | **Exceeding Expectations**  **On MCAS, a student at this level:** |
| **Number and Quantity** | * Rewrites expressions involving integer exponents using the properties of exponents * Uses units as a way to understand problems and chooses units consistently in formulas * Chooses the scale and the origin in graphs and data displays * Identifies significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure * Identifies appropriate quantities for the purpose of descriptive modeling | * Rewrites expressions involving radical and rational exponents using the properties of exponents * Performs operations on rational and irrational numbers * Determines whether the solution of operations on two numbers would be rational or irrational * Interprets units consistently in formulas and uses units to solve multi-step problems. * Interprets the scale and the origin in graphs and data displays * Defines appropriate quantities for the purpose of descriptive modeling * Chooses a level of accuracy appropriate to limitations on measurement when reporting quantities * Describes the effects of approximate error in measurement and rounding on measurements and on computed values from measurements | * Explains how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of radical exponents * Explains why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational numbers is irrational; and that the product of a nonzero rational number and an irrational number is irrational |
| **Algebra** | * Usually interprets parts and structures of linear expressions * Chooses an equivalent form of an expression to reveal properties of the quantity represented by the expression * Identifies, combines and expands like terms when performing operations on polynomial expressions * Creates linear equations and inequalities in one variable and uses them to solve problems * Creates equations in two variables to represent relations between quantities * Graphs the equations on coordinate axes with labels and scales * Rearranges formulas to highlight a quantity of interest using the same reasoning as in solving equations * Solves and explains each step in solving linear equations and inequalities in one variable * Solves system of linear equations exactly and approximately * Knows that the graph of an equation in two variables is the set of all its solutions * Graphs the solutions of linear inequality in two variables | * Consistently interprets parts of an expression based on real-world context * Usually interprets the structure of quadratic and exponential expressions with integer exponents * Factors polynomial expressions * Creates quadratic and exponential equations in one variable and uses them to solve problems * Creates equations with more than two variables * Represents constraints by linear equations/ inequalities and by systems of linear equations/inequalities * Constructs viable arguments to justify or refute a solution method for linear equations/inequalities * Usually solves linear equation/inequalities in one variable involving absolute value * Solves a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically * Finds and is able to explain the solutions of linear equations y = f(x) and y = g(x) approximately, using technology to graph the functions and make tables of values * Graphs the solution set of a system of linear inequalities in two variables | * Interprets complicated expressions by viewing one or more of their parts as a single entity * Chooses and produces an equivalent form of an expression to explain properties of the quantity represented by the expression * Completes the square in a quadratic expression to reveal the maximum or minimum value of the function it defines * Recognizes that the system of polynomials is similar to the system of integers in that they are both closed under certain operations * Interprets solutions of linear equations or inequalities as viable or non-viable options in a modeling context * Uses the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x* – *p*)2 = *q* that has the same solutions * Derives the quadratic formula * Recognizes when solutions of a quadratic equation results in non-real solutions and write them as a ± b*i* for real numbers a and b * Proves that, given a system of equations in two variables, replacing one equation by the sum of that equation and a multiple of the other to produces a system with the same solutions |
| **Functions** | * Knows the structure of a function and uses function notation to evaluate and interpret functions * Distinguishes between an arithmetic and a geometric sequence * Interprets key features of graphs and tables for a function that models a relationship * Calculates and interprets the average rate of change of a function presented symbolically or as a table * Graphs linear functions to show intercepts * Compares properties of functions each represented algebraically, graphically, numerically in tables, or by verbal descriptions * Distinguishes between situations that model linear functions and exponential functions * Constructs linear functions given a graph, a description of a relationship, or input-output pairs * Draws comparisons between exponential and linear graphs | * Interprets symmetries of graphs and tables in terms of the quantities * Relates the domain of a function to its graph * Estimates the rate of change from a graph. * Graphs functions and uses the properties of functions to create equivalent functions * Interprets zeros, maximum/minimum values, and symmetry of the graph * Writes quadratic and exponential functions to describe relationship between quantities * Determines an explicit expression or steps for calculation from a context * Writes arithmetic and geometric sequences both recursively and with an explicit formula * Identifies the effect on a graph of a function by replacing f(x) with f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k * Finds the inverse of a linear function * Constructs exponential functions given a graph, a description of a relationship, or input-output pairs * Draws comparisons between exponential and quadratic graphs * Interprets the parameters in a linear function | * Recognizes that sequences are functions that are sometimes defined recursively * Interprets relative maximums and minimums and end behavior of graphs and tables in terms of the quantities * Uses graphs to show relative maximums and minimums; symmetries; and end behavior * Graphs piecewise-defined functions, including step functions * Creates equivalent functions to explain different properties of the function * Uses process of completing the square in a quadratic function to show zeros, maximum/minimum values, and symmetry of the graph * Determines a recursive process, or steps for calculation from a context * Uses recursive and explicit formulas to model situations, and translates between the two forms * Utilizes technology to experiment with cases and illustrates an explanation of the effects on the graph of linear, quadratic, exponential, or absolute value functions * Interprets the parameters in an exponential function |
| **Geometry** | * Knows precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc * Represents rigid transformations in the plane * Compares transformations that preserve distance and angle to those that do not and identifies a sequence of transformations that will carry a given figure onto another * Finds angle sum and exterior angle of triangles, angles created when parallel lines are cut by a transversal, and angle-angle criterion for similarity of triangles * Uses congruence and similarity criteria for triangles to solve problems * Uses Pythagorean Theorem to solve right triangles * Uses coordinates to compute perimeters of polygons and areas of triangles and rectangles * Uses volume formulas for cylinders, cones, and spheres to solve problems | * Uses geometric descriptions of rigid motions to solve problems * Applies properties of polygons to the solutions of problems * Verifies experimentally the properties of dilations given by a center and a scale factor * Uses congruence and similarity criteria for triangles to prove relationships in geometric figures * Knows that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles * Uses Pythagorean Theorem to solve right triangles in applied problems * Identifies relationships among inscribed angles, radii, and chords * Uses the fact that the length of the arc intercepted by an angle is proportional to the radius to solve problems * Uses the slope criteria for parallel and perpendicular lines to solve geometric problems * Finds the point on a directed line segment between two given points that partitions the segment in a given ratio * Uses volume formulas for pyramids to solve problems | * Develops definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments * Explains how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions * Makes formal geometric constructions * Proves theorems about:   + triangles   + parallelograms   + circles   + polygons * Proves the Pythagorean Theorem using triangle similarity * Explains the relationship between the sine and cosine of complementary angles. * Uses trigonometric ratios to solve right triangles in applied problems * Uses relationships among inscribed angles, radii, and chords to solve problems * Derives the formula for the area of a sector. * Derives the equation of a circleto find the center and the radius * Derives the equation of a parabola given a focus and directrix * Uses coordinates to prove simple geometric theorems algebraically, including the distance formula and its relationship to the Pythagorean Theorem * Proves the slope criteria for parallel and perpendicular lines * Uses dissection arguments, Cavalieri’s principle, and informal limit arguments to give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone |
| **Statistics and Probability** | * Represents data with plots on the real number line * Usually uses statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets * Usually interprets differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) * Interprets relative frequencies in the context of the data * Represents data on two quantitative variables on a scatter plot and describes how the data are related * Fits a linear function for a scatter plot that suggests a linear association and interprets the slope and the intercept of the model * Informally assesses the fit of a function by plotting and analyzing residuals * Describes events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events * Constructs and interprets two-way frequency tables of data when two categories are associated with each object being classified | * Consistently uses statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets * Consistently interprets differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) * Recognizes possible associations and trends in the data contained in a two-way frequency table * Fits a linear function to the data and uses the fitted function to solve problems in the context of the data * Computes and interprets the correlation coefficient of a linear fit * Distinguish between dependent and independent events * Uses a two-way table to approximate conditional probabilities * Recognizes the concepts of conditional probability and independence in everyday language and everyday situations * Applies the addition rule to calculate probabilities | * Applies the addition rule and interprets the answer in terms of the model * Distinguishes between correlation and causation * Knows that the conditional probability of A given B is P(A and B)/P(B) and uses it to solve problems * Explains the concepts of conditional probability and independence in everyday language and everyday situations |

Appendix B – Final Recommended Cut Scores on IRT Scale and Scaling Constants

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Subject** | **Grade** | **Cut Score (IRT)** | | | **Scaling Constants** | |
| **Partially Meeting Expectations** | **Meeting Expectations** | **Exceeding Expectations** | **A** | **B** |
| STE | 5 | -1.62097 | -0.11154 | 1.39789 | 19.87505 | 502.2169 |
| STE | 8 | -1.49893 | -0.02015 | 1.45863 | 20.28695 | 500.4088 |
| ELA | 10 | -1.72777 | -0.29884 | 1.13009 | 20.99473 | 506.2741 |
| Math | 10 | -1.72060 | -0.31698 | 1.08665 | 21.37327 | 506.7748 |