

# Characteristics of Highly Effective Mathematics Teaching and Learning

## Section One: Learning Climate

**Learning Climate:** a safe environment supported by the teacher in which high, clear expectations and positive relationships are fostered; active learning is promoted

### **Teacher Characteristics:**

**A – Teacher creates learning environments where students are active participants as individuals and as members of collaborative groups. The teacher:**

1) models literacy and numeracy strategies to enable students to communicate and analyze mathematical problems/tasks and solutions.

**B – Teacher motivates students and nurtures their desire to learn in a safe, healthy and supportive environment which develops compassion and mutual respect.**

**C – Teacher cultivates cross cultural understandings and the value of diversity.**

**D – Teacher encourages students to accept responsibility for their own learning and accommodates the diverse learning needs of all students.**

**E – Teacher displays effective and efficient classroom management that includes classroom routines that promote comfort, order and appropriate student behaviors.**

**F – Teacher provides students equitable access to technology, space, tools and time. The teacher:**

1) provides access to the common core curriculum by utilizing differentiated teaching strategies, interventions, manipulatives, calculators, information technology, etc.

**G – Teacher effectively allocates time for students to engage in hands-on experiences, discuss and process content and make meaningful connections**

**H – Teacher designs lessons that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of learning.**

**I – Teacher creates an environment where student work is valued, appreciated and used as a learning tool. The teacher:**

1) provides opportunities for students to share mathematical ideas with others and to problem solve.

### **Student Characteristics:**

**A – Student accepts responsibility for his/her own learning. The student:**

1) asks for clarifications or additional resources when needed,

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- 2) explains alternate methods to determine solutions and/or
- 3) analyzes mathematical concepts for understanding.

## **B – Student actively participates and is authentically engaged. The student:**

- 1) utilizes literacy and numeracy skills to communicate and analyze mathematical problems/tasks and solutions.

## **C – Student collaborates/teams with other students. The student:**

- 1) collaborates to examine mathematical ideas and procedures to communicate, reason and problem solve.

## **D – Student exhibits a sense of accomplishment and confidence.**

## **E – Student takes educational risks in class. The student:**

- 1) refutes mathematical processes/solutions,
- 2) listens carefully and
- 3) asks questions to clarify mathematical thinking.

## **F – Student practices and engages in safe, responsible and ethical use of technology.**

## Section Two: Classroom Assessment and Reflection

**Classroom Assessment and Reflection:** the teacher and student collaboratively gather information and reflect on learning through a systematic process that informs instruction

### **Teacher characteristics:**

**A – Teacher uses multiple methods and systematically gathers data about student understanding and ability.**

**B – Teacher uses student work/data, observations of instruction, assignments and interactions with colleagues to reflect on and improve teaching practice. The teacher:**

- 1) uses practical applications of current research on classroom assessment as a basis on which to improve mathematics pedagogy.

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**C – Teacher revises instructional strategies based upon student’s achievement data. The teacher:**

- 1) makes assessments (formative and summative) an integral component of instructional decision making.
- 2) utilizes assessment guidelines explicitly for the purpose of improving instruction and increasing student achievement.

**D – Teacher uncovers students’ prior understanding of the concepts to be addressed and addresses students’ misconceptions/incomplete conceptions. The teacher:**

- 1) uses this information to determine students’ range of strategies and skills in order to design cutting-edge instruction to stretch student thinking.

**E – Teacher co-develops scoring guides/rubrics with students and provides adequate modeling to make clear the expectations for quality performance. The teacher:**

- 1) shares this information for the purpose of demonstrating proficient work in mathematics.

**F – Teacher guides students to apply rubrics to assess their performance and identify improvement strategies.**

**G – Teacher provides regular and timely feedback to students and parents that moves learners forward. The teacher:**

- 1) gives feedback that is focused, descriptive, and qualitative.

**H – Teacher allows students to use feedback to improve their work before a grade is assigned.**

**I – Teacher facilitates students in self- and peer-assessment.**

**J – Teacher reflects on work and makes adjustments as learning occurs.**

### **Student Characteristics:**

**A – Student recognizes what proficient work looks like and determines steps necessary for improving his/her work.**

**B– Student develops and/or uses scoring guides periodically to assess his/her own work or that of peers.**

**C– Student uses teacher feedback to improve his/her work.**

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**D – Student reflects on work and makes adjustments as learning occurs.**

**E-Student reflects on work and makes adjustments as learning occurs.**

## Section Three: Instructional Rigor and Student Engagement

**Instructional Rigor and Student Engagement:** a teacher supports and encourages a student’s commitment to initiate and complete complex, inquiry-based learning requiring creative and critical thinking with attention to problem solving

### **Teacher Characteristics:**

**A – Teacher instructs the complex processes, concepts and principles contained in state and national standards using differentiated strategies that make instruction accessible to all students.**

**The teacher:**

- 1) plans and integrates appropriate differentiated strategies to ensure all students have access to quality mathematics.
- 2) utilizes current curriculum documents in the development of course outlines/maps in order to ensure instructional rigor.

**B – Teacher scaffolds instruction to help students reason and develop problem-solving strategies.**

**The teacher:**

- 1) scaffolds instruction to align with students’ levels of learning for the purpose of helping students reason and solve cognitively challenging mathematical tasks utilizing appropriate problem-solving strategies.

**C – Teacher orchestrates effective classroom discussions, questioning, and learning tasks that promote higher-order thinking skills. The teacher:**

- 1) facilitates effective classroom discussion and learning tasks that promote reasoning higher-order thinking skills that involve reasoning, conjecturing, proof, and validating.
- 2) helps students understand mathematical structures and the connections among them.

**D – Teacher provides meaningful learning opportunities for students. The teacher:**

- 1) provides opportunities for students to be actively engaged in mathematics activities which promote meaningful learning and discussions among students.
- 2) introduces appropriate mathematics representations (pictures, objects, symbols) that allow students to communicate and connect mathematical ideas effectively.

**E – Teacher challenges students to think deeply about problems and encourages/models a variety of approaches to a solution. The teacher:**

- 1) models a variety of approaches for solving mathematics problems and challenges students to reflect on their approaches and the approaches of other students.

**F – Teacher integrates a variety of learning resources with classroom instruction to increase learning options. The teacher:**

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1) models and integrates a variety of learning resources (technology including computers, software, calculators, manipulatives, diagrams) in classroom instruction for the purpose of understanding and solving mathematics problems and communicating their solutions.

**G – Teacher structures and facilitates ongoing formal and informal discussions based on a shared understanding of rules and discourse.**

**H – Teacher integrates the application of inquiry skills into learning experiences. The teacher:**

1) requires students to explore and reason about mathematical ideas.

**I – Teacher clarifies and shares with students learning intentions/targets and criteria for success.**

**The teacher:**

1) communicates these using student friendly language so that students have an understanding of mathematical proficiency.

### Student Characteristics:

**A – Student articulates and understands learning intentions/targets and criteria for success.**

**B – Student reads with understanding a variety of texts. The student:**

1) reads and solves contextual problems using a variety of strategies.

**C – Student applies and refines inquiry skills. The student:**

- 1) asks questions and identifies concepts to guide problem solving,
- 2) uses appropriate tools (technology and manipulatives) to facilitate mathematical reasoning,
- 3) collaborates with other students, and/or
- 4) justifies solutions to problems by communicating through symbolic, hands-on, or spoken representations.

## Section Four: Instructional Relevance

**Instructional Relevance:** a teacher's ability to facilitate learning experiences that are meaningful to students and prepare them for their futures.

### Teacher Characteristics:

**A – Teacher designs learning opportunities that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of the learning. The teacher:**

- 1) designs learning opportunities that allow students to participate in relevant activities.
- 2) establishes a learning environment so that students will realize learning is a process and mistakes are a natural part of learning.
- 3) models the characteristics of a lifelong learner in his/her instruction by asking guiding questions of self and students.

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**B – Teacher links concepts and key ideas to students’ prior experiences and understandings, uses multiple representations, examples and explanations. The teacher:**

- 1) demonstrates how the big ideas in mathematics are connected.
- 2) uses multiple representations, relevant examples and clear explanations to enhance student learning.

**C – Teacher incorporates student experiences, interests and real-life situations in instruction.**

**D – Teacher selects and utilizes a variety of technology that support student learning.**

**E – Teacher effectively incorporates 21st Century Learning Skills that prepare students to meet future challenges.**

**F – Teacher works with other teachers to make connections between and among disciplines. The teacher:**

- 1) poses real-world problems involving other disciplines for students to solve by applying mathematical reasoning.

**G – Teacher makes lesson connections to community, society, and current events. The teacher:**

- 1) poses real-world problems involving community, society and current events for students to solve by applying mathematical reasoning.

### **Student Characteristics:**

**A – Student poses and responds to meaningful questions. The student:**

- 1) listens carefully.
- 2) asks questions to clarify mathematical thinking.
- 3) refutes mathematical processes/solutions.
- 4) shows persistence during the process of learning.

**B – Student uses appropriate tools and techniques to gather, analyze, and interpret quantitative and qualitative data. The student:**

- 1) uses multiple representations (e.g., charts, models, graphs, symbols, tables, and diagrams) to communicate mathematically and to uncover different aspects of the problem.

**C – Student develops descriptions, explanations, predictions, and models using evidence. The student:**

- 1) uses these when communicating about mathematical reasoning.

**D – Student works collaboratively to address complex, authentic problems which require innovative approaches to solve. The student:**

- 1) works on mathematics that is connected to other content areas.
- 2) communicates how the big ideas in mathematics are connected.
- 3) uncovers mathematical connections that may lead to deeper understanding.

**E – Student communicates knowledge and understanding in a variety of real-world forms. The student:**

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- 1) draws from prior learning knowledge to learn new mathematics content.
- 2) utilizes 21st Century Learning Skills to prepare to meet future challenges.

## **F – Student communicates knowledge and understanding for a variety of purposes. The student:**

- 1) connect his/her personal experiences to mathematics learning and
- 2) provide examples of how mathematics is used outside the classroom.

## Section Five: Knowledge of Content

**Knowledge of Content:** a teacher’s understanding and application of the current theories, principles, concepts and skills of a discipline.

### **Teacher Characteristics:**

#### **A- Teacher demonstrates an understanding and in-depth knowledge of content and maintains an ability to convey this content to students. The teacher:**

- 1) demonstrates an understanding and in-depth knowledge of mathematics content (mathematical content knowledge for teaching) and uses this knowledge as a basis for developing and applying pedagogical content knowledge.
- 2) provides opportunities for students to develop profound reasoning and a deeper understanding of content.
- 3) demonstrates an in-depth knowledge of mathematics content and is able to engage in dialogue about the content with colleagues, students, parents, and others in the community.

#### **B- Teacher maintains on-going knowledge and awareness of current content developments. The teacher:**

- 1) maintains awareness of current developments in the field of mathematics and can explain what these developments mean to each group of stakeholders.
- 2) maintains an awareness of current developments in the field of mathematics education.
- 3) uses current developments to build pedagogical content knowledge.
- 4) engages in professional dialogue with colleagues regarding the research implications for sound practice that develops students’ advanced thinking, robust fluency and flexible use of mathematical content.

#### **C- Teacher designs and implements standards-based courses/lessons/units using state and national standards. The teacher:**

- 1) poses tasks that
  - are based on sound and significant mathematics.
  - are based on knowledge of students' understandings, interests, and experiences.
  - are based on knowledge of the range of ways that diverse students learn mathematics.
  - call for problem formulation, problem solving, and mathematical reasoning.

#### **D- Teacher uses and promotes the understanding of appropriate content vocabulary. The teacher:**

- 1) models the appropriate use of mathematical language and provides opportunities for students to learn content vocabulary and communicate using precise mathematical language.

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### **E- Teacher provides essential supports for all students. The teacher:**

- 1) provides essential supports by drawing on pedagogical content knowledge in order to provide supports for all students in mathematics (e.g., ESL, students with disabilities, Title I students, G/T).
- 2) differentiates content levels according to evidence of student need.

### **F- Teacher accesses a rich repertoire of instructional practices, strategies, resources and applies them appropriately. The teacher:**

- 1) demonstrates that mathematical understandings occur as a result of solving meaningful problems rather than merely performing procedures.
- 2) encourages students to identify the underlying procedures or create procedures using protocols, protocols, properties, and mathematical reasoning.
- 3) asks questions that allow for rich discussion and deep student thinking about the richness of related mathematical ideas.

### **Student Characteristics:**

#### **A- Student demonstrates growth in content knowledge. The student:**

- 1) communicates, orally and in writing, deep understanding, i.e. reflects on connections between concepts, procedures, and connections.

#### **B- Student uses and seeks to expand appropriate content vocabulary.**

#### **C- Student connects ideas across content areas. The student:**

- 1) connects mathematical ideas among different content strands (e.g., number , measurement, probability).
- 2) connects related operations/ideas within a content strand (e.g. inverse operations; using related facts; equivalence; functional representations).

#### **D- Student uses ideas in realistic problem solving situations. The student:**

- 1) applies mathematical concepts to all problem situations including those in practical/authentic contexts or abstract contexts.