TEKS Cluster: Measurement

2.9 **Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time.

Length

Readiness Standards

2.9(E) determine a solution to a problem involving length, including estimating lengths

Supporting Standards

2.9(A) find the length of objects using concrete models for standard units of length

2.9(B) describe the inverse relationship between the size of the unit and the number of units needed to equal the length of an object

2.9(C) represent whole numbers as distances from any given location on a number line

2.9(D) determine the length of an object to the nearest marked unit using rulers, yardsticks, meter sticks, or measuring tapes

Area

Supporting Standards

2.9(F) use concrete models of square units to find the area of a rectangle by covering it with no gaps or overlaps, counting to find the total number of square units, and describing the measurement using a number and the unit

Time

Readiness Standards

2.9(G) read and write time to the nearest one-minute increment using analog and digital clocks and distinguish between a.m. and p.m.

2.9(E) Readiness

TEKS Scaffold

TEKS	Student Expectation
3.7(B)	determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems (R)
2.9(E)	**2.9 Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to: **(E) determine a solution to a problem involving length, including estimating lengths**
1.7(D)	describe a length to the nearest whole unit using a number and a unit (R)
K.7(B)	compare two objects with a common measurable attribute to see which object has more of/less of the attribute and describe the difference (R)

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Content Builder (see Appendix for Tree Diagram)

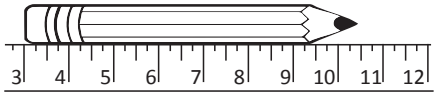
- Determine a solution to a problem involving length
- Estimate lengths

Instructional Implications

Instruction should provide a variety of problem situations involving length. Vary the context of the measurement problems, for example:

- How many centimeters long is your pencil?
- If by sharpening your pencil you lost 2 centimeters of length, how long would the newly sharpened pencil be?
- How many inches longer is your notebook than your pencil?
- If you taped two pieces of paper together, how long would the new piece of paper be?

Word problems should include estimations as well, such as estimating the length of an eraser in centimeters. In conjunction with 2.9(A), students use mental images of standard units of measure in order to effectively estimate (e.g., I know a unit cube is about a centimeter and it looks like my eraser would be about 2 of those unit cubes; I estimate the length of my eraser to be 2 centimeters). Instruction should also include measuring with a measurement tool that does not start at zero (e.g., using your broken ruler, measure the length of your pencil).



Learning from Mistakes

Students may make the following mistakes:

- Not aligning the zero marking of the ruler appropriately
- Inaccurately reading the length of an object being measured with a tool not aligned at the zero marking
- Thinking that an object measuring 12 inches in length is longer than an object measuring one foot because 12 is bigger than 1
- Not estimating a measurement reasonably because they do not have a good understanding of the size of various measures

Academic Vocabulary

estimation language (about, a little more/less than, close to, approximately)
length

2.9(A) **2.9 Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

(A) find the length of objects using concrete models for standard units of length

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Academic Vocabulary

estimation language (about, a little more/less than, close to, approximately)
length
standard unit of length (feet/inch/centimeter/decimeter/meter/yard)

Role in Concept Development

Supports

- 3.7(B) determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems
- 2.9(E) determine a solution to a problem involving length, including estimating lengths

Connection/ Relevance

This supporting standard develops the conceptual understanding that perimeter is the measurement of length. The use of non-standard units of measure (concrete objects) to measure length develops a visual benchmark of various lengths which support a student's ability to estimate lengths more appropriately.

When to Teach

Before/Prerequisite to 3.7(B), 2.9(E)

Instructional Implications

The concrete models for standard units of length should be restricted to models that represent an approximate standard unit of length (e.g., unit cube edge represents one centimeter, a color tile edge represents an inch, length of a ruler represents a foot, etc.). As non-standard units of measure are also used to determine area [see 2.9(F)], it is critical to identify that only the length of one of the sides of the manipulative is used, not the entire object (e.g.,  "When measuring in inches, we will only be using the length of one of the sides of a color tile to determine length"). Students measure lengths of various objects and record the measurements in standard units of measure (e.g., "The length of a notebook was approximately 11 color tiles in length measuring 11 inches"). It is imperative that instruction allow plenty of time for students to engage in the use of concrete models representing a standard unit of measure, as a mental image of the length of a centimeter, inch, foot, yard, etc. leads to more educated estimations and reasonableness of length [see 2.9(E)].

Learning from Mistakes

Students may make the following mistakes:

- Not using the edges of concrete models to determine length (e.g., turning the objects on their sides, standing them up, etc.)
- Not starting a linear measure at a zero point for a given object
- Not aligning manipulatives back-to-back with no gaps or overlaps

2.9(B)

2.9 Geometry and measurement. The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

(B) describe the inverse relationship between the size of the unit and the number of units needed to equal the length of an object

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Academic Vocabulary

length
standard unit of length (feet/inch/centimeter/decimeter/meter/yard)

Role in Concept Development

Supports

- 3.7(B) determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems
- 2.9(E) determine a solution to a problem involving length, including estimating lengths

Connection/ Relevance

Measuring the length of objects with a variety of concrete models supports the understanding that length of objects can be measured in various units. This supporting standard allows the learner to experience how the shorter the unit of measure, the more units needed to measure the length; the longer the unit of measure, the fewer units needed to measure the length. As students begin moving to measuring with a ruler, this non-standard unit of measurement experience supports how objects can be measured in centimeters and inches and how the inverse relationship between the size of the units and the number of units are needed to equal the length of an object.

When to Teach

Before/Prerequisite to 3.7(B), 2.9(E)

Instructional Implications

Students should measure the length of a given object with more than one unit of measure (e.g., measure the length of an index card using unit cubes and color tiles). In conjunction with 2.9(A), students record both measurements in standard units of measure (e.g., 5 color tiles = 5 inches, 15 unit cubes = 15 centimeters). Students need to justify how it is possible to have two different measurement recordings for the same object (the length of the object was measured with different measurement tools). Instruction should lead to the discovery that the longer the unit of measure, the fewer units of measure needed; the shorter the unit of measure, the more units of measure needed. This concept leads to future understanding of how an object measuring 2 yards in length is not shorter than an object measuring 6 feet in length.

Learning from Mistakes

Students may make the following mistakes:

- Thinking that an object measuring 15 centimeters in length is longer than an object measuring 5 inches because 15 is bigger than 5

2.9(C) **2.9 Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

(C) represent whole numbers as distances from any given location on a number line

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Academic Vocabulary

length

Role in Concept Development

Supports

- 3.5(A) represent one- and two-step problems involving addition and subtraction of whole numbers to 1,000 using pictorial models, number lines, and equations
- 3.2(D) compare and order whole numbers up to 100,000 and represent comparisons using the symbols >, <, or =
- 2.2(D) use place value to compare and order whole numbers up to 1,200 using comparative language, numbers, and symbols (>, <, or =)
- 2.9(E) determine a solution to a problem involving length, including estimating lengths

Connection/ Relevance

Identifying whole numbers as distances from any given location can relate to the effective use of a ruler. This understanding supports solving problems involving length. Being able to represent whole numbers on a number line supports the comparing and ordering of numbers as larger numbers progress to the right and smaller numbers progress to the left of a number line. The understanding of whole numbers as distances from a given location supports the use of a number line as a strategy to add and subtract numbers.

When to Teach

- Before/Prerequisite to 3.5(A), 3.2(D)
- With 2.2(D), 2.9(E)

Instructional Implications

Students locate and name points on a number line [see 2.2(E)/(F)]. Instruction needs to address that whole numbers identified on a number line represent the distance away from zero. This understanding is then related to the use of the ruler and how the whole numbers identified on a ruler represent a measurable length [see 2.9(D)].

Students should understand that length measure is determined by the number of whole units between a starting point and an ending point, even if the starting point is not zero.

Learning from Mistakes

Students may make the following mistakes:

- Misreading the length between two whole number units of measure when the starting point is not zero (e.g., with a start at 14 inches and end at 18 inches, stating that the length is 18 inches instead of 4 inches)

2.9(D) **2.9 Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

(D) determine the length of an object to the nearest marked unit using rulers, yardsticks, meter sticks, or measuring tapes

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Academic Vocabulary

estimation language (about, a little more/less than, close to, approximately)
length
measuring tape
meter stick
ruler
yardstick

Role in Concept Development

Supports

- 3.7(B) determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems
- 2.9(E) determine a solution to a problem involving length, including estimating lengths

Connection/ Relevance

Hands-on experiences measuring the length of objects with a variety of measurement tools is essential for students to estimate length and solve problems involving length, including perimeter.

When to Teach

Before/Prerequisite to 3.7(B), 2.9(E)

Instructional Implications

This standard begins the transition from using concrete objects to measure length to using a formal measurement tool. Students begin associating the number line to the representation of various measurement tools (e.g., the whole numbers represented on a ruler).

In conjunction with 2.9(A), students can begin comparing the size of the concrete object they used to measure length to the standard measuring tool (e.g., align 12 color tiles next to a ruler to demonstrate how 12 inches equals one foot). Students measure the lengths of various objects using a variety of standard measurement tools (e.g., ruler, yard stick, meter stick, measuring tape). Students only measure to the nearest whole number.

Learning from Mistakes

Students may make the following mistakes:

- Starting measure at the “physical end” of the ruler instead of at zero
- Starting measure at the number 1 instead of zero (without compensation)
- Not measuring to the nearest marked unit correctly because they have difficulty reading a number line/ruler

2.9 Geometry and measurement. The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to:

2.9(F) **(F) use concrete models of square units to find the area of a rectangle by covering it with no gaps or overlaps, counting to find the total number of square units, and describing the measurement using a number and the unit**

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Academic Vocabulary

area
estimation language (about, a little more/less than, close to, approximately)
square unit

Role in Concept Development

Supports
3.6(C) determine the area of rectangles with whole number side lengths in problems using multiplication related to the number of rows times the number of unit squares in each row

Connection/ Relevance
Hands-on experiences covering rectangles with square units with no gaps or overlaps develop the concrete understanding of area. The use of square units to cover the region of a rectangle supports the future understanding of how area is reflected in square units.

When to Teach
Before/Prerequisite to 3.6(C)

Instructional Implications
Students use square units (e.g., unit cubes, color tiles, sticky note pads, etc.) to determine the area of various rectangles. As concrete models were used to represent standard units to determine length in 2.9(A), it is critical to identify that only the length of one of the sides of the manipulative was used to determine the length of an object. To determine area, we use the entire object (e.g.,  when measuring length, draw a line along one of the sides to visually demonstrate that we only use this component of the measuring tool to determine length;  when measuring area, outline and shade in the area of the square unit).

As students begin to measure the area of various rectangles, they need to understand that they are measuring the amount of space inside an object, that the unit of measure must be consistent (e.g., unit cubes and color tiles cannot be mixed to cover the area of an object), and that manipulatives must completely fill the interior with no gaps or overlaps in the square units. As with any measurement, area will not always be exact. Students should be able to describe the covered areas in terms of square units (e.g., it takes about 24 color tiles to cover the area of the index card, therefore, the index card is about 24 square units).

Learning from Mistakes
Students may make the following mistakes:
- Using rectangles instead of squares for concrete models when covering a rectangular area

2.9(G) Readiness

TEKS Scaffold

TEKS	Student Expectation
3.7(C)	determine the solutions to problems involving addition and subtraction of time intervals in minutes using pictorial models or tools such as a 15-minute event plus a 30-minute event equals 45 minutes (S)
2.9(G)	**2.9 Geometry and measurement.** The student applies mathematical process standards to select and use units to describe length, area, and time. The student is expected to: **(G) read and write time to the nearest one-minute increment using analog and digital clocks and distinguish between a.m. and p.m.**
1.7(E)	tell time to the hour and half hour using analog and digital clocks (R)

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph
Equation/ Expression	Manipulatives	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures

Content Builder (see Appendix for Tree Diagram)

- Read time to the nearest one-minute increment using:
  - analog clock
  - digital clock
- Write time to the nearest one-minute using:
  - analog clock
  - digital clock
- Distinguish between a.m. and p.m.

Instructional Implications

To help students understand how to read and tell time:

- Relate the clock to a circular, closed number line [see 2.2(E)/(F)].
- Create a number line identifying the whole numbers 0 -12.
- Demonstrate how to connect both ends of the number line to create a circular number line referencing how the hour numerals on the clock relate to those on a number line.
- Extend the use of the closed number line to include the minute increments. Instruction should relate the hour and minute hands from the analog clock to the digits represented on a digital clock.
- Clarify that the colon (:) on the digital clock is used to separate the hours (whole) from the minutes (part).

Instruction should include discussions about how our day is divided into two equal parts (a.m. and p.m.). Activities that happen from midnight until noon are considered to occur in the a.m., and activities that happen from noon until midnight are considered to occur in the p.m. Creating a timeline of classroom activities with the appropriate a.m./p.m. recordings may support this understanding.

Learning from Mistakes

Students may make the following mistakes:

- Confusing the hour and minute hand on an analog clock
- Not being able to accurately read the hour hand as it falls between two hour points
- Reading time accurately but struggling when asked to represent a given time on a clock
- Thinking that activities that happen in the day time are all a.m. times and activities that happen in the night time are all p.m. times
- Confusing 12:00 a.m. and 12:00 p.m.
- Not relating a number line to telling time on a clock (e.g., counting tick marks instead of unit spaces or hops)

Academic Vocabulary

a.m./p.m.
estimation language (about, a little more/less than, close to, approximately)
half past
hour
minute
quarter after/quarter past
quarter to/quarter 'til