

Instructional Focus Document

Grade 8 Mathematics

TITLE : Unit 02: Statistics with Univariate Data

SUGGESTED DURATION : 6 days

UNIT OVERVIEW

This unit bundles student expectations that address mean absolute deviation and generalizations of random samples of the same size from a population. According to the Texas Education Agency, mathematical process standards including application, a problem-solving model, tools and techniques, communication, representations, relationships, and justifications should be integrated (when applicable) with content knowledge and skills so that students are prepared to use mathematics in everyday life, society, and the workplace. The introduction to the grade level standards state, “While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology.” Additionally, the availability of graphing technology is required during STAAR testing.

Prior to this unit, in Grade 6, students used graphical representations of numeric data to describe data distribution, summarized numeric data with numerical summaries, including mean, median, range, interquartile range, mode, and percents to describe data distribution. In Grade 7, students compared two groups of numeric data using comparative dot plots or box plots to compare data distribution. Grade 7 students also compared two populations based on data in random samples from populations and built on data collection with probabilistic events to draw comparisons to sampling from a population with known characteristics.

During this unit, students extend their knowledge of ordering numbers and finding the mean to calculate the mean absolute deviation of up to 10 data points and describe the data by comparing each data point to the mean absolute deviation. Univariate data, data with one variable, is examined as students describe the spread and shape of data through the lens of variation from the mean. Additionally, students develop the notion that random samples of a population with known characteristics are representative of a population from which they were selected. Students explore appropriate methods for simulating such samples.

After this unit, in Unit 06, students will explore bivariate data, data with two variables, as they construct a scatterplot and describe the observed data to address questions of association such as linear trend, non-linear trend, and no trend or no association. Students will also use trend lines to approximate linear relationships between bivariate sets of data to make predictions.

In Grade 8, determining the mean absolute deviation and using this quantity as a measure of the average distance data are from the mean, using a data set of no more than 10 data points, is identified as STAAR Supporting Standard 8.11B and part of the Grade 8 STAAR Reporting Category 4: Data Analysis and Personal Financial Literacy. Simulating the generation of random samples of the same size from a population with known characteristics to develop the notion of a random sample being representative of the population from which it was selected is standard 8.11C and is neither Supporting nor Readiness, but is foundational to the conceptual understanding of statistical reasoning. Both of these are subsumed under the Grade 8 *Texas Response to Curriculum Focal Points* (TxRCFP): Making inferences from data. This unit is supporting the development of the *Texas College and Career Readiness Standards* (TxCCRS): I. Numeric Reasoning, IV. Measurement Reasoning, V. Probabilistic Reasoning, VI. Statistical Reasoning, VIII. Problem Solving and Reasoning, IX. Communication and Representation, and X. Connections.

According to the National Council for Teachers of Mathematics (2013), “variability plays a role in each component of the statistical problem-solving process... Employing this statistical problem-solving process is critical in developing an understanding of the big ideas in statistics” (p. 10). Van de Walle and Lovin (2006) note that, “In the middle grades, students should continue to build on this basic knowledge, developing a better understanding of these representations and statistics as they learn about new representations...The emphasis in middle grades should first be placed on activities leading to intuitive understanding and conceptual knowledge” (p. 308).

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National Council of Teachers of Mathematics. (2008). *Focus in grade 8 teaching with curriculum focal points*. Reston, VA: National Council of Teachers of Mathematics, Inc.

National Council of Teachers of Mathematics. (2013). *Developing essential understanding of statistics grades 9 – 12*. Reston, VA: National Council of Teachers of Mathematics, Inc.

Texas Education Agency & Texas Higher Education Coordinating Board. (2009). *Texas college and career readiness standards*. Retrieved from <http://www.theccb.state.tx.us/index.cfm?objectid=E21AB9B0-2633-11E8-BC500050560100A9>

Texas Education Agency. (2013). *Texas response to curriculum focal points for kindergarten through grade 8 mathematics*. Retrieved from <https://www.texasgateway.org/resource/txrcfp-texas-response-curriculum-focal-points-k-8-mathematics-revised-2013>

Van de Walle, J., & Lovin, L. (2006). *Teaching student-centered mathematics grades 5 – 8*. Boston, MA: Pearson Education, Inc.

OVERARCHING UNDERSTANDINGS AND QUESTIONS

Statistical displays often reveal patterns within data that can be analyzed to interpret information, inform understanding, make predictions, influence decisions, and solve problems in everyday life with degrees of confidence.

- How does society use or make sense of the enormous amount of data in our world available at our fingertips?
- How can data and data displays be purposeful and powerful?
- Why is it important to be aware of factors that may influence conclusions, predictions, and/or decisions derived from data?

PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
<p>Mathematics Grade 8 Unit 02 PA 01</p> <p>Click on the PA title to view related rubric.</p> <p><i>Provide students with data of the daily high and low</i></p>	<p>Measurement and Data</p> <ul style="list-style-type: none"> • Data <ul style="list-style-type: none"> • Numeric data • Numerical summaries 	<p>Data can be described and quantified using various methods in order to communicate and reason statically about the entire data set.</p> <ul style="list-style-type: none"> • What process is used to find the mean absolute deviation? • What is the relationship between the mean absolute deviation and

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PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
<p><i>temperatures in Austin, Texas between the months of April and June or access to the Internet as well as technologies for students to select to conduct a simulation to generate random samples of data.</i></p> <p>Analyze the problem situation(s) described below. Organize and record your work for each of the following tasks. Using precise mathematical language, justify and explain each solution process.</p> <p>1. The average temperature in Austin, Texas between the months of April and June is 76°F.</p> <ol style="list-style-type: none"> Design a simulation that can be used to generate a random sample of the high and low temperatures between the months of April and June for ten days in Austin, Texas, with or without technology. Complete the simulation to identify a random sample of the high and low temperatures for ten days in Austin, Texas. Organize a table to display the generated dates and the high and low temperatures for those dates. Analyze and compare the spread of the data for the high and low temperatures with the range and mean absolute deviation of the high and low temperatures. Describe how the random sample of 	<ul style="list-style-type: none"> Populations Conclusions and predictions Random samples Variability <p><u>Associated Mathematical Processes</u></p> <ul style="list-style-type: none"> Application Problem Solving Model Tools and Techniques Communication Representations Relationships Justification 	<p>the distance of data points on a number line?</p> <ul style="list-style-type: none"> Why would the mean absolute deviation be used to describe the spread of a set of data instead of another measure of variability? How are random samples of a population with known characteristics generated? When is a random sample representative of the population from which it was selected?

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PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
<p>generated high and low temperatures is representative of the average temperature in Austin, Texas between the months of April and June.</p> <p>Standard(s): 8.1A, 8.1B, 8.1C, 8.1D, 8.1E, 8.1F, 8.1G, 8.11B, 8.11C, ELPS.c.1A, ELPS.c.1C, ELPS.c.2D, ELPS.c.3B, ELPS.c.3D, ELPS.c.3H, ELPS.c.4H, ELPS.c.4J, ELPS.c.5B, ELPS.c.5G</p>		



MISCONCEPTIONS / UNDERDEVELOPED CONCEPTS

Misconceptions:

- Students may confuse the group being surveyed with the entire population.
- Students might confuse the terms mean and median, and how to calculate each measure.
- Students may incorrectly find the absolute value of the difference between each data value and the mean when calculating the mean absolute deviation.

Underdeveloped Concepts:

- Some students may forget to divide after adding when finding the mean.

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UNIT VOCABULARY

- **Mean absolute deviation** – a measure of variability of data around the mean calculated by finding the sum of the absolute values of the differences between each data point of a given set and the mean of that data set divided by the number of data points
- **Population** – total collection of persons, objects, or items of interest
- **Random sample** – a subset of the population selected without bias in order to make inferences about the entire population
- **Sample** – a subset of the population selected in order to make inferences about the entire population
- **Simulation** – an experiment or model used to test the outcomes of an event

Related Vocabulary:

- Absolute value
- Bias
- Data
- Difference
- Experiment
- Mean
- Number line
- Random
- Spread
- Variability

UNIT ASSESSMENT ITEMS	SYSTEM RESOURCES	OTHER RESOURCES
Unit Assessment Items that have been published by your district may be accessed through Search All Components in the District Resources tab. Assessment items may also be found using the Assessment Creator if your district has granted access to that tool.	Mathematics Concepts Charts Mathematics Grade 8 Backward Design Document Mathematics Grade 8 Enhanced TEKS Clarification Mathematics Grade 8 Focal Points with Aligned Standards and TEKS Introduction Mathematics Grade 8 STAAR Analysis Resources Mathematics Grade 8 STAAR Blueprint and Item Percentages	Texas Higher Education Coordinating Board – Texas College and Career Readiness Standards Texas Education Agency – Texas Response to Curriculum Focal Points for K-8 Mathematics Revised 2013 Texas Education Agency – Mathematics Curriculum Texas Education Agency – STAAR Mathematics Resources Texas Education Agency Texas Gateway – Revised

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	Mathematics Grade 8 STAAR Enhanced Blueprint Mathematics Grade 8 Vertical Alignment Mathematics Grade 8 Unit 02 TEKS Resource System STAAR Analysis Mathematics Long Term Transfer Goals Mathematics Suggested Basic Manipulatives by Grade Level Mathematics Texas Education Agency Grade 8 TEKS Supporting Information (with TEKS Resource System Comments) Mathematics Vertical Quick Guide	Mathematics TEKS: Vertical Alignment Charts Texas Education Agency Texas Gateway – Mathematics TEKS: Supporting Information Texas Education Agency Texas Gateway – Interactive Mathematics Glossary Texas Education Agency Texas Gateway – Resources Aligned to Grade 8 Mathematics TEKS Texas Instruments – Graphing Calculator Tutorials
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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
	<p><u>Legend:</u></p> <ul style="list-style-type: none"> • <i>Bold black text in italics: Knowledge and Skills Statement (TEKS)</i> • Black text: Student Expectation (TEKS) • <i>Bold red text in italics: Student Expectation identified by TEA as a Readiness Standard for STAAR</i> • <i>Bold green text in italics: Student Expectation</i> 	<p><u>Legend:</u></p> <ul style="list-style-type: none"> • Blue text: Supporting Information / Clarifications from TCMPC (Specificity) • <i>Blue Italic text: Unit-specific clarification</i> • Black text: TEA Texas Response to Curriculum Focal Points (TxRCFP); Texas College and Career Readiness Standards (TxCCRS); TEA STAAR

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	<p>identified by TEA as a Supporting Standard for STAAR</p> <ul style="list-style-type: none"> • Strike-through: Indicates portions of the Student Expectation that are not included in this unit but are taught in previous or future unit 	
8.1	Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	
8.1A	Apply mathematics to problems arising in everyday life, society, and the workplace.	<p>Apply</p> <p>MATHEMATICS TO PROBLEMS ARISING IN EVERYDAY LIFE, SOCIETY, AND THE WORKPLACE</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Mathematical problem situations within and between disciplines <ul style="list-style-type: none"> ◊ Everyday life ◊ Society ◊ Workplace <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data

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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		<ul style="list-style-type: none"> • TxCCRS: <ul style="list-style-type: none"> ◊ X. Connections
8.1B	<p>Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.</p>	<p>Use</p> <p>A PROBLEM-SOLVING MODEL THAT INCORPORATES ANALYZING GIVEN INFORMATION, FORMULATING A PLAN OR STRATEGY, DETERMINING A SOLUTION, JUSTIFYING THE SOLUTION, AND EVALUATING THE PROBLEM-SOLVING PROCESS AND THE REASONABLENESS OF THE SOLUTION</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Problem-solving model <ul style="list-style-type: none"> ◊ Analyze given information ◊ Formulate a plan or strategy ◊ Determine a solution ◊ Justify the solution ◊ Evaluate the problem-solving process and the reasonableness of the solution <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data • TxCCRS: <ul style="list-style-type: none"> ◊ VIII. Problem Solving and Reasoning

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8.1C	Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.	<p>Select</p> <p>TOOLS, INCLUDING REAL OBJECTS, MANIPULATIVES, PAPER AND PENCIL, AND TECHNOLOGY AS APPROPRIATE, AND TECHNIQUES, INCLUDING MENTAL MATH, ESTIMATION, AND NUMBER SENSE AS APPROPRIATE, TO SOLVE PROBLEMS</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Appropriate selection of tool(s) and techniques to apply in order to solve problems <ul style="list-style-type: none"> ◊ Tools <ul style="list-style-type: none"> • Real objects • Manipulatives • Paper and pencil • Technology ◊ Techniques <ul style="list-style-type: none"> • Mental math • Estimation • Number sense <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data • TxCCRS: <ul style="list-style-type: none"> ◊ VIII. Problem Solving and Reasoning

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8.1D	Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.	<p>Communicate</p> <p>MATHEMATICAL IDEAS, REASONING, AND THEIR IMPLICATIONS USING MULTIPLE REPRESENTATIONS, INCLUDING SYMBOLS, DIAGRAMS, GRAPHS, AND LANGUAGE AS APPROPRIATE</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Mathematical ideas, reasoning, and their implications <ul style="list-style-type: none"> ◊ Multiple representations, as appropriate <ul style="list-style-type: none"> • Symbols • Diagrams • Graphs • Language <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data • TxCCRS: <ul style="list-style-type: none"> ◊ IX. Communication and Representation
8.1E	Create and use representations to organize, record, and communicate mathematical ideas.	Create, Use

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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		<p>REPRESENTATIONS TO ORGANIZE, RECORD, AND COMMUNICATE MATHEMATICAL IDEAS</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Representations of mathematical ideas <ul style="list-style-type: none"> ◊ Organize ◊ Record ◊ Communicate • Evaluation of the effectiveness of representations to ensure clarity of mathematical ideas being communicated • Appropriate mathematical vocabulary and phrasing when communicating mathematical ideas <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data • TxCCRS: <ul style="list-style-type: none"> ◊ IX. Communication and Representation
8.1F	Analyze mathematical relationships to connect and communicate mathematical ideas.	<p>Analyze</p> <p>MATHEMATICAL RELATIONSHIPS TO CONNECT AND COMMUNICATE MATHEMATICAL IDEAS</p> <p>Including, but not limited to:</p>

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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		<ul style="list-style-type: none"> • Mathematical relationships <ul style="list-style-type: none"> ◊ Connect and communicate mathematical ideas <ul style="list-style-type: none"> • Conjectures and generalizations from sets of examples and non-examples, patterns, etc. • Current knowledge to new learning <p>Note(s):</p> <ul style="list-style-type: none"> • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: <ul style="list-style-type: none"> ◊ Representing, applying, and analyzing proportional relationships ◊ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◊ Making inferences from data • TxCCRS: <ul style="list-style-type: none"> ◊ X. Connections
8.1G	Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.	<p>Display, Explain, Justify</p> <p>MATHEMATICAL IDEAS AND ARGUMENTS USING PRECISE MATHEMATICAL LANGUAGE IN WRITTEN OR ORAL COMMUNICATION</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Mathematical ideas and arguments <ul style="list-style-type: none"> ◊ Validation of conclusions <ul style="list-style-type: none"> • Displays to make work visible to others <ul style="list-style-type: none"> ◊ Diagrams, visual aids, written work, etc. • Explanations and justifications

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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		<p>◊ Precise mathematical language in written or oral communication</p> <p>Note(s):</p> <ul style="list-style-type: none"> The mathematical process standards may be applied to all content standards as appropriate. TxRCFP: <ul style="list-style-type: none"> Representing, applying, and analyzing proportional relationships Using expressions and equations to describe relationships, including the Pythagorean Theorem Making inferences from data TxCCRS: <ul style="list-style-type: none"> IX. Communication and Representation
<u>8.11</u>	<i>Measurement and data. The student applies mathematical process standards to use statistical procedures to describe data. The student is expected to:</i>	
<u>8.11B</u>	<p>Determine the mean absolute deviation and use this quantity as a measure of the average distance data are from the mean using a data set of no more than 10 data points.</p> <p><i>Supporting Standard</i></p>	<p>Determine</p> <p>THE MEAN ABSOLUTE DEVIATION AND USE THIS QUANTITY AS A MEASURE OF THE AVERAGE DISTANCE DATA ARE FROM THE MEAN USING A DATA SET OF NO MORE THAN 10 DATA POINTS</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> Mean absolute deviation – a measure of variability of data around the mean calculated by finding the sum of the absolute values of the differences between each data point of a given set and the mean of that data set divided by the number of data points Data set has less variability when mean absolute deviation is closer to zero

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TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		<ul style="list-style-type: none"> Given or collected data limited to no more than 10 data points Process for calculating the mean absolute deviation <ul style="list-style-type: none"> Find mean of the data Find absolute value of the difference between each data point and the mean Find mean of the absolute differences Relationship between mean absolute deviation and distance of data points on a number line <p>Note(s):</p> <ul style="list-style-type: none"> Grade Level(s): <ul style="list-style-type: none"> Grade 6 represented data with box plots using quartiles to show the spread of data relative to the median. This representation did not take into account every data point explicitly as the data are clustered into quartiles. The variation focused on median. Grade 7 compared two groups of numeric data using comparative dot plots or box plots by comparing their shapes, centers, and spreads. Various mathematical process standards will be applied to this student expectation as appropriate. TxRCFP: <ul style="list-style-type: none"> Making inferences from data TxCCRS: <ul style="list-style-type: none"> I. Numeric Reasoning IV. Measurement Reasoning VI. Statistical Reasoning VIII. Problem Solving and Reasoning IX. Communication and Representation
8.11C	Simulate generating random samples of the same size from a population with known characteristics	Simulate

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	<p>to develop the notion of a random sample being representative of the population from which it was selected.</p>	<p>GENERATING RANDOM SAMPLES OF THE SAME SIZE FROM A POPULATION WITH KNOWN CHARACTERISTICS TO DEVELOP THE NOTION OF A RANDOM SAMPLE BEING REPRESENTATIVE OF THE POPULATION FROM WHICH IT WAS SELECTED</p> <p>Including, but not limited to:</p> <ul style="list-style-type: none"> • Population – total collection of persons, objects, or items of interest • Sample – a subset of the population selected in order to make inferences about the entire population • Random sample – a subset of the population selected without bias in order to make inferences about the entire population <ul style="list-style-type: none"> ◊ Random samples are more likely to contain data that can be used to make predictions about a whole population. • Simulation – an experiment or model used to test the outcomes of an event • Developing a design for a simulation • Appropriate methods to simulate random samples from a population <ul style="list-style-type: none"> ◊ With technology <ul style="list-style-type: none"> • Calculator • Computer model • Random number generators ◊ Without technology <ul style="list-style-type: none"> • Spinners (even and uneven sections) • Color tiles • Two-color counters • Coins • Deck of cards • Marbles • Number cubes

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		<p>Note(s):</p> <ul style="list-style-type: none"> Grade Level(s): <ul style="list-style-type: none"> Grade 7 compared two populations based on data in random samples from these populations, including informal comparative inferences about differences between the two populations. Various mathematical process standards will be applied to this student expectation as appropriate. TxRCFP: <ul style="list-style-type: none"> Making inferences from data TxCCRS: <ul style="list-style-type: none"> V. Probabilistic Reasoning VI. Statistical Reasoning VIII. Problem Solving and Reasoning IX. Communication and Representation

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ELPS#	SUBSECTION C: CROSS-CURRICULAR SECOND LANGUAGE ACQUISITION ESSENTIAL KNOWLEDGE AND SKILLS.
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The English Language Proficiency Standards (ELPS), as required by 19 Texas Administrative Code, Chapter 74, Subchapter A, §74.4, outline English language proficiency level descriptors and student expectations for English language learners (ELLs). School districts are required to implement ELPS as an integral part of each subject in the required curriculum.

School districts shall provide instruction in the knowledge and skills of the foundation and enrichment curriculum in a manner that is linguistically accommodated commensurate with the student's levels of English language proficiency to ensure that the student learns the knowledge and skills in the required curriculum.

School districts shall provide content-based instruction including the cross-curricular second language acquisition essential knowledge and skills in subsection (c) of the ELPS in a manner that is linguistically accommodated to help the student acquire English language proficiency.

<http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074a.html#74.4>

Choose appropriate ELPS to support instruction.

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