Model Lesson

Unit Name: Cow Pens and Bull Pens	Unit Length: 2 class days
Overview: Multiple Representations of Functions	

DESIRED RESULTS

TEKS and Student Expectations (See Appendix A for detailed description.)
(A.1) **Foundations for functions.** (A), (B), (C), (D), (E),
(A.2) **Foundations for functions.** (A), (B), (C), (D).
(A.3) **Foundations for functions.** (A), (B).
(A.5) **Linear functions.** (A), (B), (C).
(A.6) **Linear functions.** (A), (B).

Enduring Understandings (Big Ideas)	**Essential Questions**	**Critical Vocabulary**
Patterns can be represented in multiple ways that lead to function equations. Vertical Alignment from simple models to calculator applications leads to better understanding	What are the reasons for representing patterns and functions in multiple ways? What is the difference in discrete vs. continuous representation? Why is it important to know the difference in dependent and independent variables? Why is the labeling of the coordinate axes important? How is "rate of change" affected? What is the significance of the y-intercept?	rate of change ordered pairs x-intercept y-intercept domain range intervals slope discrete continuous table of data mapping

Learning Goals	**Materials Needed**
Multiple Representation of Functions using: models ordered pairs tables graphs equations verbal descriptors	linking cubes graph paper colored pencils calculators

Submitted by:	Mary Pate	Date:	10-25-07
Edited by:	Larry White -- (proofed by Beth Grounds)	Date:	11-18-07
Edited by:	Pat Curtin & John Beck, MELL Staff	Date	March, 2008

calculators	

ASSESSMENT PLAN

Performance Tasks	**Other Evidence**
A rubric list (See Attachment for a possible example) will be used to check the required items from the students': *linking cube models *pencil/paper activity includes model, table, ordered pairs, graph, and equation *calculator representations in y = , table, graph	Compare the graph paper table of ordered pairs and the graph of the equation with the corresponding information on the graphing calculator. Check students' understanding of setting the window min/max values in the calculator.

GENERAL MELL CONNECTIONS THAT APPLY TO ALL LESSONS

(MC-01) - To assist the ELLs, the teacher should avoid speaking too rapidly and when possible use basic words rather than unfamiliar ones to introduce new concepts.

(MC-02) - Teachers should foster trusting relationships with ELLs through informal conversations and presentation of a culturally rich classroom.

(MC-03) - ELLs may need extra opportunities to demonstrate mastery. Grading policies should be flexible enough to provide multiple learning opportunities without severe grade penalties.

(MC-04) - ELLs may work at a slower pace than other students because of limited English language skills and should be provided with shortened assignments, or when appropriate, extra time to work on assignments.

(MC-05) - ELLs should be scheduled in a math class that has students who have some proficiency in both languages. Teachers may need to work with counselors and others to ensure that this happens.

(MC-06) - Teachers should offer tutoring as frequently as possible and encourage ELLs to come in for extra assistance. If possible, the teacher should arrange for an aide or parent volunteer who speaks the language of the ELL to help with translation during the tutoring period on a regular schedule

(for example, on Tuesdays and Thursdays, after school).

LEARNING PLAN	
Introduction: Explain how ranchers enclose cows in large pens together and that cows are docile animals. Show students the power point slides for building fences/pens for cows. (MC-17)	**Specific MELL Connections for This Lesson**
Cow Pens -- Models/Graph Paper Activity-Day 1 (Class Activity)	(MC-17) - Examples that are relevant to the lives of ELLs are helpful in motivating students and in promoting their engagement with the content. .
• Teacher explains how the representation of the linking cubes will be used in this lesson. (MC-01) • Students receive a sandwich baggie containing 25 linking cubes. (MC-08) • Teacher shows a power point slide that explains the cow pen scenario. (see attached) (MC-09) • Teacher discusses how ranchers keep cows in a pen. The word "docile" is discussed. (MC-01) • Teacher shows the first model as a power point slide. (1 cow, 8 pens) (MC-09) • Students construct their first cow pen model with the linking cubes. (MC-08) • Students construct the second cow pen model with the linking cubes. (MC-08) • Students construct the third cow pen model with the linking cubes. (MC-08) • Class discussion about how the models changed when each cow was added. (MC-01, MC-14) • Teacher leads graph paper activity showing multiple repesentations. (MC-09) • Students use graph paper to: sketch their linking cube models;	(MC-08) - Hands-on activities involving math manipulatives are typically helpful to ELLs because the lesson involves multiple learning modalities and does not require the student to rely solely upon his/her ability to understand verbal instruction. (MC-09) - To assist the ELLs, the teacher should model the expected task and use visual representations to reinforce concepts and/or steps in the problem-solving process. Critical concepts should be clearly emphasized and repeated. (MC-14) - Teachers should support ELLs who need extra time for dialogue by providing opportunities to work in groups. When possible, pair each ELL with

create ordered pairs in table form;

plot the points on a Cartesian coordinate system;

and create an equation. (MC-08, MC-16)
• Class discussion regarding discrete graph vs. continuous
   graph. (MC-01, MC-14)
• Class discussion regarding independent vs. dependent
   variables, labeling the table and the axes. (MC-01, MC-14)
• Class discussion regarding rate of change. (MC-01, MC-14)
• Students enter their data into their graphing calculators and
   graph their equation. (MC-09)

Bull Pens -- Models/Graph Paper
Activity-Day 1
(Individual Activity)

• Teacher discusses the word "hostile", hence why the bulls
   will be separated and the function rule must change.
   (MC-01, MC-09)
• Students do the same tasks with the bulls as they did with
   the cows. (MC-08)

Foldable Activity-Day 2   (MC-09, MC-10)

• Students will create a "secret book" foldable of their
   cow/bull pen activities.
• Each of the following items will be put in a different
   section of the foldable:
vocabulary; model, table of values,
   graph, equation, etc.
• Part of the foldable will be for the cow scenario and part of
   it will be for the bull scenario. Any remaining sections will
   be used for miscellaneous items from the Day 1 activities.

another student who has some fluency in the ELL's dominant language and who can function as a "peer tutor."

(MC-16) - When monitoring ELLs during instruction, the teacher should make a special effort to to assist, re-explain and demonstrate again, if necessary. Encouragement and reinforcement should be used frequently.

(MC-10) - ELLs should be provided with or assisted in developing a learning aid that shows math vocabulary in both English and their native language and should be allowed to use this tool when working on assignments. Student-made glossaries, word walls, and compare and contrast charts may help ELLs learn mathematics vocabulary.

• Students will be allowed to use their foldables during formative testing.	

English Language Proficiency Standards Quick Reference. (Chapter 74. Curriculum Requirements Subchapter A. Required Curriculum, §74.4. English Language Proficiency Standards). _The standards checked here are merely examples for the teacher's consideration for inclusion in this lesson._

Cross-curricular second language acquisition/ listening. The ELL listens to a variety of speakers including teachers, peers, and electronic media to gain an increasing level of comprehension of newly acquired language in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in listening. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:	[X] (c)(2)(A) - distinguish sounds and intonation patterns of English with increasing ease; (c)(2)(B) - recognize elements of the English sound system in newly acquired vocabulary such as long and short vowels, silent letters, and consonant clusters; [X] (c)(2)(C) - learn new language structures, expressions, and basic and academic vocabulary heard during classroom instruction and interactions; [X] (c)(2)(D) - monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed; [X] (c)(2)(E) - use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language; (c)(2)(F) - listen to and derive meaning from a variety of media such as audio tape, video, DVD, and CD ROM to build and reinforce concept and language attainment; [X] (c)(2)(G) - understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are

	familiar to unfamiliar; (c)(2)(H) - understand implicit ideas and information in increasingly complex spoken language commensurate with grade-level learning expectations; and [X] (c)(2)(I) - demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs.
Cross-curricular second language acquisition/speaking. The ELL speaks in a variety of modes for a variety of purposes with an awareness of different language registers (formal/informal) using vocabulary with increasing fluency and accuracy in language arts and all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in speaking. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:	[X] (c)(3)(A) - practice producing sounds of newly acquired vocabulary such as long and short vowels, silent letters, and consonant clusters to pronounce English words in a manner that is increasingly comprehensible; (c)(3)(B) - expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication; (c)(3)(C) - speak using a variety of grammatical structures, sentence lengths, sentence types, and connecting words with increasing accuracy and ease as more English is acquired; [X] (c)(3)(D) - speak using grade-level content area vocabulary in context to internalize new English words

	and build academic language proficiency;
	[X] (c)(3)(E) - share information in cooperative learning interactions;
	(c)(3)(F) - ask and give information ranging from using a very limited bank of high-frequency, high- need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments;
	(c)(3)(G) - express opinions, ideas, and feelings ranging from communicating single words and short phrases to participating in extended discussions on a variety of social and grade-appropriate academic topics;
	[X] (c)(3)(H) - narrate, describe, and explain with increasing specificity and detail as more English is acquired;
	(c)(3)(I) - adapt spoken language appropriately for formal and informal purposes; and
	(c)(3)(J) - respond orally to information presented in a wide variety of print, electronic, audio, and visual media to build and reinforce concept and language attainment.
Cross-curricular second language acquisition/reading. The ELL reads a variety of texts for a variety of purposes with an increasing level of comprehension in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high	(c)(4)(A) - learn relationships between sounds and letters of the English language and decode (sound out) words using a combination of skills such as recognizing sound-letter relationships and identifying cognates, affixes, roots, and

stage of English language acquisition in reading. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. For Kindergarten and Grade 1, certain of these student expectations apply to text read aloud for students not yet at the stage of decoding written text. The student is expected to:

base words;

(c)(4)(B) - recognize directionality of English reading such as left to right and top to bottom;

(c)(4)(C) - develop basic sight vocabulary, derive meaning of environmental print, and comprehend English vocabulary and language structures used routinely in written classroom materials;

(c)(4)(D) - use prereading supports such as graphic organizers, illustrations, and pretaught topic- related vocabulary and other prereading activities to enhance comprehension of written text;

(c)(4)(E) - read linguistically accommodated content area material with a decreasing need for linguistic accommodations as more English is learned;

[X] (c)(4)(F) - use visual and contextual support and support from peers and teachers to read grade- appropriate content area text, enhance and confirm understanding, and develop vocabulary, grasp of language structures, and background knowledge needed to comprehend increasingly challenging language;

[X] (c)(4)(G) - demonstrate comprehension of increasingly complex English by participating in shared reading, retelling or summarizing material, responding to questions, and taking notes commensurate with content area and grade level needs;

(c)(4)(H) - read silently with increasing ease and

	comprehension for longer periods; [X] (c)(4)(I) - demonstrate English comprehension and expand reading skills by employing basic reading skills such as demonstrating understanding of supporting ideas and details in text and graphic sources, summarizing text, and distinguishing main ideas from details commensurate with content area needs; (c)(4)(J) - demonstrate English comprehension and expand reading skills by employing inferential skills such as predicting, making connections between ideas, drawing inferences and conclusions from text and graphic sources, and finding supporting text evidence commensurate with content area needs; and (c)(4)(K) - demonstrate English comprehension and expand reading skills by employing analytical skills such as evaluating written information and performing critical analyses commensurate with content area and grade-level needs.
Cross-curricular second language acquisition/writing. The ELL writes in a variety of forms with increasing accuracy to effectively address a specific purpose and audience in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. In order for the ELL to meet grade-level learning expectations across foundation and enrichment curriculum, all	(c)(5)(A) - learn relationships between sounds and letters of the English language to represent sounds when writing in English; (c)(5)(B) - write using newly acquired basic vocabulary and content-based grade-level vocabulary; (c)(5)(C) - spell familiar English words with increasing accuracy, and employ English spelling patterns and rules with increasing accuracy as more English is acquired;

instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. For Kindergarten and Grade 1, certain of these student expectations do not apply until the student has reached the stage of generating original written text using a standard writing system. The student is expected to:	(c)(5)(D) - edit writing for standard grammar and usage, including subject-verb agreement, pronoun agreement, and appropriate verb tenses commensurate with grade-level expectations as more English is acquired;
	e(c)(5)(E) - employ increasingly complex grammatical structures in content area writing commensurate with grade-level expectations, such as:
	(i) using correct verbs, tenses, and pronouns/antecedents;
	(ii) using possessive case (apostrophe *s*) correctly; and
	(iii) using negatives and contractions correctly;
	(c)(5)(F) - write using a variety of grade-appropriate sentence lengths, patterns, and connecting words to combine phrases, clauses, and sentences in increasingly accurate ways as more English is acquired; and
	(c)(5)(G) - narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired.

Appendix A
TEKS and Student Expectations

(A.1) **Foundations for functions.** The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways.
The student is expected to:
(A) describe independent and dependent quantities in functional relationships;
(B) gather and record data and use data sets to determine functional relationships between quantities;
(C) describe functional relationships for given problem situations and write equations or inequalities to answer questions arising from the situations;
(D) represent relationships among quantities using concrete models, tables, graphs, diagrams, verbal descriptions, equations, and inequalities; and
(E) interpret and make decisions, predictions, and critical judgments from functional relationships.

(A.2) **Foundations for functions.** The student uses the properties and attributes of functions.
The student is expected to:
(A) identify and sketch the general forms of linear ($y = x$) and quadratic ($y = x2$) parent functions;
(B) identify mathematical domains and ranges and determine reasonable domain and range values for given situations, both continuous and discrete;
(C) interpret situations in terms of given graphs or creates situations that fit given graphs; and
(D) collect and organize data, make and interpret scatter plots (including recognizing positive, negative, or no correlation for data approximating linear situations), and model, predict, and make decisions and critical judgments in problem situations.

(A.3) **Foundations for functions.** The student understands how algebra can be used to express generalizations and recognizes and uses the power of symbols to represent situations.
The student is expected to:
(A) use symbols to represent unknowns and variables; and
(B) look for patterns and represent generalizations algebraically.

(A.5) **Linear functions.** The student understands that linear functions can be represented in different ways and translates among their various representations.
The student is expected to:
(A) determine whether or not given situations can be represented by linear functions;
(B) determine the domain and range for linear functions in given

situations; and
(C) use, translate, and make connections among algebraic, tabular, graphical, or verbal descriptions of linear functions.

(A.6) **Linear functions.** The student understands the meaning of the slope and intercepts of the graphs of linear functions and zeros of linear functions and interprets and describes the effects of changes in parameters of linear functions in real-world and mathematical situations.
The student is expected to:
(A) develop the concept of slope as rate of change and determine slopes from graphs, tables, and algebraic representations; and
(B) interpret the meaning of slope and intercepts in situations using data, symbolic representations, or graphs.

Formative Assessment Rubric

Part a) **Correct Solution: Yes   No**

Criteria	4	3	2	1
Part b) **Conceptual Knowledge**	**Attribute(s) of concept(s)** Correctly identifies attributes of the problem, which leads to correct inferences **Inferences** Combines the critical attributes of the problem in order to describe correctly the mathematical relationship(s) inherent in the problem	**Attribute(s) of concept(s)** Correctly identifies attributes of the problem, which leads to correct inferences. **Inferences** Combines the critical attributes of the problem in order to describe correctly the mathematical relationship(s) inherent in the problem	**Attribute(s) of concept(s)** Identifies some of the attributes of the problem, which leads to partially correct inferences **Inferences** Combines the identified attributes of the problem which leads to a partial identification of the mathematical relationship(s) inherent in the problem	**Attribute(s) of concept(s)** Lacks identification of any of the critical attributes of the problem. **Inferences** Combines few of the attributes of the problem which leads to an incomplete identification of the mathematical relationship(s) inherent in the problem
Part c) **Procedural Knowledge**	**Appropriate strategy** Selects and implements an appropriate strategy. **Representational form** Uses appropriate representation to connect the procedure to the concept of the problem. **Algorithmic competency** Correctly implements procedure to arrive at a correct solution.	**Appropriate strategy** Selects and implements an appropriate strategy. **Representational form** Uses appropriate representation to connect the procedure to the concept of the problem. **Algorithmic competency** Implements selected procedure but arrives at an incorrect solution.	**Appropriate strategy** Selects and implements an appropriate strategy. **Representational form** Uses inconsistent or insufficient representation for the selected solution strategy. **Algorithmic competency** Implements selected procedure but arrives at an incorrect or correct solution. (See Part a above)	**Appropriate strategy** Selects and implements an inappropriate strategy. **Representational form** Uses incorrect representations. **Algorithmic competency** Makes significant errors.
Part d) **Communication**	**Justification** Fully answers the question of "why" for the strategy selection, explains procedure, and/or evaluates reasonableness of solution. **Terminology** Uses appropriate terminology and notation.	**Justification** Fully answers the question of "why" for the strategy selection, explains procedure, and/or evaluates reasonableness of solution. **Terminology** Uses some appropriate terminology or notation.	**Justification** Incompletely answers the question of "why" for the strategy selection; explains procedure; and/or evaluates reasonableness of solution. **Terminology** Uses some appropriate terminology or notation.	**Justification** Provides very little or no explanation of what was done and wny. **Terminology** Uses limited or inappropriate terminology or notation.