Engage

Leader Notes: Lesson Learned?

Purpose:

The purpose of the Engage phase of the professional development is to connect participants' prior knowledge of teaching and learning related to Algebra 2 TEKS to the new learning which will take place in the professional development. To begin discussions related to the big ideas forming the core of this professional development, participants will explore the notion of parent functions from two perspectives: teaching and learning.

The Engage phase also serves as an initial window through which the facilitator can view participants' current understandings and beliefs related to:

- Participants' knowledge of teaching and learning related to parent functions and
- Participants' perceived stumbling blocks regarding the teaching and learning related to parent functions.

Descriptor:

Participants will analyze sets of data based on notions of parent functions. After working with the data sets, participants will work in small groups to study a sample lesson plan that uses the data sets. After analyzing the 5E lesson plan, participants will generate questions that help students focus on attributes of data that may indicate the use of a particular function in the process of generating a model for a set of data. To conclude, participants will generate a list of potential stumbling blocks related to the teaching and learning of parent functions.

Duration:

45 minutes

TEKS:

a5 Tools for algebraic thinking. Techniques for working with functions and equations are essential in understanding underlying relationships. Students use a variety of representations (concrete, pictorial, numerical, symbolic, graphical, and verbal), tools, and technology (including, but not limited to, calculators with graphing capabilities, data collection devices, and computers) to model mathematical situations to solve meaningful problems.

a6 Underlying mathematical processes. Many processes underlie all content areas in mathematics. As they do mathematics, students continually use problem-solving, language and communication, and reasoning (justification and proof) to make connections within and outside mathematics. Students also use multiple representations, technology, applications and modeling, and numerical fluency in problem-solving contexts.

2A.1 **Foundations for functions.** The student uses properties and attributes of functions and applies functions to problem situations.

2A.1A The student is expected to identify the mathematical domains and ranges of functions and determine reasonable domain and range values for continuous and discrete situations.

2A.1B The student is expected to collect and organize data, make and interpret scatterplots, fit the graph of a function to the data, interpret the results, and proceed to model, predict, and make decisions and critical judgments.

TAKS Objectives Supported:

While the Algebra 2 TEKS are not tested on TAKS, the concepts addressed in this lesson reinforce the understanding of the following objectives.

- Objective 1: Functional Relationships
- Objective 2: Properties and Attributes of Functions
- Objective 10: Mathematical Processes and Mathematical Tools

Materials:

Per Participant: **Setting the Stage**, **Ms. G's Lesson Plan**, **A Teaching Perspective**, and **A Learning Perspective** handouts

Leader Notes:

The purpose of this activity is to engage participants in the study of data with the intent of modeling the data using appropriate functional relationships. Participants will study Mrs. G's 5E lesson. This is a nonjudgmental task. During this phase of the professional development, avoid correcting participants or guiding them to a particular answer. Presenter questions should center on why a participant or group made the choice(s) they did. These questions allow the presenter to understand the set of knowledge and beliefs that participants bring to the training.

Engage

Part 1: Data Analysis (15 minutes)

*Distribute the S**etting the Stage** handout and **Ms. G's Lesson Plan** handout to each participant. Assign each group of participants one set of data to use as a reference as they work through the Case Study Lesson Page.*

Prompt the participants to work through the lesson using the assigned data set. This will allow participants to acquaint themselves with the lesson while the leader is able to gauge participants' knowledge about and comfort with analyzing sets of data. If the individuals in a group are not interacting with each other or seem to be struggling with responding to the questions, use the facilitation questions to help begin, focus, or continue the conversation.

Facilitation Questions

- Why is it important to consider the domain and range of the data?
  Answers may vary.
- Why is it important to consider whether the data are continuous or discrete?
  Answers may vary.
- Is there an interval where the rate of change indicates a particular parent function?
  Answers may vary.

Part 2: A Teaching Perspective (10 minutes)

*Distribute **A Teaching Perspective** handout to each participant. Participants should remain in their initial groups as they respond to the questions posed on the handout. The facilitator should be listening to the participants' responses as a means of gaining insight into beliefs about teaching Algebra II content. If the individuals in a group are not interacting with each other or seem to be struggling with responding to the questions, use the facilitation questions to help begin, focus, or continue the conversation.*

Facilitation Questions

- What questions might we pose to prompt students to explain whether or not the data represent a function?
  Answers may vary.
- What questions might we pose to ensure that the students are interpreting the data in graphical form?
  Answers may vary.
- What questions might we pose to prompt students to consider the importance of intervals when analyzing data?
  Answers may vary.
- What questions might we pose to prompt students to consider rates of change within the data and/or intervals of data?
  Answers may vary.

<u>Part 3</u>: A Learning Perspective (10 minutes)

*Distribute **A Learning Perspective** handout to each participant. Participants should remain in their groups as they respond to the questions posed on the handout. The facilitator should redirect any groups that begin to speak negatively about students and their capabilities. The facilitation questions might need to begin with the stem "What would you hope to hear a student…" If the individuals in a group are not interacting with each other or seem to be struggling with responding to the questions, use the facilitation questions to help begin, focus, or continue the conversation.*

Facilitation Questions

- What might a student write or say that would provide insight into his or her understanding about whether or not the data represent a function?
  Answers may vary.
- What might a student write or say that would provide insight into his or her understanding about interpreting the data in graphical form?
  Answers may vary.
- What might a student write or say that would provide insight into his or her understanding about the importance of intervals when analyzing data?
  Answers may vary.
- What might a student write or say that would provide insight into his or her understanding about rates of change within the data and/or intervals of data?
  Answers may vary.

Part 4: Reflection (10 minutes)
In a whole group setting, prompt participants to share their responses to the following questions. Simultaneously scribe the group's responses on two sheets of chart paper (Stumbling Blocks to Teaching and Stumbling Blocks to Learning) for use in the Evaluate Phase of the professional development. Answers may vary widely depending on the make-up of your group of participants.

1. **What opportunities for student interaction does Mrs. G provide?**
   As participants respond ask if their response should be listed as a stumbling block to teaching or a stumbling block to learning.

2. **How is Mrs. G supporting the needs of her English Language Learners, Students with Special Needs, and At-Risk Students?**
   As participants respond ask if their response should be listed as a stumbling block to teaching or a stumbling block to learning.

3. **How do we balance the need to review and refresh with the demands of new instruction in Algebra II? What are the implications of that balance?**
   As participants respond ask if their response should be listed as a stumbling block to teaching or a stumbling block to learning.

4. **Are there any additional stumbling blocks you would like to add?**
   As participants respond ask if their response should be listed as a stumbling block to teaching or a stumbling block to learning.

5. **Are these stumbling blocks only applicable to parent functions? Why?**
   Answers may vary.

6. **Why begin a professional development with a discussion about stumbling blocks?**
   Answers may vary. Beginning with a short discussion of stumbling blocks allows the facilitator to "table" what often leads to off-task discussions until the end of the professional development. Many of the strategies used in this professional development will address the stumbling blocks. These stumbling blocks will be part of the reflective process in the Evaluate phase.

 *While the answers to the questions posed in the Engage phase will vary, responses open a window into participants' cognitive, pedagogical, and philosophical beliefs. The facilitator listens carefully in a nonjudgmental fashion and should focus on the substance of participant responses related to cognitive, pedagogical, and philosophical beliefs.*

Setting the Stage

Ms. G has 8 years of experience teaching Algebra II. This year she has five sections of Algebra II filled with 11^{th} and 12^{th} grade students. Ten percent of her students are enrolled in Algebra II for the second time. Ten percent of her students speak little or no English and have Spanish or Vietnamese as their primary language. Twenty-five percent of her students are fluent in English and Spanish. Five percent of her students are fluent in English and Vietnamese. Ten percent of her students have IEPs requiring accommodations and/or modifications. Thirty percent of her students did not pass the TAKS as tenth graders. Forty percent of her students are classified as low SES. Ms. G is sometimes overwhelmed with finding approaches that address the needs of all of the students in her classes.

Ms. G prefers to plan whole group instruction. She is trying to incorporate small group instruction a few times each six weeks. Ms. G feels that she gets the best feedback from students when everyone is focused on one task together. She has recently started to have her students write about the mathematics they are studying.

Prior to this lesson, Ms. G reviewed linear, quadratic, and exponential parent functions to help students remember what they learned in Algebra I. She provided a brief explanation of the absolute value parent function as a non-example of the other functions. The students used graphing technology to graph the parent functions, perform transformations on the parent functions, and analyze the rates of change associated with the parent functions.

Ms. G's Lesson Plan

TEKS:

2A.1A The student uses properties and attributes of functions and applies functions to problem situations. The student is expected to identify the mathematical domains and ranges of functions and determine reasonable domain and range values for continuous and discrete situations.

2A.1B The student uses properties and attributes of functions and applies functions to problem situations. The student is expected to collect and organize data, make and interpret scatterplots, fit the graph of a function to the data, interpret the results, and proceed to model, predict, and make decisions and critical judgments.

Engage:

The U.S. Geological Survey (USGS) is dedicated to the timely, relevant, and impartial study of the landscape, our natural resources, and the natural hazards that threaten us. To accomplish this, the USGS collects real-time data about the depth of water in streams, bayous, ponds, and lakes in the United States. Why might they do this?
http://www.usgs.gov/

Explore:

1. Assign each group one of the four sets of data. Provide each group with the appropriate graph and table of data.
2. Prompt students to answer the questions on the activity page for their assigned graph and table of data.
3. Prompt students to create a poster that summarizes their learning.

Explain:

1. Have students share their group summaries.
2. Debrief using these questions.
   a. How did the reasonable domains compare for these different situations?
   b. How did the reasonable ranges compare for these different situations?
   c. Are the data continuous or discrete? Why?
   d. Which, if any, parts of these graphs can be modeled by a parent function? Why?

Elaborate:

1. Assign each group a different set of data.
2. Direct each group to analyze this new set of data. How does it compare to your original set of data? How is it different?

Evaluate:

Prompt students to complete 2 of the 3 sentence starters.

1. Understanding domain and range helps me to…
2. A parent function tells…
3. The rate of change of data helps us identify a possible parent function because…

Ms. G's Lesson Plan: Student Activity Page

1. What is the title of your set of data?

2. What do you notice about the graph of the data?

3. What is a reasonable domain for this situation? Why?

4. What is a reasonable range for this situation? Why?

5. Are the data continuous or discrete? Why?

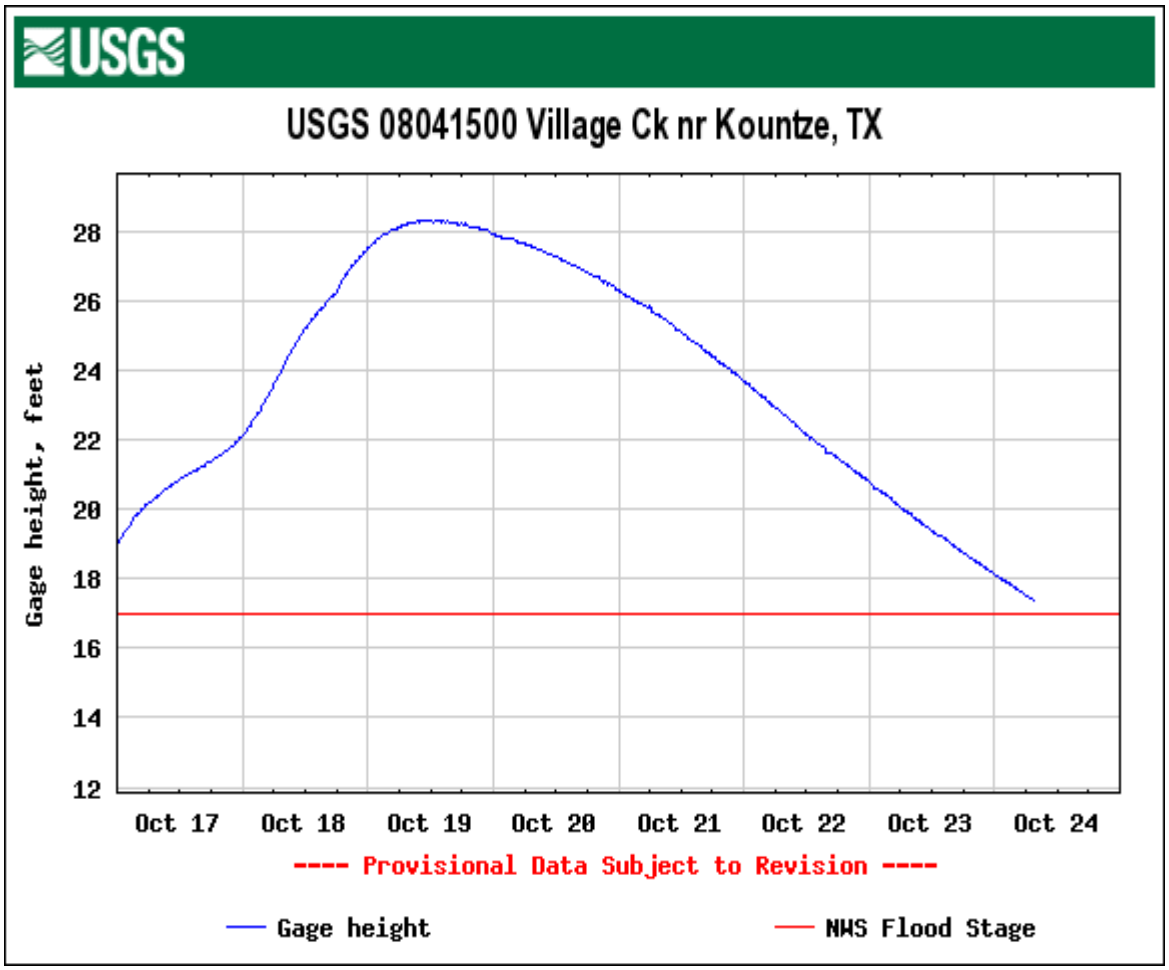
6. Which, if any, part of this graph can be modeled by a linear function? How do you know?

7. Which, if any, part of this graph can be modeled by a quadratic function? How do you know?

8. Which, if any, part of this graph can be modeled by an exponential function? How do you know?

9. Which, if any, part of this graph can be modeled by an absolute value function? How do you know?

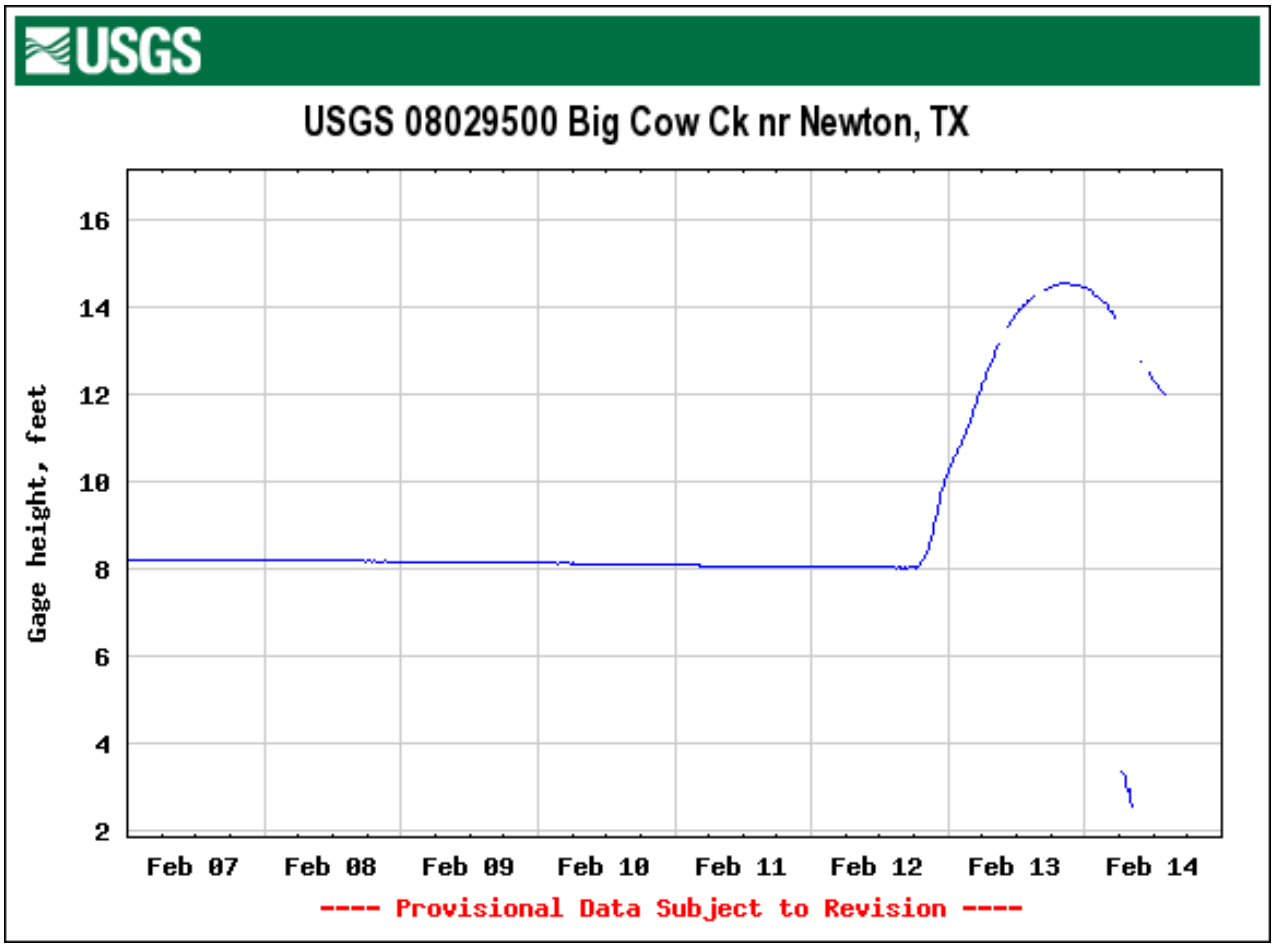
Ms. G's Lesson Plan: Data Set A



Date	Gage Height at Noon (ft)
Oct. 17	20.8
Oct. 18	25.4
Oct. 19	28.2
Oct. 20	27.1
Oct. 21	25.0
Oct. 22	22.1
Oct. 23	19.2

http://waterdata.usgs.gov/nwis/rt

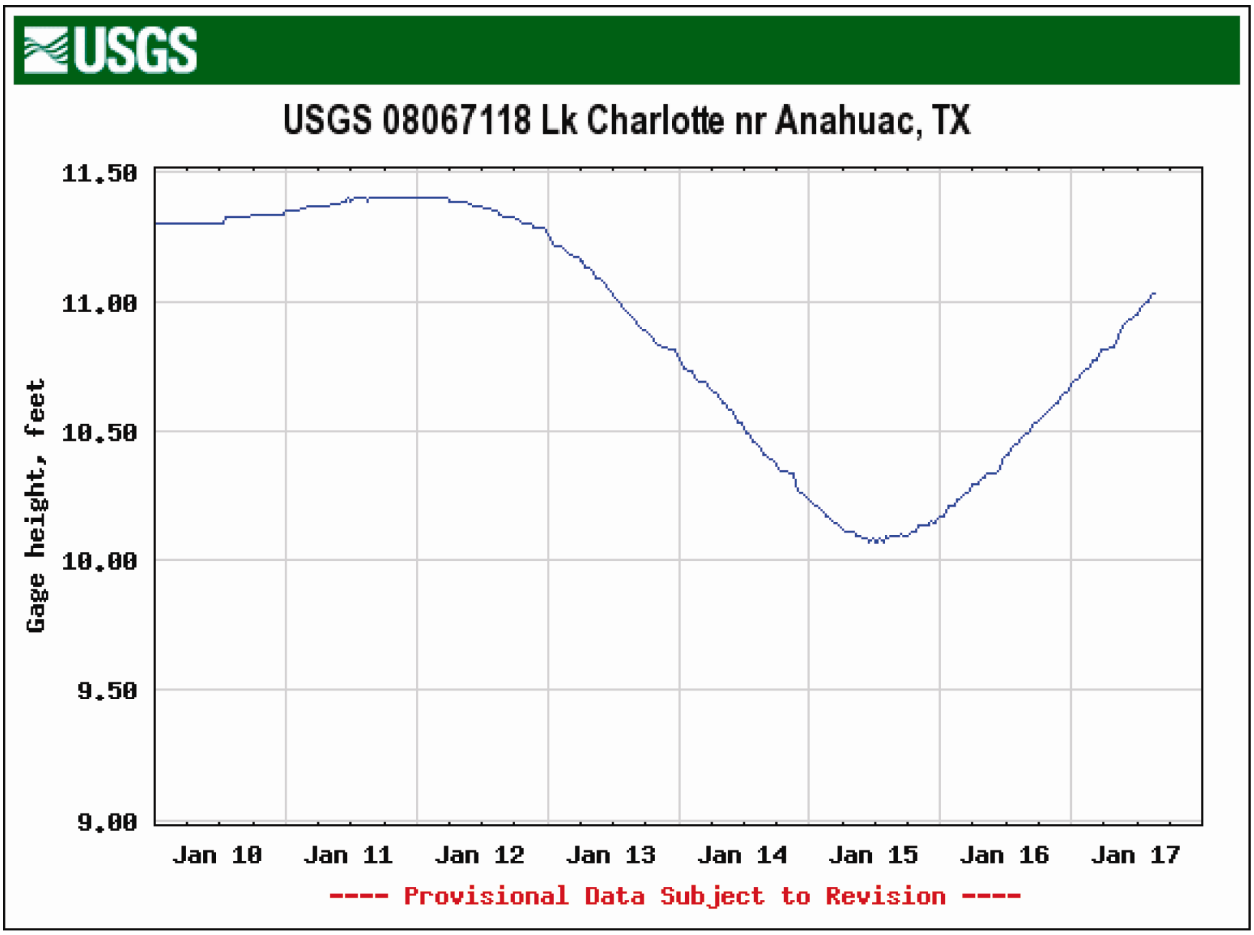
Ms. G's Lesson Plan: Data Set B



Date	Gage Height at Noon (ft)
Feb. 7	8.2
Feb. 8	8.2
Feb. 9	8.2
Feb. 10	8.1
Feb. 11	8.0
Feb. 12	8.0
Feb. 13	13.5
Feb. 14	12.1

http://waterdata.usgs.gov/nwis/rt

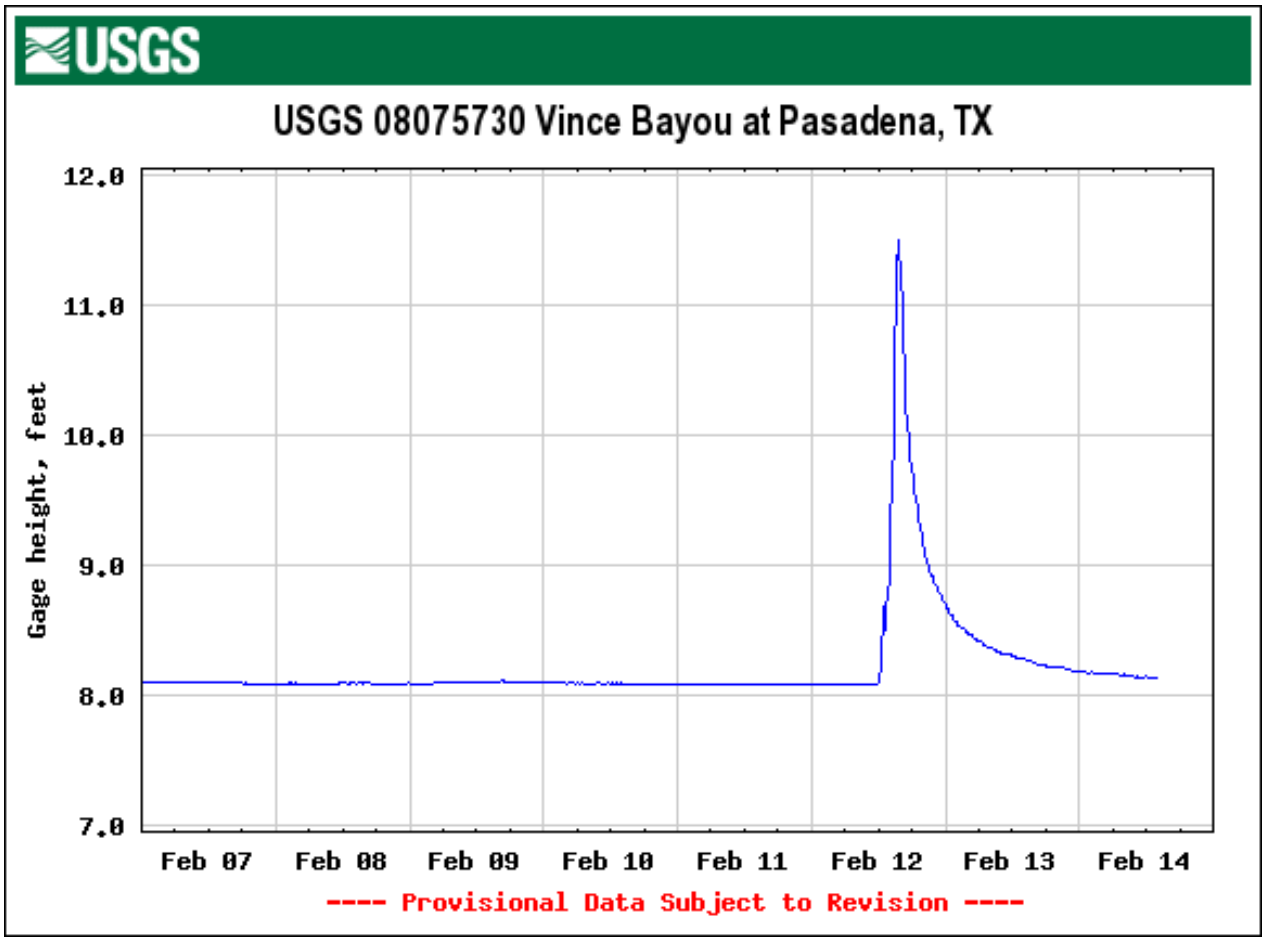
Ms. G's Lesson Plan: Data Set C



Date	Gage Height at Noon (ft)
Jan. 10	11.30
Jan. 11	11.35
Jan. 12	11.32
Jan. 13	11.08
Jan. 14	10.51
Jan. 15	10.10
Jan. 16	10.40
Jan. 17	10.90

http://waterdata.usgs.gov/nwis/rt

Ms. G's Lesson Plan: Data Set D



Date	Gage Height at Noon (ft)
Feb. 7	8.1
Feb. 8	8.1
Feb. 9	8.1
Feb. 10	8.1
Feb. 11	8.1
Feb. 12	8.1
Feb. 13	8.3
Feb. 14	8.2

http://waterdata.usgs.gov/nwis/rt

A Teaching Perspective

1. How does this lesson teach students to become better problem solvers?

2. How does this lesson teach students to communicate mathematics?

3. How does this lesson teach students to reason mathematically?

4. What questions should the teacher pose during this lesson?

5. What teaching suggestions would you offer this teacher?

A Learning Perspective

1. What should be the learning outcomes for this lesson?

2. What prior learning is needed for students to be successful with this lesson?

3. What evidence of learning is provided by this lesson?

4. What evidence of learning is lacking?

5. What misconceptions might students develop based on this lesson?

6. What about this lesson helps students learn to value mathematics?

7. How does this lesson help students become more confident in their ability to do mathematics?