Roadmaps for Formative Assessment

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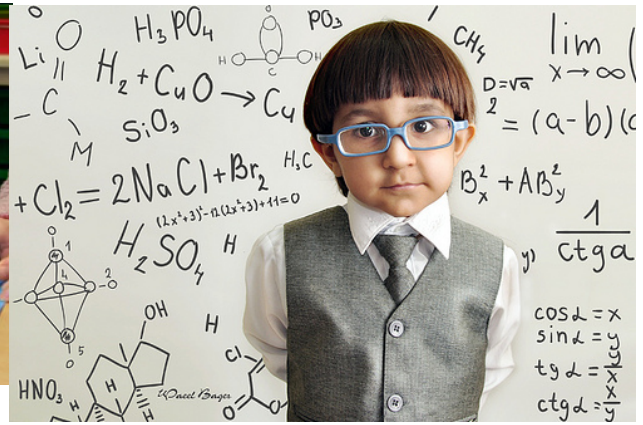
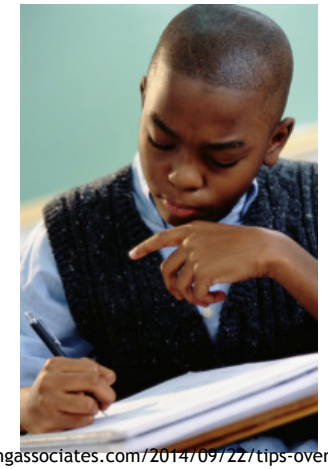
Wide array of students

https://www.theodysseyonline.com/dear-struggling-students.

https://www.dseusa.org/en-us/



http://www.elist10.com/top-10-genius-kids-that-astounded-the-world/



http://www.academiccoachingassociates.com/2014/09/22/tips-overcoming-math-anxiety/

http://il5.picdn.net/shutterstock/videos/8333005/thumb/10.jpg

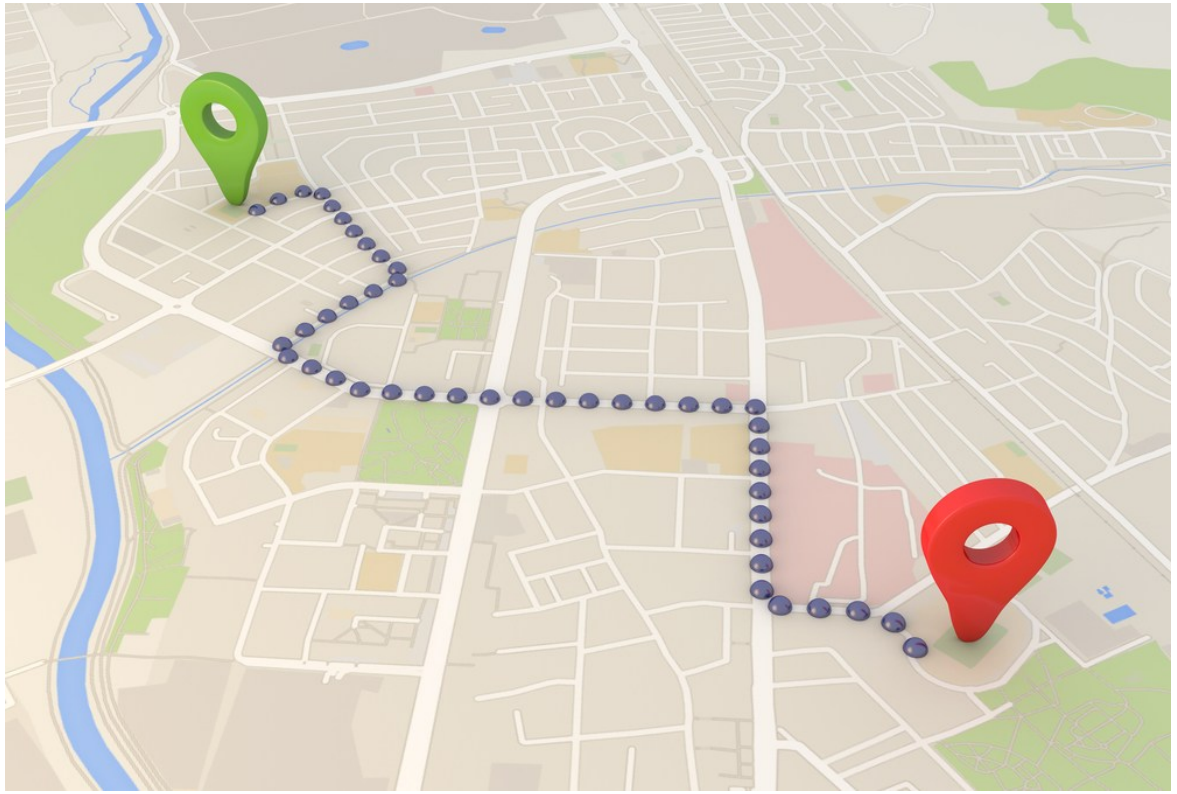
https://d17td7dfmj97sg.cloudfront.net/wp-content/uploads/2015/11/childheadondesk.jpg

How do you move these students forward?

- Teacher has to be able to gain access to what the kid does and does not know
- Pinpoint what the student knows about the topic that you're teaching – or anything that could impact their understanding
- Assess prior knowledge –think some more how to say this in more descriptive terms but not too scholarly
- Identify gaps or misconceptions
- Get "advanced" students thinking
- Ask students to help/teach each other

Many paths…

- Regardless of where the student is/starts, our goal as a teacher is to move them forward in their learning
- Different starting and ending points
- Different routes



- Lay out all the reasons why kids struggle and then point to the tool
- Here's a tool that helps us collect evidence about student thinking so that we know how to move them forward
  - Where they are starting
  - Have a better understanding of prior knowledge

Learning Map Model

- FA and the learning map address this problem of all kids being so diverse in their needs
- FA helps you collect the evidence
- LM gives you the diagnostic tool
- Takes guess work out of it.
- --helps you create questions to collect evidence
- --go back to the map to figure out how to collect more evidence about the kid's progress
- Cycle

Our Approach to Formative Assessment

- Assessment *of* learning
- Interim assessment
- Summative assessment
- Giving a test at the end of a sequence of learning
- Assigning or reporting grades
- Giving students test results
- Individual assignment scores/completion points

NO

Source: Margaret Heritage

Our Approach to Formative Assessment

YES

- Assessment *for* learning
- Collect evidence of student thinking
- The focus is on informing learning, rather than measuring it
- To **gauge** how student learning is progressing while students are in the process of learning
- To **inform students** about their progress – not for grading purposes
- To **inform instructional decisions** and immediate adjustments to the learning environment
- Move learning forward from its current status
- Use evidence to inform immediate or near immediate teaching and learning
- Provide ongoing feedback to learners
- Generate evidence of student progress through observation, discussion, questioning, and review of student work

"Formative assessment is a planned process in which teachers or students use assessment-elicited evidence to improve what they're doing" (Popham, 2011, p. 2).

Source: Margaret Heritage

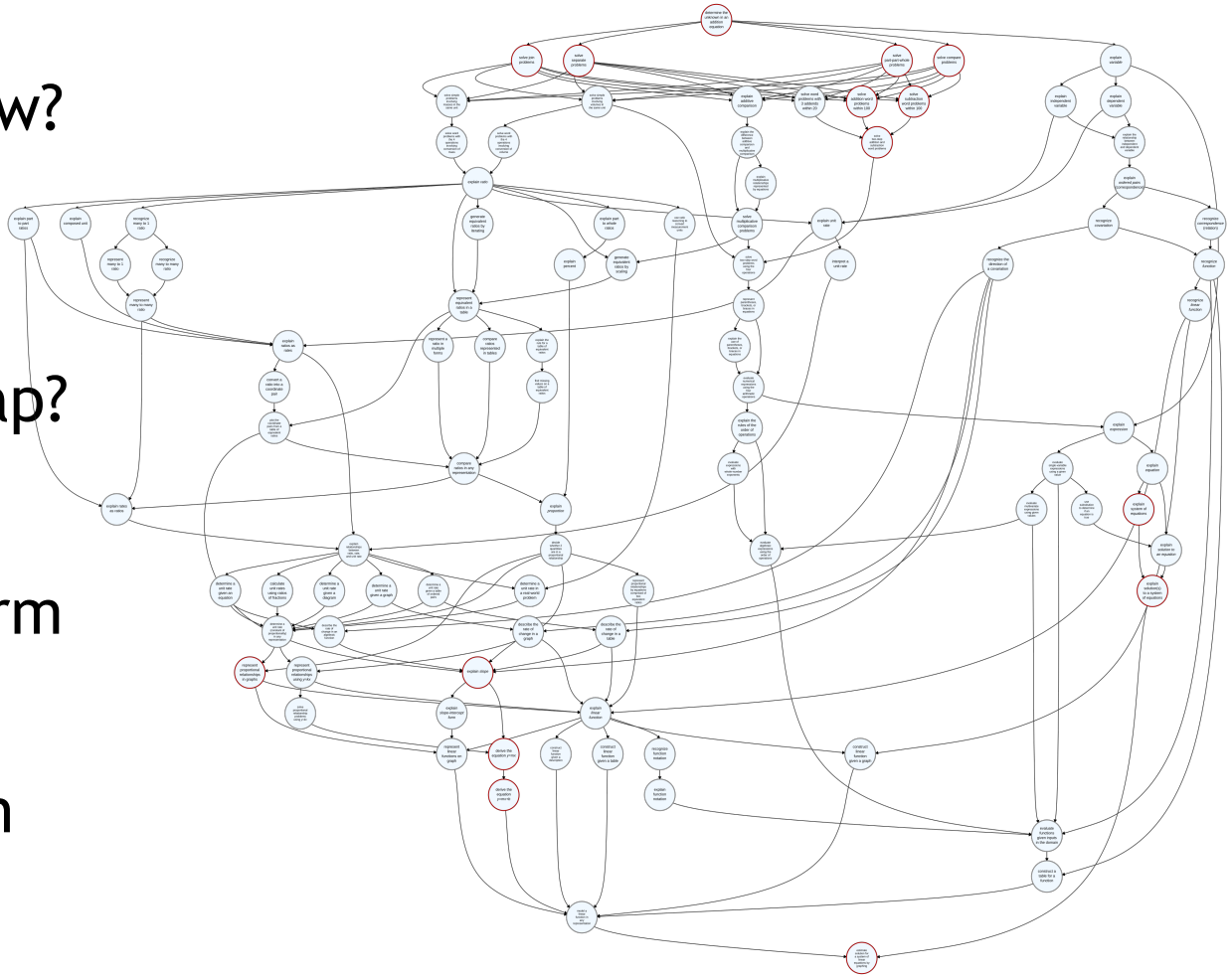
Our Learning Map Model + Resources

- Combines classroom activities and opportunities to implement formative assessment
- Makes the work teachers do more efficient
- No human being has time or knowledge to build a map that reflects the way students progress through learning

Our Learning Map Model

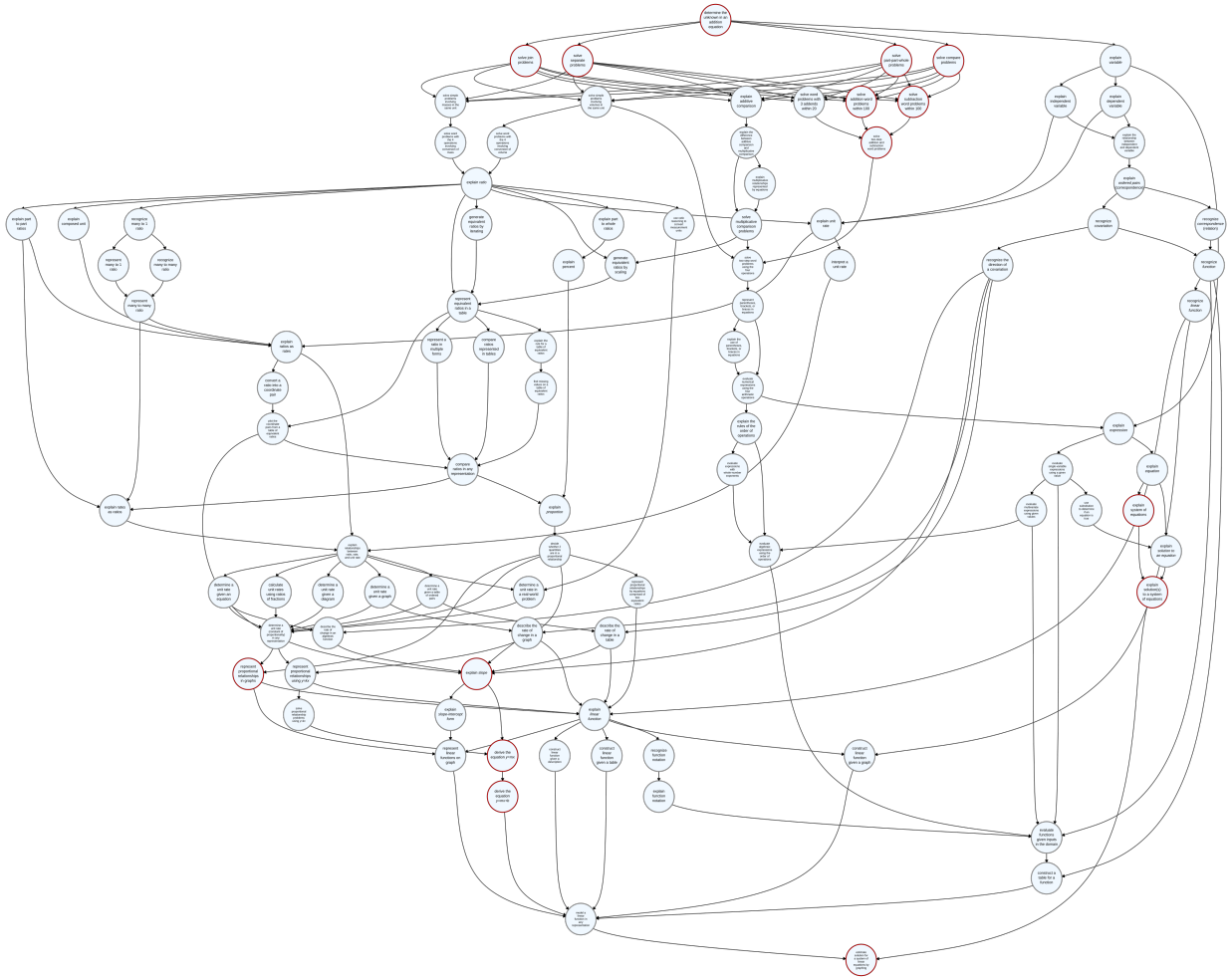
- What do I already know?
- What am I ready to learn?
- Where can I go next?
- How can I close the gap?

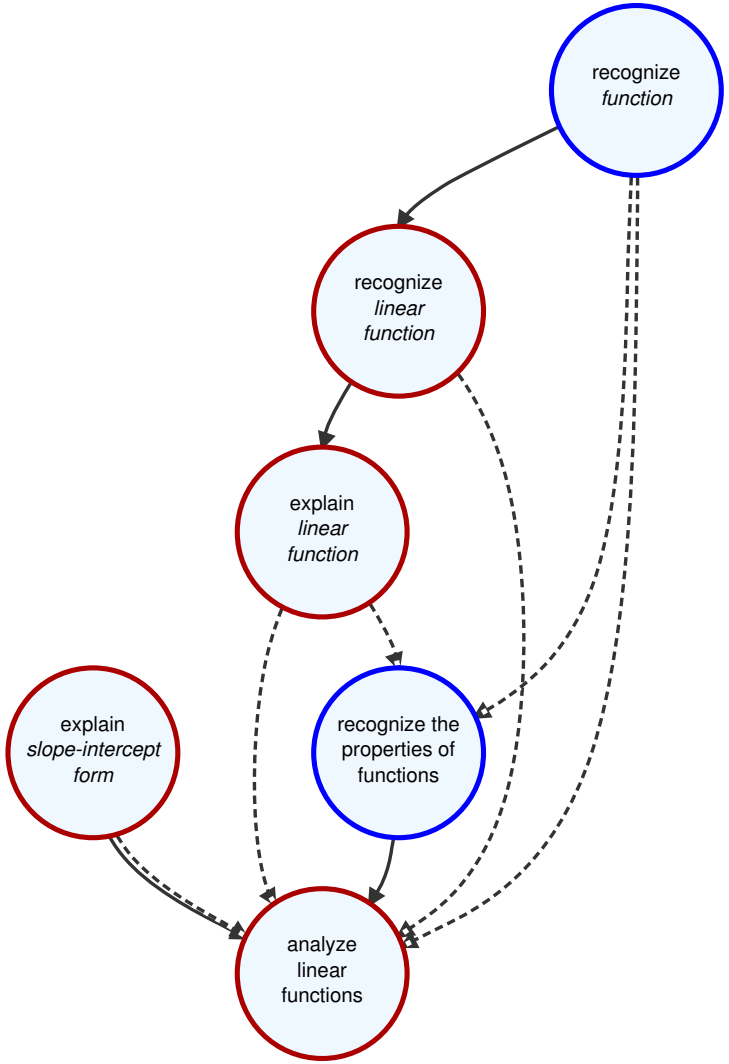
- What is the benefit of using this map to inform our instructional decisions?
- Make a transition from FA to LM (Margaret Heritage)



Our Learning Map Model

- ELA
- Mathematics
- Birth through HS



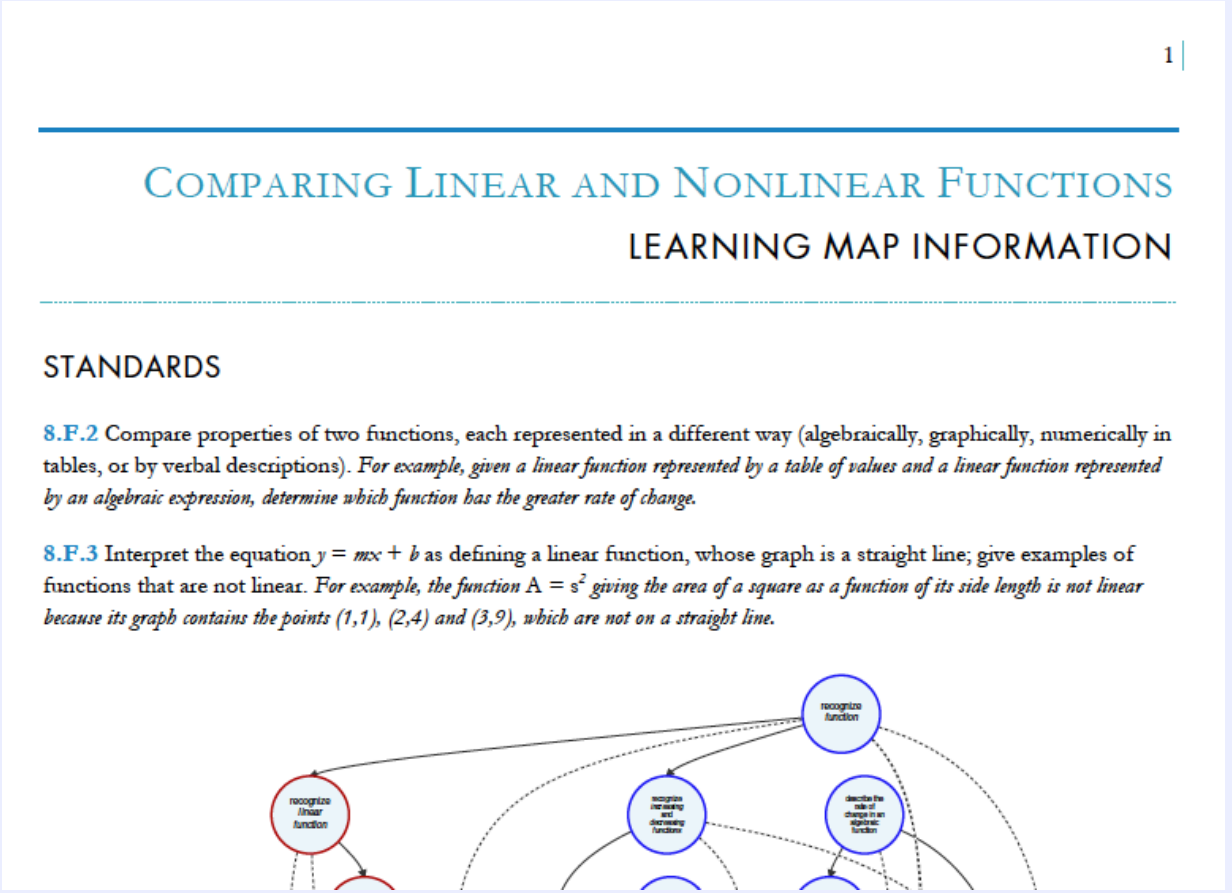


This Model Helps Teachers…

- Identify prerequisite knowledge
- Identify next steps in learning
- See how concepts are related to each other
- Ask questions about particular skills and concepts

Learning Map Information

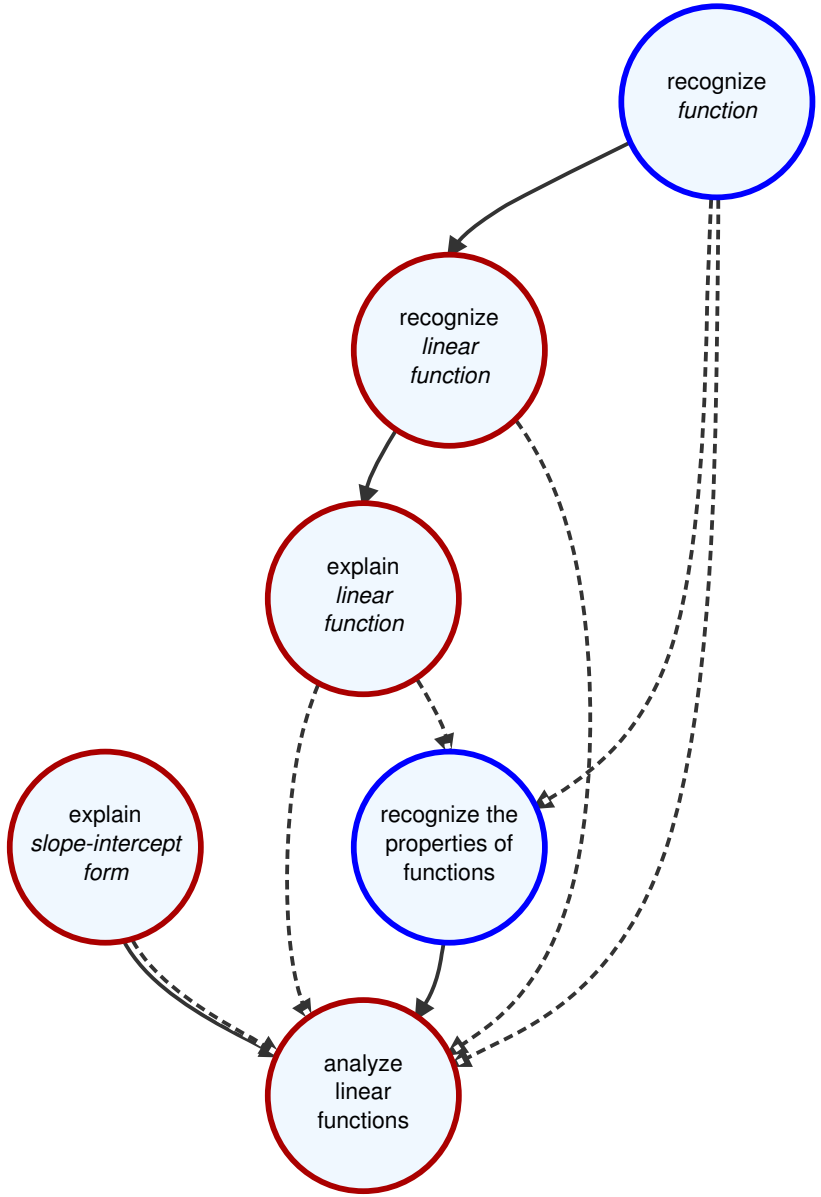
- **Examine** the learning map model for the unit.
- **What information** in the learning map model attracted your attention most?
- How might **you** use the information in the learning map model?



LEARNING MAP INFORMATION

Learning Map Model

8.F.3: Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.



Target skill

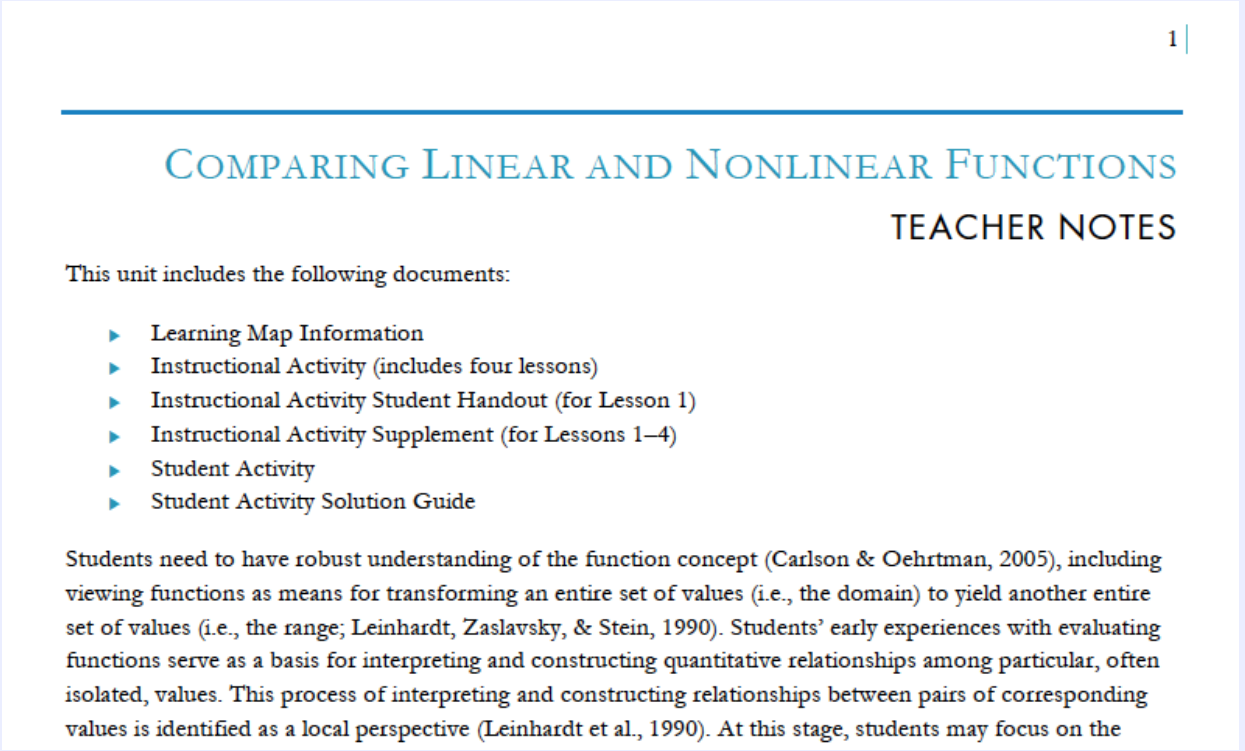
Prerequisite or related skill

Direct path

Indirect path

Teacher Notes

- **Read or skim** the Teacher Notes document for the unit.
- How might you structure a **professional development session** around a Teacher Notes document?
- What **benefits** do you anticipate teachers will gain from reading these documents?



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COMPARING LINEAR AND NONLINEAR FUNCTIONS

TEACHER NOTES

This unit includes the following documents:

- Learning Map Information
- Instructional Activity (includes four lessons)
- Instructional Activity Student Handout (for Lesson 1)
- Instructional Activity Supplement (for Lessons 1–4)
- Student Activity
- Student Activity Solution Guide

Students need to have robust understanding of the function concept (Carlson & Oehrtman, 2005), including viewing functions as means for transforming an entire set of values (i.e., the domain) to yield another entire set of values (i.e., the range; Leinhardt, Zaslavsky, & Stein, 1990). Students' early experiences with evaluating functions serve as a basis for interpreting and constructing quantitative relationships among particular, often isolated, values. This process of interpreting and constructing relationships between pairs of corresponding values is identified as a local perspective (Leinhardt et al., 1990). At this stage, students may focus on the

Teacher Notes

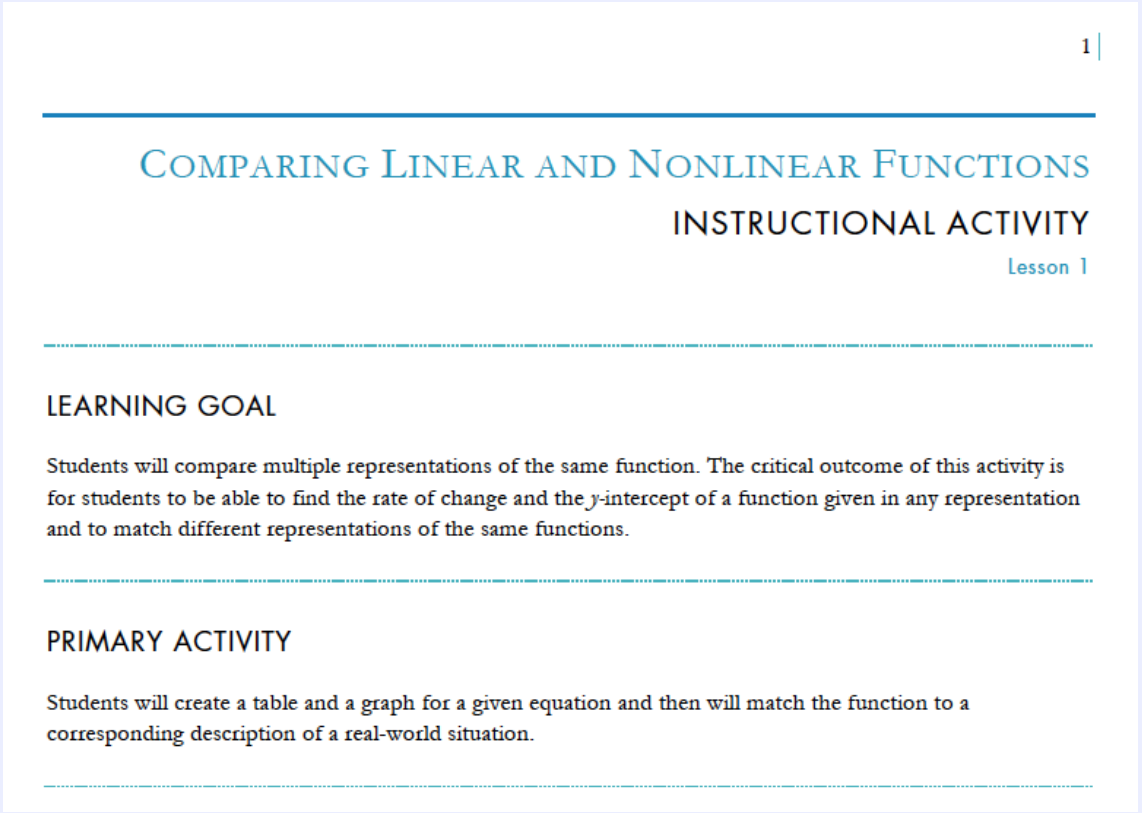
TEACHER NOTES

for developing an understanding of functions as predictable relationships between quantities (Leinhardt et al., 1990). Alternatively, students need learning experiences to **reinforce the idea that functions accept inputs and produce outputs according to predictable rules**, such as a rate of change, as is the case for linear functions. They also need opportunities to **consider how functions act on entire intervals** so they may develop global, rather than local, perspectives.

Students' understanding is deepened through activities that require them **to work with the same function in multiple representations**, such as symbolic, graphical, numerical, or verbal forms (Carlson & Oehrtman, 2005; Leinhardt et al., 1990; Lloyd, Herbel-Eisenmann, & Star, 2011; Ronau, Meyer, Crites, & Dougherty, 2014). As students **examine the characteristics of a function in its different representations**, they should be able to articulate how each characteristic can be shown in different ways. For example, the y-intercept appears as (1) an initial value in a verbal description, (2) an ordered pair of the form (0, #) in numerical representation, (3) a point lying on the y-axis of a graph,

Instructional Activity

- Choose **one lesson** in the unit to read and try participating in the described activities.
- What reactions do you have about the **activities** students would engage in during the lesson you reviewed?
- What reactions do you have about the **Guiding Questions**?



1

COMPARING LINEAR AND NONLINEAR FUNCTIONS

INSTRUCTIONAL ACTIVITY

Lesson 1

LEARNING GOAL

Students will compare multiple representations of the same function. The critical outcome of this activity is for students to be able to find the rate of change and the *y*-intercept of a function given in any representation and to match different representations of the same functions.

PRIMARY ACTIVITY

Students will create a table and a graph for a given equation and then will match the function to a corresponding description of a real-world situation.

Instructional Activity

LEARNING GOAL

Students will **compare multiple representations of the same function**. The critical outcome of this activity is for students to be able to find the rate of change and the y-intercept of a function given in any representation and to match different representations of the same functions.

PRIMARY ACTIVITY

Students will create a table and a graph for a given equation and then will **match the function to a corresponding description of a real-world situation.**

INSTRUCTIONAL ACTIVITY

Instructional Activity

Function 1	Common Properties of Functions 1 and 2	Function 2

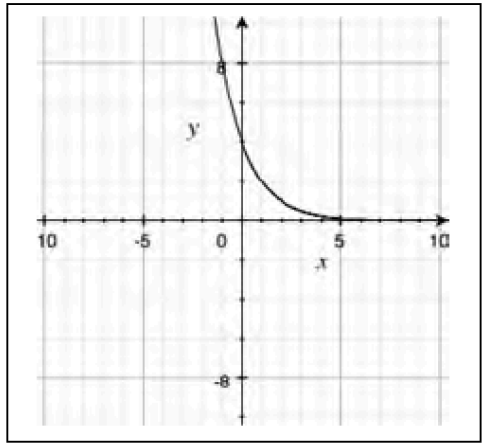
x	y
0	0
1	–5
2	–10
3	–15
4	–20

linear function

lesser *y*-intercept

constant rate of change

decreasing function



nonlinear function

greater *y*-intercept

variable rate of change

INSTRUCTIONAL ACTIVITY

Guiding Questions

Elicit student thinking:

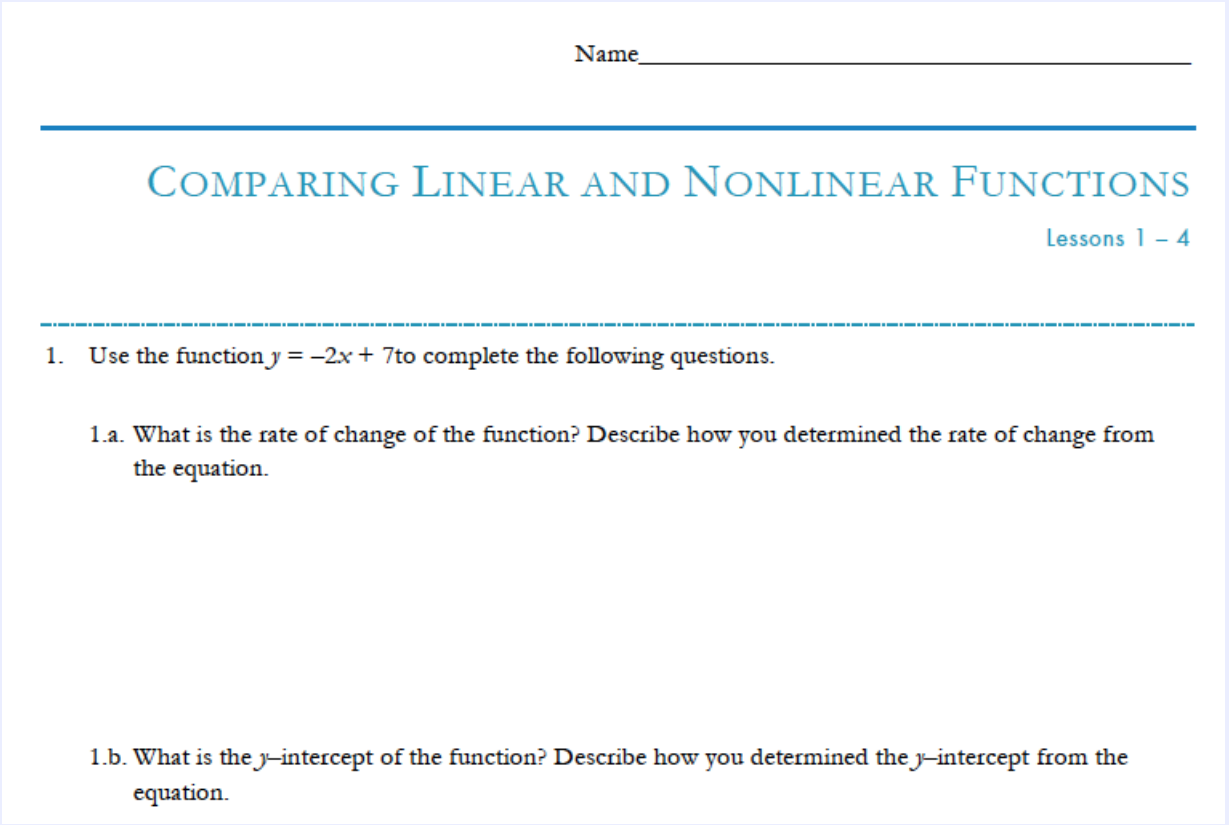
- How do different representations of the same function show you details about the function?

Determine if the student can RECOGNIZE THE PROPERTIES OF FUNCTIONS:

- Looking at this function only, what is its *y*-intercept?
- Is this function increasing, decreasing, constant, or both increasing and decreasing?

Student Activity

- Read through the **student activity** for the unit.
- What is your reaction to the **tasks** in the activity?
- How do you think **you** could incorporate these in your routine instructional planning?



Name_____

COMPARING LINEAR AND NONLINEAR FUNCTIONS

Lessons 1 – 4

1. Use the function $y = -2x + 7$ to complete the following questions.

1.a. What is the rate of change of the function? Describe how you determined the rate of change from the equation.

1.b. What is the y–intercept of the function? Describe how you determined the y–intercept from the equation.

Student Activity

STUDENT ACTIVITY
& SOLUTION GUIDE

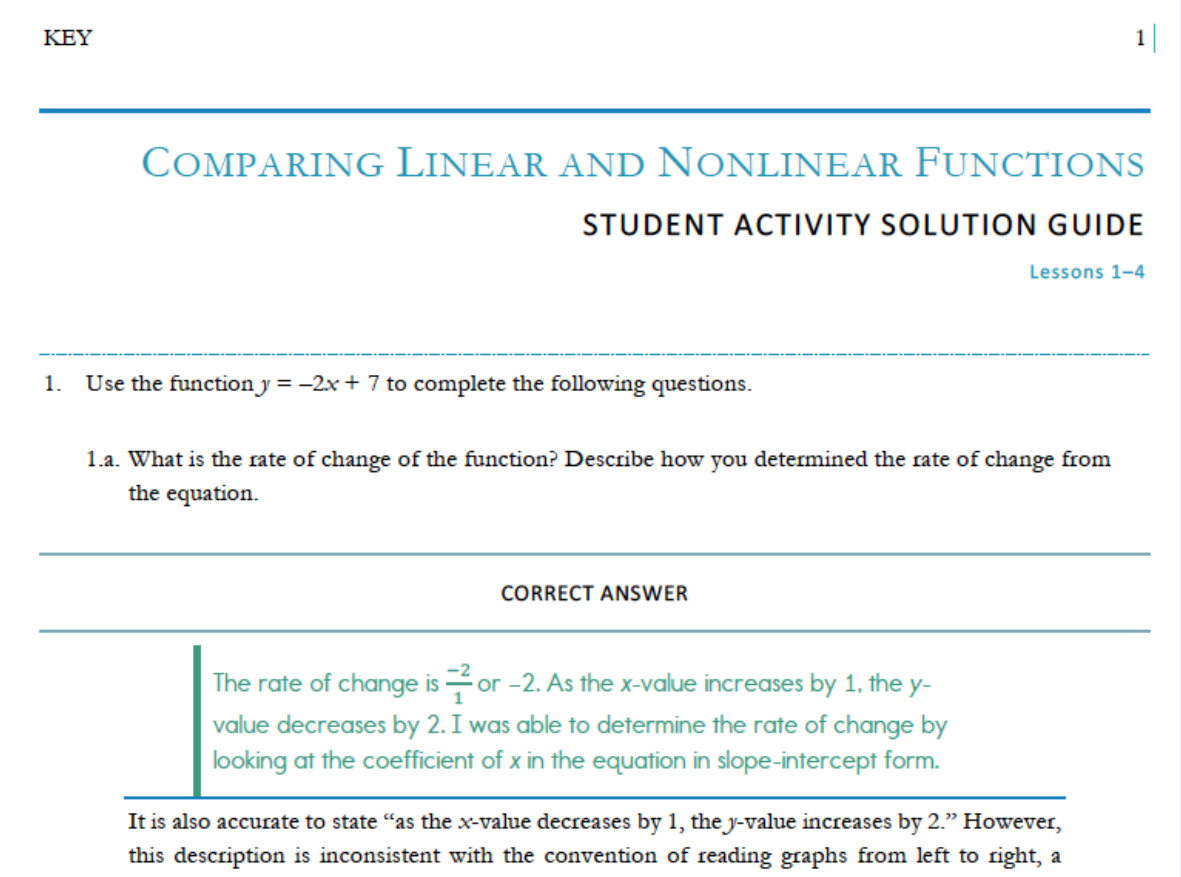
WORD BANK

positive rate of change	negative rate of change	zero rate of change	positive y–intercept
negative y–intercept	zero y–intercept	linear function	nonlinear function
constant rate of change	variable rate of change	increasing function	decreasing function
constant function	increasing and decreasing function		

FUNCTION 1	FUNCTION 2
$y = 1 + x$	Sam has \$12. Sam buys baseball cards for \$1 each. How much money does Sam have left if he buys x baseball cards?
PROPERTIES OF FUNCTION 1	PROPERTIES OF FUNCTION 2

Solution Guide

- Read through the **solution guide** for the unit.
- What is your reaction to the **information** provided?
- How do you think you could use this information to
  - Consider student work?
  - Address students' needs?



KEY 1

COMPARING LINEAR AND NONLINEAR FUNCTIONS

STUDENT ACTIVITY SOLUTION GUIDE

Lessons 1–4

1. Use the function $y = -2x + 7$ to complete the following questions.

1.a. What is the rate of change of the function? Describe how you determined the rate of change from the equation.

CORRECT ANSWER

The rate of change is $\frac{-2}{1}$ or –2. As the x-value increases by 1, the y-value decreases by 2. I was able to determine the rate of change by looking at the coefficient of x in the equation in slope-intercept form.

It is also accurate to state "as the x-value decreases by 1, the y-value increases by 2." However, this description is inconsistent with the convention of reading graphs from left to right, a

Solution Guide

STUDENT ACTIVITY
& SOLUTION GUIDE

CORRECT ANSWER

FUNCTION 1	FUNCTION 2
$y = 1 + x$	Sam has \$12. Sam buys baseball cards for \$1 each. How much money does Sam have left if he buys x baseball cards?
PROPERTIES OF FUNCTION 1	**PROPERTIES OF FUNCTION 2**
greater rate of change lesser y-intercept increasing function	lesser rate of change greater y-intercept decreasing function
COMMON PROPERTIES OF FUNCTION 1 AND FUNCTION 2	
constant rate of change linear function graphs are equally steep	

Solution Guide

STUDENT ACTIVITY
& SOLUTION GUIDE

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student misplaces or does not identify *greater rate of change* or *lesser rate of change* as properties of the individual functions.	is not able to identify the rate of change in all function representations	DESCRIBE THE RATE OF CHANGE IN AN ALGEBRAIC FUNCTION
The student misplaces or does not identify *greater* y-*intercept* or *lesser* y-*intercept* as properties of the individual functions.	is not able to identify the *y*-intercept in all function representations	EXPLAIN Y-*INTERCEPT*
The student does not identify *equally steep* as a shared property.	does not understand the difference between steepness and the rate of change or slope	EXPLAIN *SLOPE*; EXPLAIN THE RATE OF CHANGE IN AN ALGEBRAIC FUNCTION
The student does not identify *linear function* as a shared property.	cannot recognize linear functions in different representations	RECOGNIZE *LINEAR FUNCTIONS*
The student does not mention the correct similarities.	can identify properties of a single function but cannot compare functions in order to identify common properties	COMPARE THE PROPERTIES OF 2 FUNCTIONS REPRESENTED IN DIFFERENT FORMS

Learning Maps Models and Teachers

- Explore **relationships** among concepts and skills
- Identify **connections**
- Identify nearby and distant **prerequisites**
- Identify **next steps** or **extensions**
- Consider **students' different learning needs**

Teacher Feedback

- *The map can be used to **take students back** to nodes/concepts where they have **gaps** that are preventing them from learning new material.*

- *I often speak of the learning gaps students have. Now I feel **I have a better tool** to help identify with the goal of filling in those gaps.*

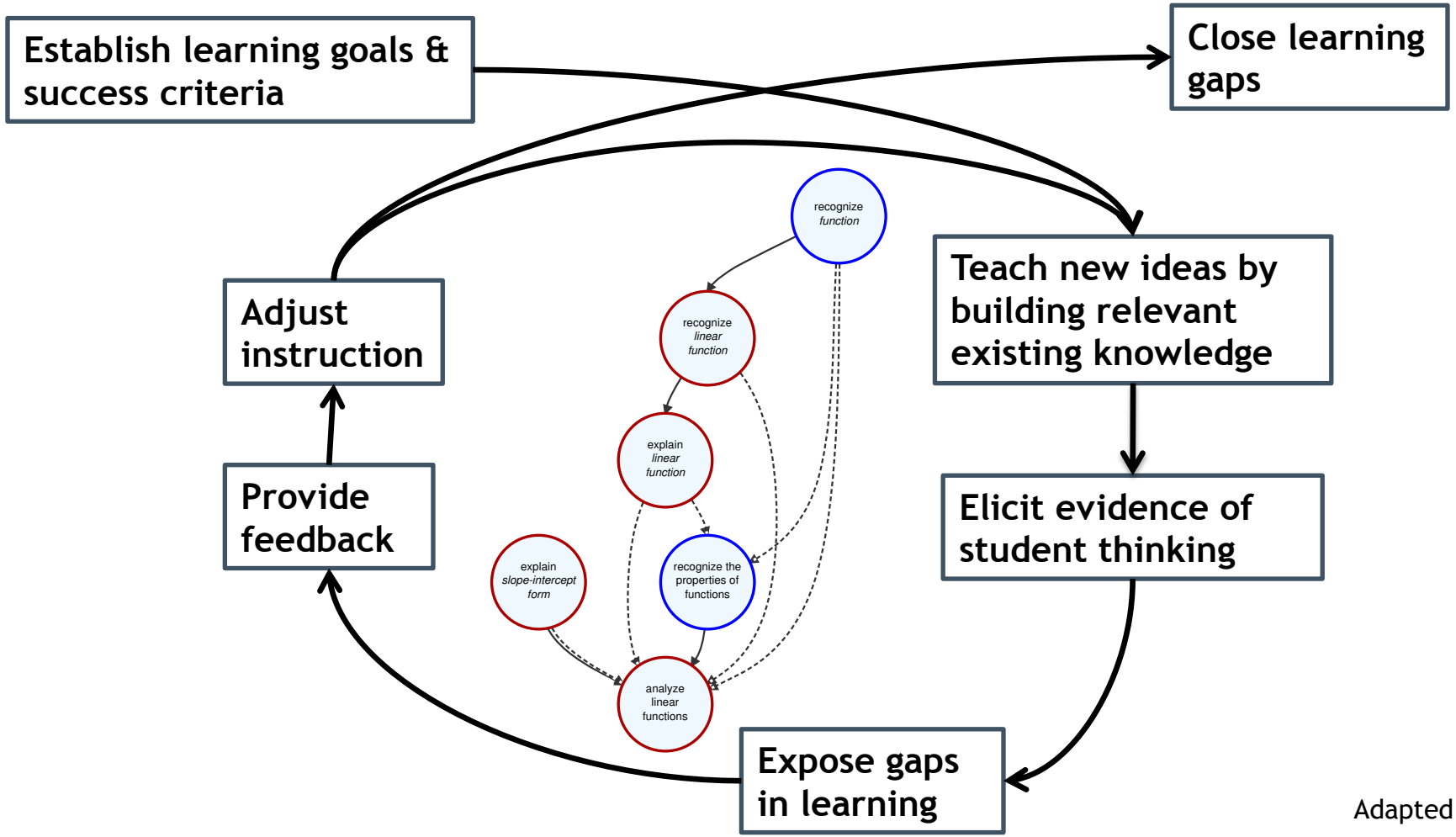
Teacher Feedback

- *Teachers can use the map to **look forward or back** depending on the **needs of their students**. This* (map) *could really help an instructor differentiate their teaching.*
- ***I have a mental roadmap** for the future of equations and functions that my students will be traveling. I really think this helps me visit the topics I currently teach.*

Learning Map Models and Formative Assessment

- **Clarify learning goals**
- **Promote effective learning** by focusing on connections
- Help to **determine where students are in their learning and move them to next steps.**

Informed Instruction

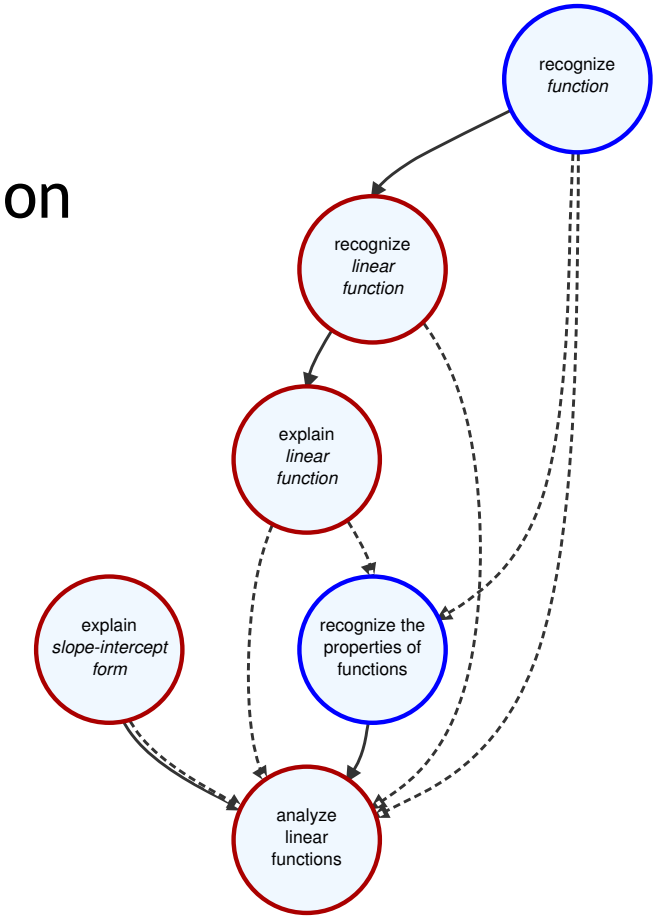


Adapted from Heritage, 2010

Scaffolding the Process

Mathematics

- Learning map information
- Teacher notes
- Instructional activity
- Student activity
- Solution guide



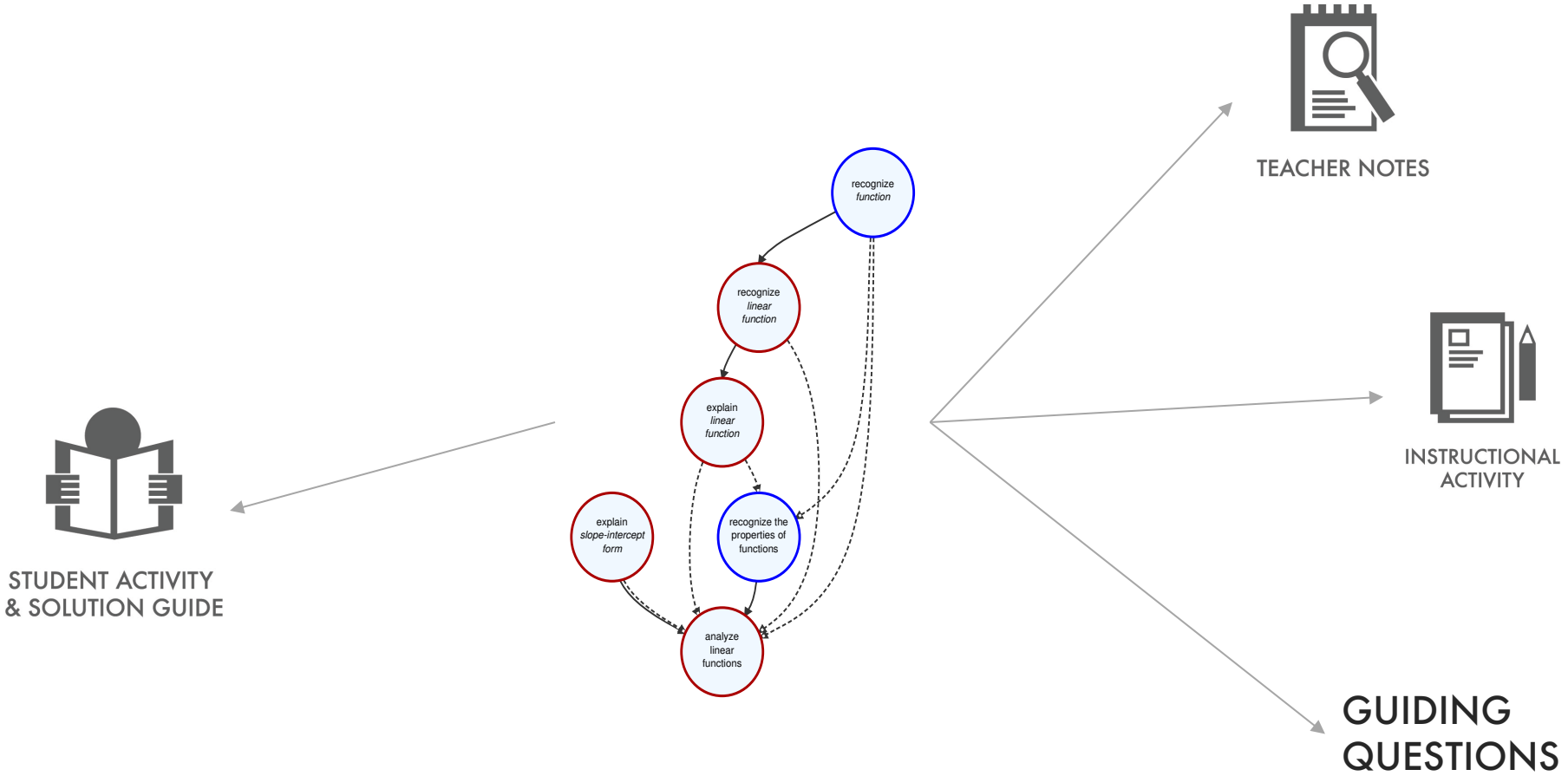
ELA

- Learning map information
- Teacher notes
- Instructional activity
- Student practice

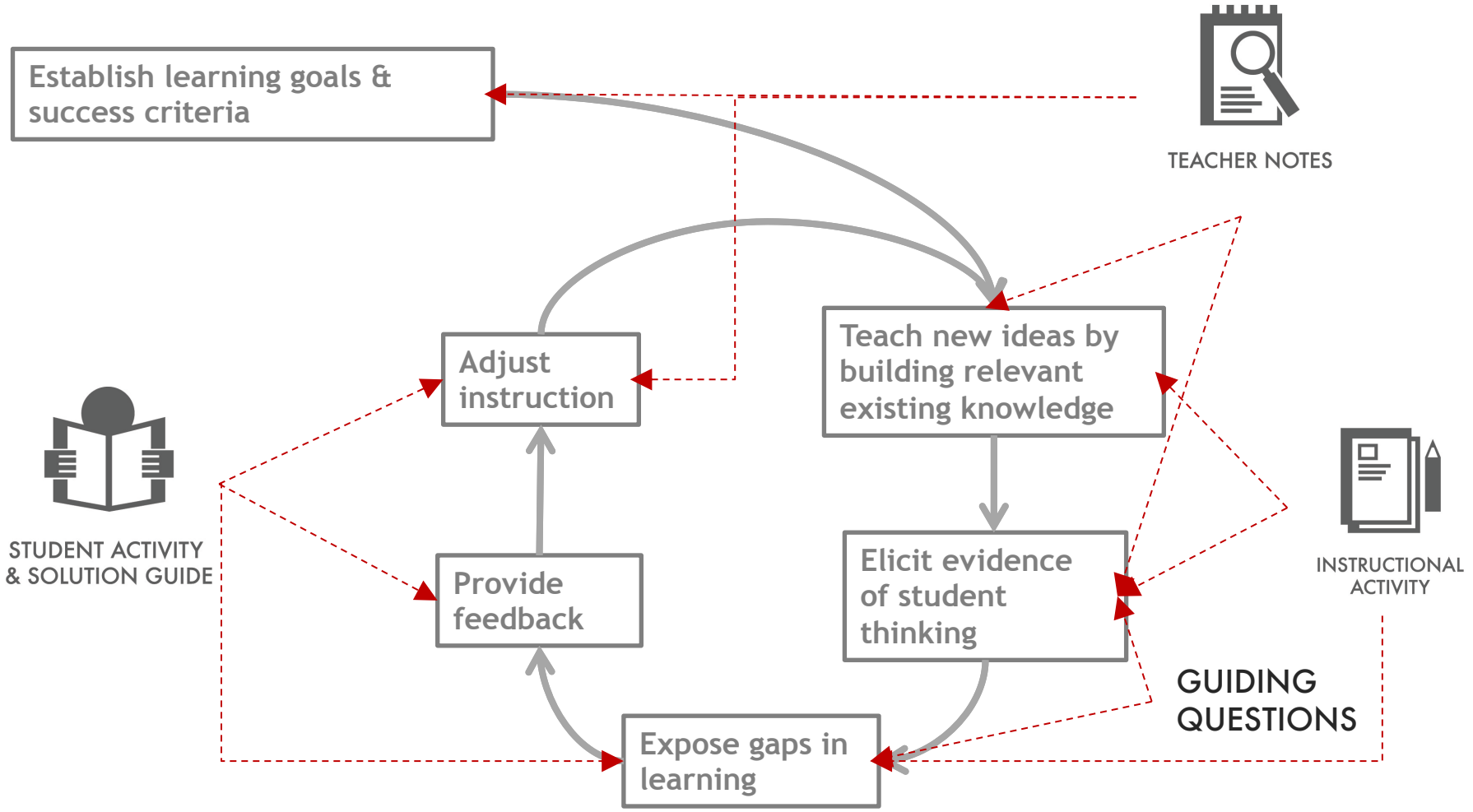
  *(in development)
- Tool for Evaluation

  *(in development)

Informed Instruction

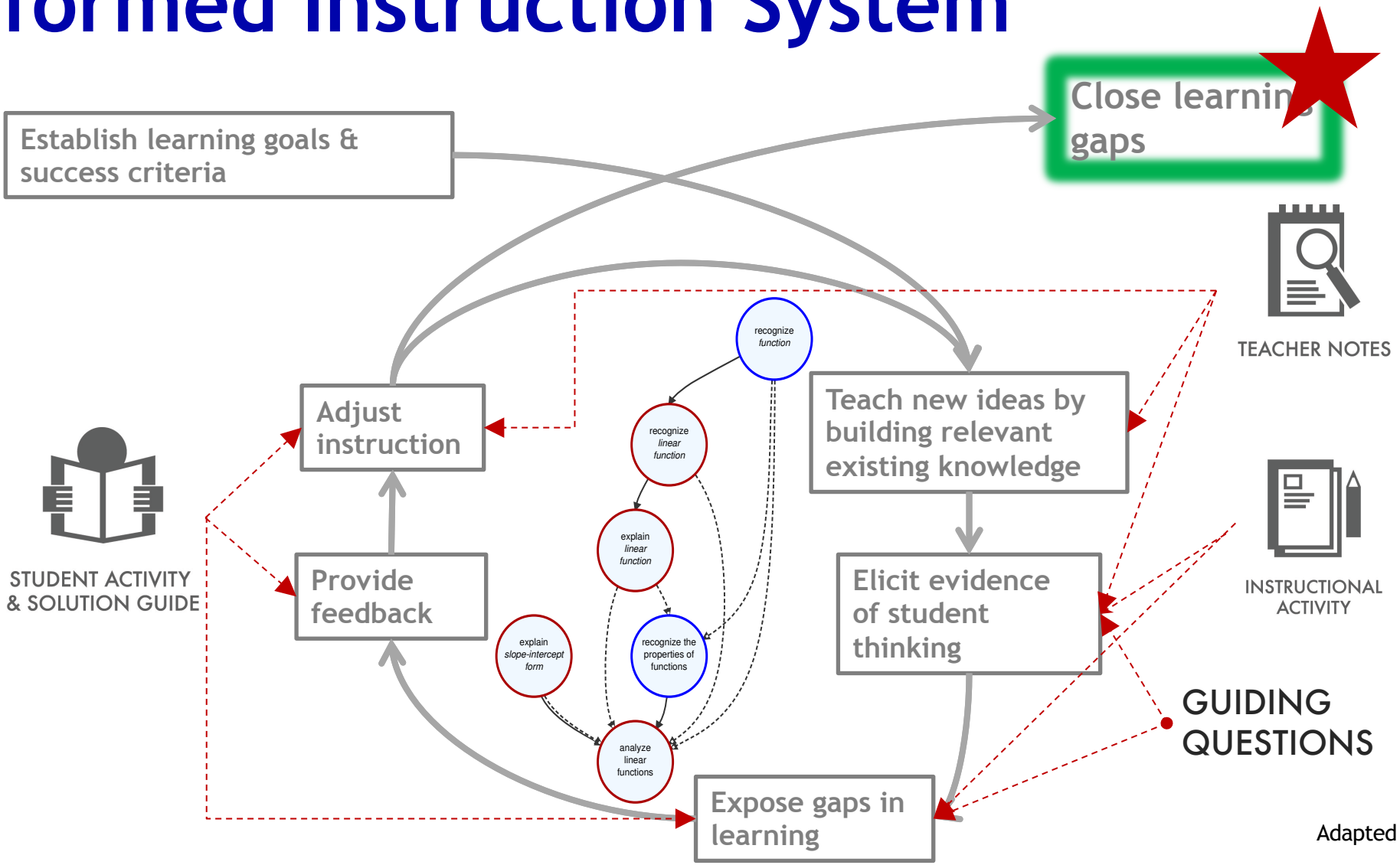


Informed Instruction



Adapted from Heritage, 2010

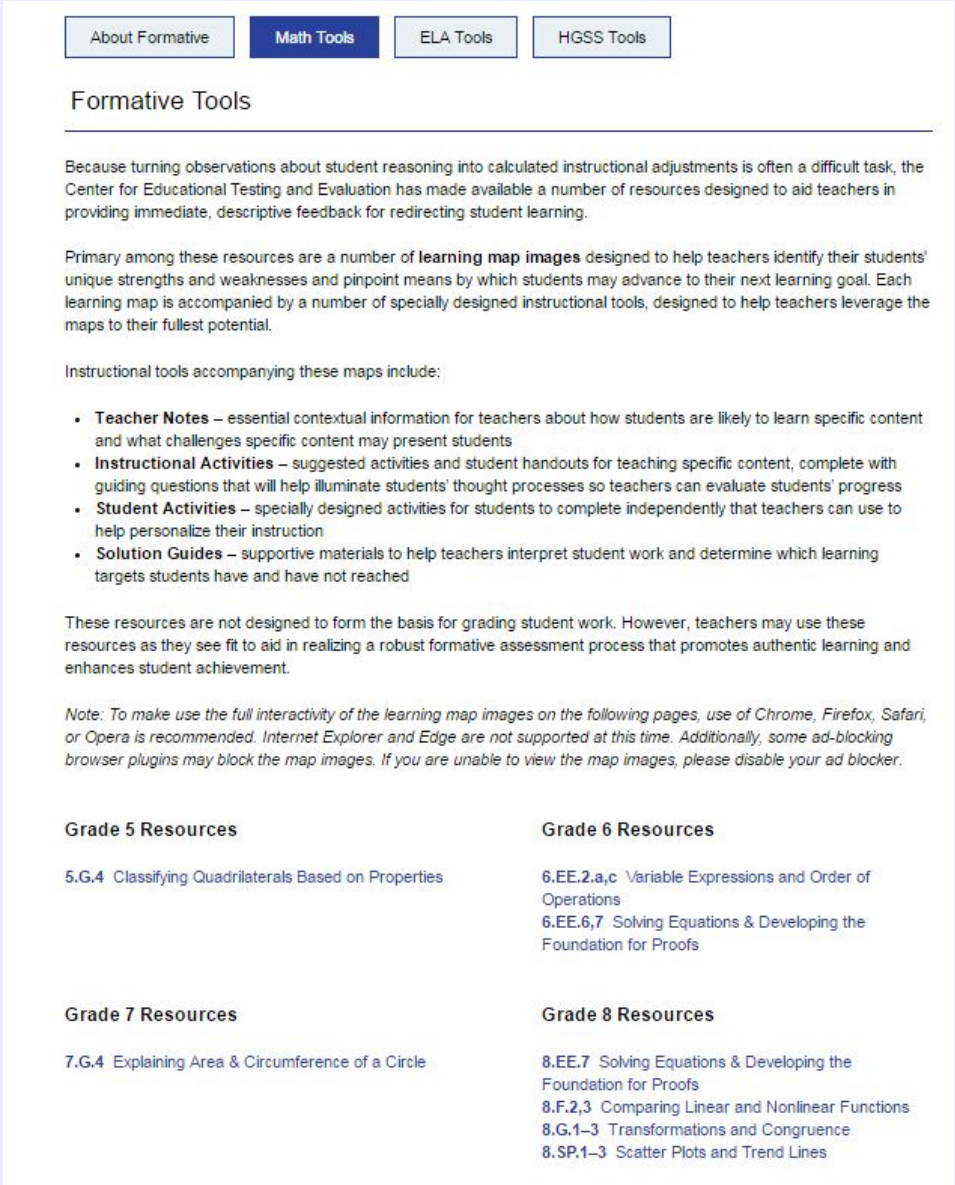
Informed Instruction System



Adapted from Heritage, 2010

Explore

- Please go to: http://www.ksassessments.org/formative
- Select one standard or group of standards
- Our opportunity to learn from your feedback starts NOW!



About Formative | Math Tools | ELA Tools | HGSS Tools

Formative Tools

Because turning observations about student reasoning into calculated instructional adjustments is often a difficult task, the Center for Educational Testing and Evaluation has made available a number of resources designed to aid teachers in providing immediate, descriptive feedback for redirecting student learning.

Primary among these resources are a number of **learning map images** designed to help teachers identify their students' unique strengths and weaknesses and pinpoint means by which students may advance to their next learning goal. Each learning map is accompanied by a number of specially designed instructional tools, designed to help teachers leverage the maps to their fullest potential.

Instructional tools accompanying these maps include:

- **Teacher Notes** – essential contextual information for teachers about how students are likely to learn specific content and what challenges specific content may present students
- **Instructional Activities** – suggested activities and student handouts for teaching specific content, complete with guiding questions that will help illuminate students' thought processes so teachers can evaluate students' progress
- **Student Activities** – specially designed activities for students to complete independently that teachers can use to help personalize their instruction
- **Solution Guides** – supportive materials to help teachers interpret student work and determine which learning targets students have and have not reached

These resources are not designed to form the basis for grading student work. However, teachers may use these resources as they see fit to aid in realizing a robust formative assessment process that promotes authentic learning and enhances student achievement.

Note: To make use the full interactivity of the learning map images on the following pages, use of Chrome, Firefox, Safari, or Opera is recommended. Internet Explorer and Edge are not supported at this time. Additionally, some ad-blocking browser plugins may block the map images. If you are unable to view the map images, please disable your ad blocker.

Grade 5 Resources

5.G.4 Classifying Quadrilaterals Based on Properties

Grade 6 Resources

6.EE.2.a,c Variable Expressions and Order of Operations
6.EE.6,7 Solving Equations & Developing the Foundation for Proofs

Grade 7 Resources

7.G.4 Explaining Area & Circumference of a Circle

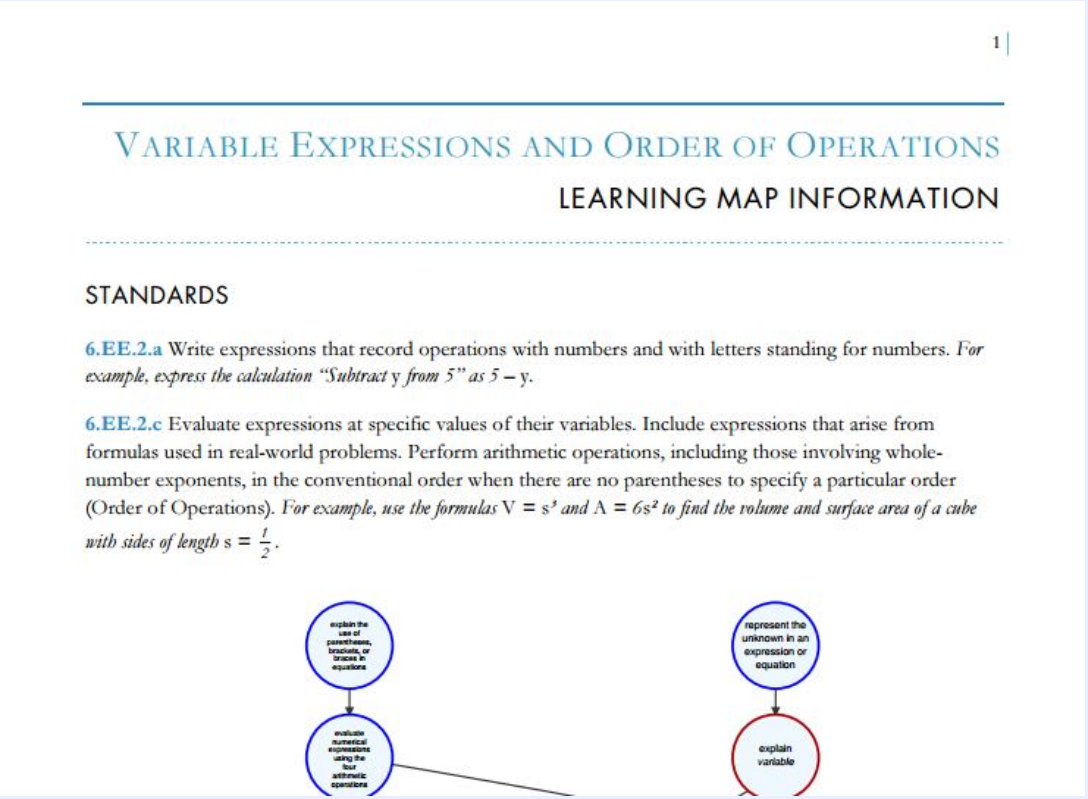
Grade 8 Resources

8.EE.7 Solving Equations & Developing the Foundation for Proofs
8.F.2,3 Comparing Linear and Nonlinear Functions
8.G.1–3 Transformations and Congruence
8.SP.1–3 Scatter Plots and Trend Lines

ELA Example

Learning Map Information

- **Examine** the learning map model for your unit.
- **What information** in the learning map model attracted attention most?
- How might **teachers** use the information in the learning map model?



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VARIABLE EXPRESSIONS AND ORDER OF OPERATIONS

LEARNING MAP INFORMATION

STANDARDS

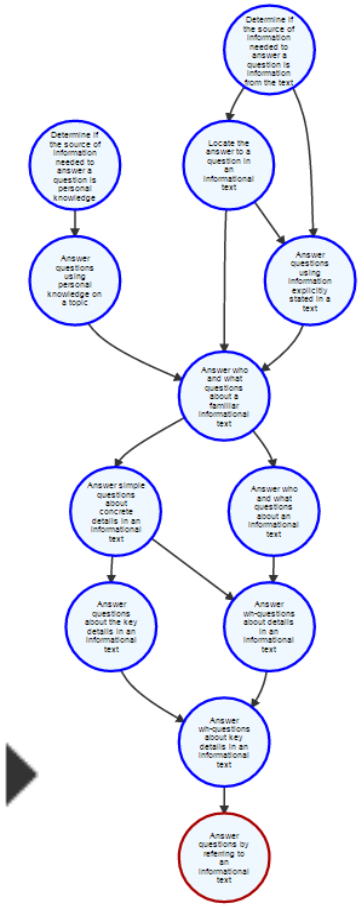
6.EE.2.a Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.*

6.EE.2.c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas* $V = s^3$ *and* $A = 6s^2$ *to find the volume and surface area of a cube with sides of length* $s = \frac{1}{2}$.

LEARNING MAP INFORMATION

Learning Map Model

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.



Target skill

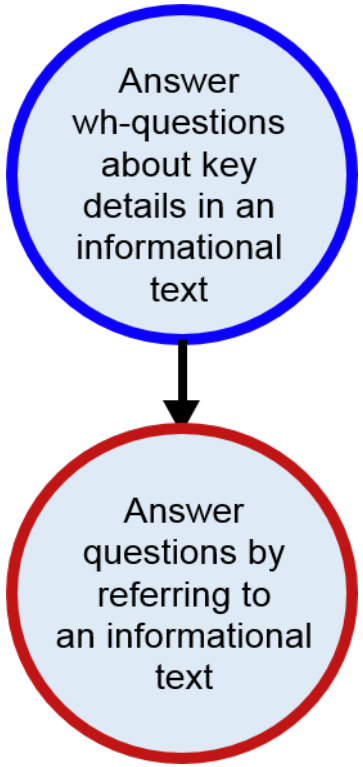
Prerequisite or related skill

Direct path

Indirect path

LEARNING MAP INFORMATION

Zooming In

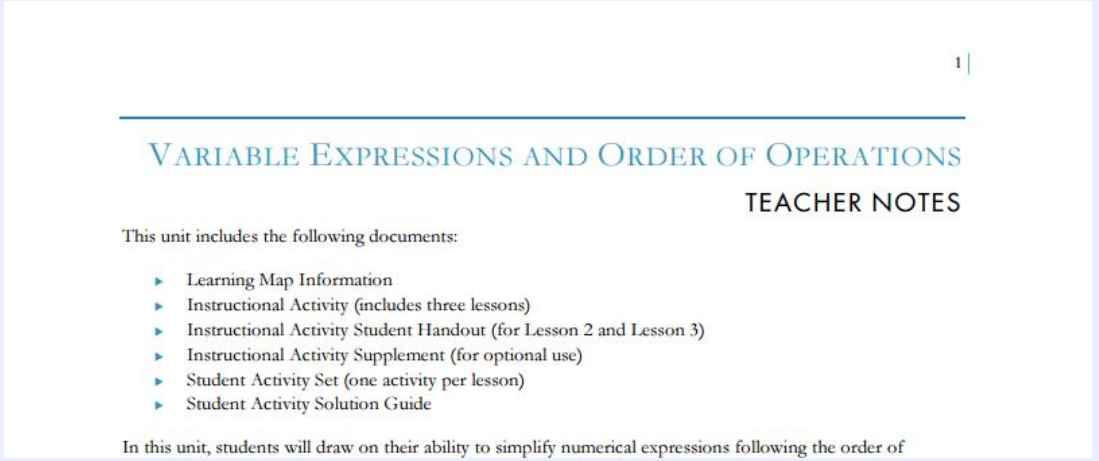


Node Description Table

NODE	DESCRIPTION
Answer questions by referring to an informational text	Answer questions about informational texts by referring back to the information and details provided in the text.
Answer wh-questions about key details in an informational text	Answer questions that use who, what, where, when, why, and how that are posed by others about the key details in an informational text.

Teacher Notes

- **Read or skim** the Teacher Notes document for your unit.
- How might you structure a **professional development session** around a Teacher Notes document?
- What **benefits** do you anticipate teachers will gain from reading these documents?



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VARIABLE EXPRESSIONS AND ORDER OF OPERATIONS

TEACHER NOTES

This unit includes the following documents:

- Learning Map Information
- Instructional Activity (includes three lessons)
- Instructional Activity Student Handout (for Lesson 2 and Lesson 3)
- Instructional Activity Supplement (for optional use)
- Student Activity Set (one activity per lesson)
- Student Activity Solution Guide

In this unit, students will draw on their ability to simplify numerical expressions following the order of

TEACHER NOTES

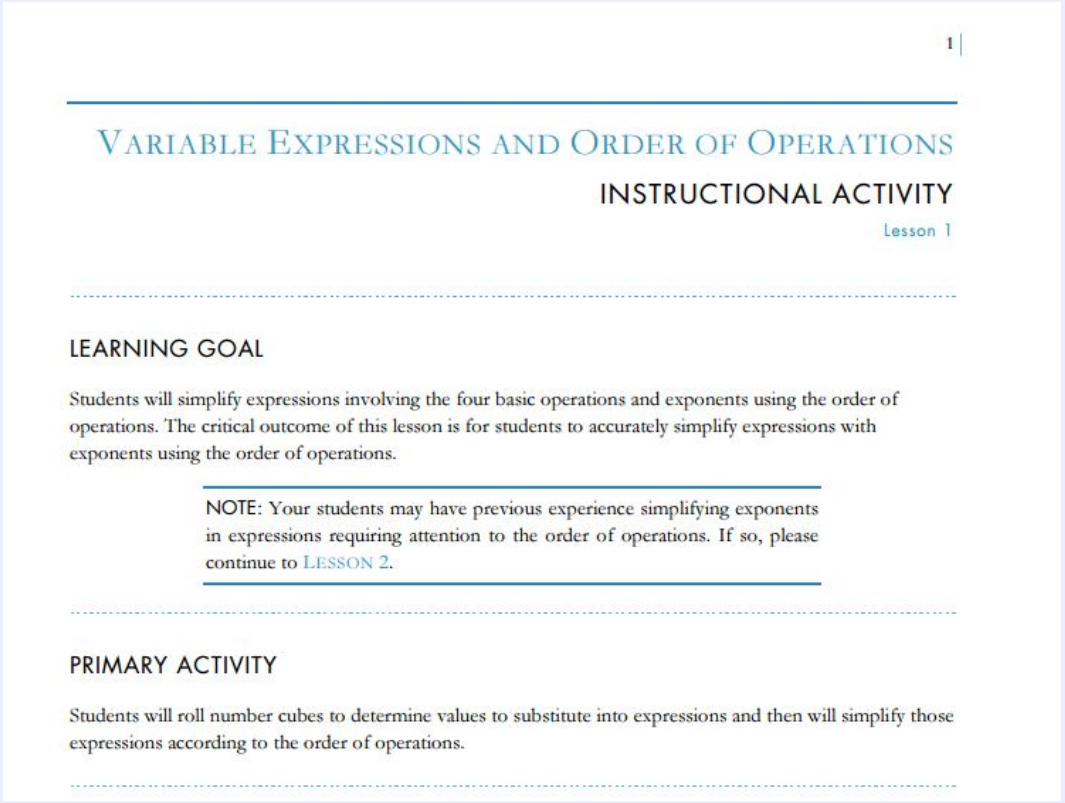
Teacher Notes

ith age, students produce more effective questions and are better able to differentiate between effective and ineffective questions (Mills et al., 2010; Mills et al., 2011). **The most successful prompts in helping students produce good questions are signal words (for example, what, who, where, how, why), generic question stems** (for example, "How are A and B similar?" and "What caused A to occur?"), and generic questions (for example, "What is the topic of the text?" and "What is the main idea of the text?"; Rosenshine, Meister, & Chapman, 1996).

To answer a question, students must identify **the kind of information the question is seeking and locate the correct information in an informational text** (Guthrie & Mosenthal, 1987). When teachers model and provide reminders about this search process, the ability of elementary and middle school students to answer questions successfully improves (Dreher & Brown, 1993; Symons, MacLatchy-Gaudet, Stone, & Reynolds, 2001).

Lessons

- Consider **one lesson** in your unit.
- What reactions do you have about the **activities** students would engage in during the lesson you reviewed?
- What reactions do you have about the **checks for understanding** or **guiding questions**?



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VARIABLE EXPRESSIONS AND ORDER OF OPERATIONS

INSTRUCTIONAL ACTIVITY

Lesson 1

LEARNING GOAL

Students will simplify expressions involving the four basic operations and exponents using the order of operations. The critical outcome of this lesson is for students to accurately simplify expressions with exponents using the order of operations.

NOTE: Your students may have previous experience simplifying exponents in expressions requiring attention to the order of operations. If so, please continue to LESSON 2.

PRIMARY ACTIVITY

Students will roll number cubes to determine values to substitute into expressions and then will simplify those expressions according to the order of operations.

Instructional Activity

LEARNING GOAL

In this lesson, students will **create and answer In the Text and In My Head questions.**

PRIMARY ACTIVITY

Students will **create In the Text and In My Head questions** using the Q & A organizer independently. Then students will be paired, trade Q & A organizers, **answer the questions**, and indicate the type of question.

Instructional Activity: ELA

Using the question cards, create at least three **In the Text** questions and three **In My Head** questions.

Question	In the Text	In My Head	Answer	What was the main source of information I used to answer this question?
1.				
2.				

INSTRUCTIONAL ACTIVITY

Checking for Understanding: ELA

Determine if students can GENERATE QUESTIONS ABOUT INFORMATIONAL TEXT USING DIFFERENT QUESTION-GENERATING APPROACHES:

- Can you point to three different question-creating approaches you used in your questions?

Determine if students can GENERATE QUESTIONS THAT HAVE ANSWERS BASED ON PERSONAL KNOWLEDGE:

- Why did you place this question in the In My Head column?

Questions?

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