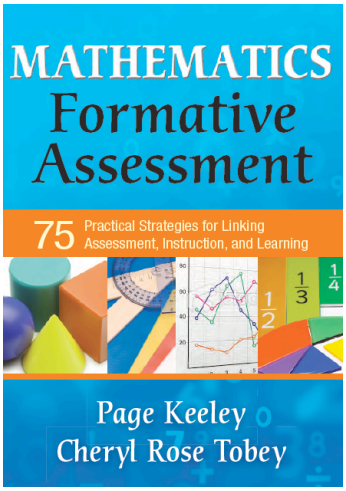
Mathematics Formative Assessment

Uncovering Student Thinking



Texas Association of Supervisors
Of Mathematics
February 20th, 2014

Cheryl Tobey
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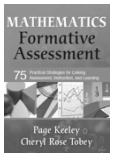
Mathematics Formative Assessment



Judson ISD
February 21st, 2014

Cheryl Rose Tobey

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Session Outcome

- Build ideas for how to support teachers in expanding their use of formative assessment classroom techniques (FACTs) in order to move students' thinking towards meeting a learning goal

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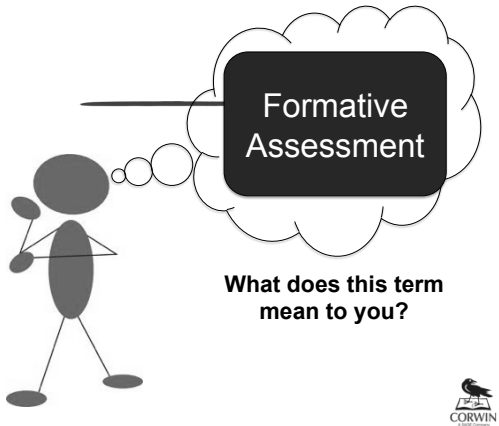

What does this term mean to you?

Formative Assessment

Definition	Characteristics
Examples:	Formative Assessment / Non-Examples:

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Formative Assessment

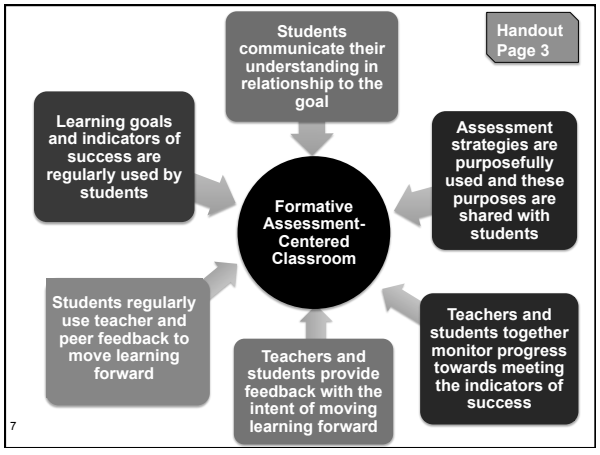
This definition for formative assessment reflects the research literature and statement articulated by the Council of Chief State School Officers:

Formative assessment is a **process** used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes.

Key Features of the Formative Assessment Process

- Links **goal-oriented** assessment and instruction
- **Promotes learning** as well as **informs instruction**
- **Used continuously**- before and **throughout** instruction
- Encourages students to become more aware of their own learning (**metacognition**) and the **ideas of others**

6



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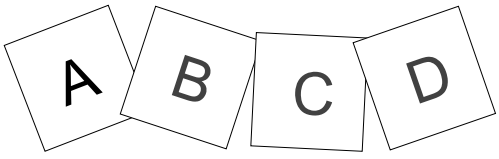
Response Cards



- Prepare your set by separating or folding into separate cards

8

Key Features of the Formative Assessment Process

•Links **goal-oriented** assessment and instruction
•**Promotes learning** as well as **informs instruction**
•**Used continuously**- before and **throughout** instruction
•Encourages students to become more aware of their own learning (**metacognition**) and the **ideas of others**

Response Card CHECK-IN

- **A: I had some of features of FA**
- **B: I had many of these features of FA**
- **C: I had all of these features of FA**

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Handout Page 6

Students communicate their understanding in

Learning goals and indicators of success are regularly used by students

Assessment strategies are purposefully sed and these purposes are shared with students

Response Card CHECK-IN

- **A: I had some of features of FA**
- **B: I had many of these features of FA**
- **C: I had all of these features of FA**

Students regularly use teacher and peer feedback to move learning forward

feedback with the intent of moving learning forward

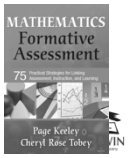
eachers and dents together nitor progress vards meeting the indicators of success

10

FACTS

Formative Assessment Classroom Techniques

•**Tangible techniques that can be used purposefully to support various stages of the formative assessment *process***



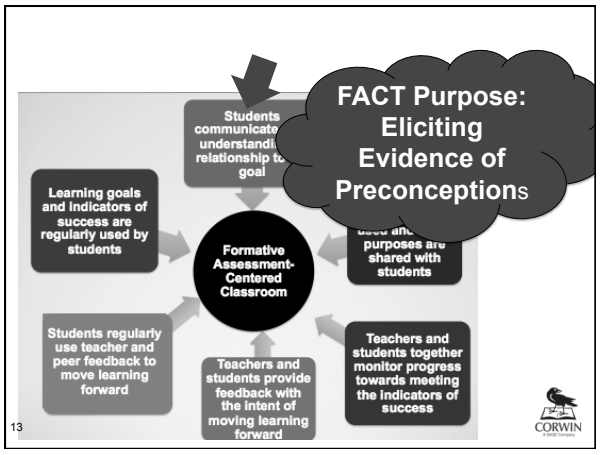
11

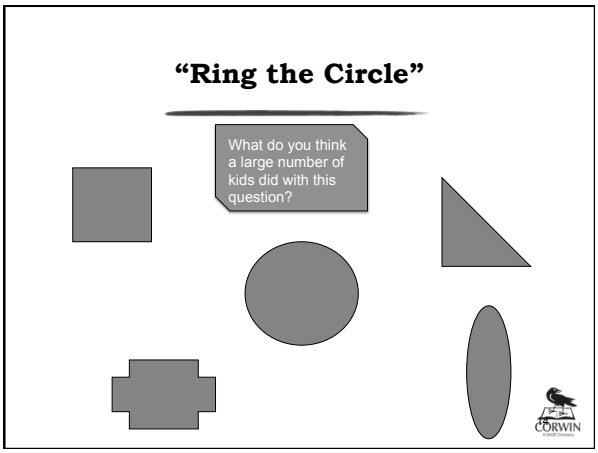
At A Glance

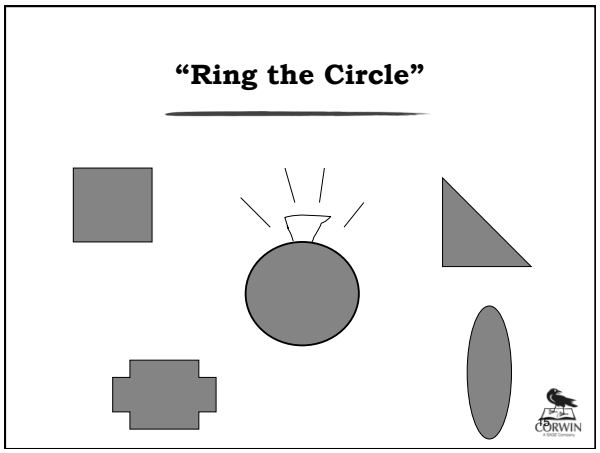
Pair up at your tables.
•Open your Math FACT book at random. With your partner, do a quick scan of the page you opened to. What do you see of interest?

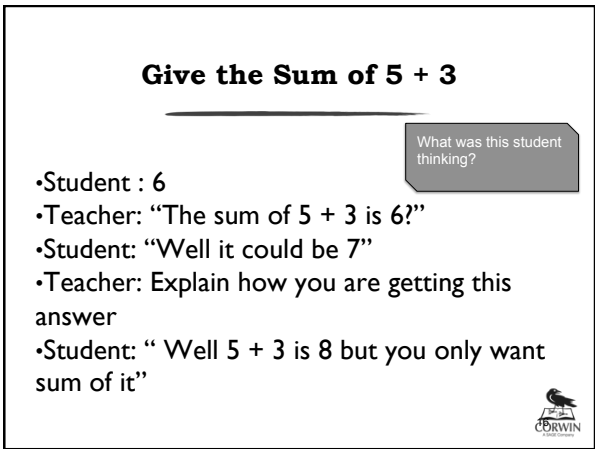
•Repeat 2-3 times to get an initial sense of what is contained in the FACT book.

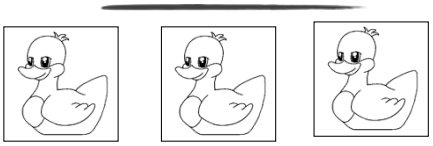
•Be prepared to share an example with the group that particularly interests you and tell why.


FACT Purpose: Eliciting Evidence of Preconceptions
Students communicate understandi relationship t goal
Learning goals and indicators of success are regularly used by students
Formative Assessment-Centered Classroom
purposes are shared with students
Students regularly use teacher and peer feedback to move learning forward
Teachers and students provide feedback with the intent of moving learning forward
Teachers and students together monitor progress towards meeting the indicators of success
13


"Ring the Circle"
What do you think a large number of kids did with this question?


"Ring the Circle"


Give the Sum of 5 + 3
What was this student thinking?
•Student : 6
•Teacher: "The sum of 5 + 3 is 6?"
•Student: "Well it could be 7"
•Teacher: Explain how you are getting this answer
•Student: " Well 5 + 3 is 8 but you only want sum of it"



The blue duck is 1st
The red duck is 2nd
The purple duck is ____

What could students be thinking?

17

The blue duck is 1st
The red duck is 2nd
The purple duck is **Goose**

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Teacher Interview with Student

Teacher: ***Is 70 Degrees Warm or Cold?***

Student: ***I don't know***

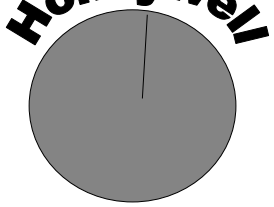
Teacher: ***Hint: What temperature does your Mom keep the thermostat on in the house during the winter?***

Student: ***At y degrees***

Teacher: ***Y? Can you show me?***

Student: OK

What do you think this student was thinking?



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What do you think this student was thinking?

•Teacher: Is 12+5 and 5 +12 equal or not equal?
•Student 12 +5 = 17 and 5 + 12= 17 so they are not equal
•Teacher: They both equal 17 but they are not equal? Why?

•Teacher: Is 12+5 and 5 +12 equal or not equal?
•Student 12 +5 = 17 and 5 + 12= 17 so they are not equal
•Teacher: They both equal 17 but they are not equal? Why?
•Student: **Because 17 is an odd number and odd numbers don't have equal pairs.**

$\frac{1}{n}\sin x = ?$

Where else have you seen this?

$\frac{1}{n}\sin x =$

$six = 6$

Misconceptions in Mathematics

A review of the literature on misconceptions in the three fields of science, mathematics and programming (Confrey). Varied terms that were in use in these fields:

- alternative conceptions
- student conceptions
- pre-conceptions
- conceptual primitives
- private concepts
- alternative frameworks
- systematic errors
- common errors
- critical barriers to learning
- naïve theories
- overgeneralizations

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Misconceptions in Mathematics

- alternative conceptions
- student conceptions
- pre-conceptions
- conceptual primitives
- private concepts
- alternative frameworks
- systematic errors
- common errors
- critical barriers to learning
- naïve theories
- overgeneralizations

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FACT: Diagnostic Assessment Probe

Purpose: Elicit Understandings and Misunderstandings

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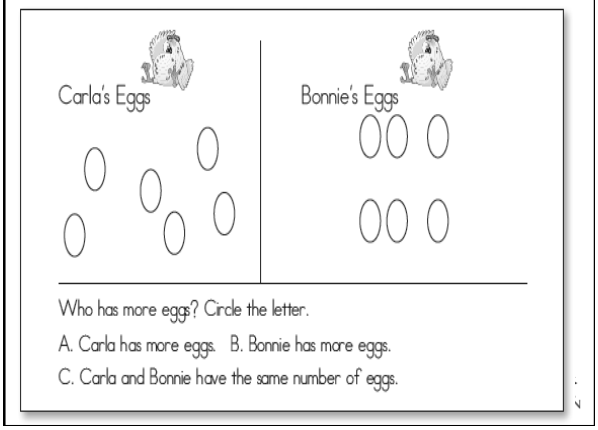
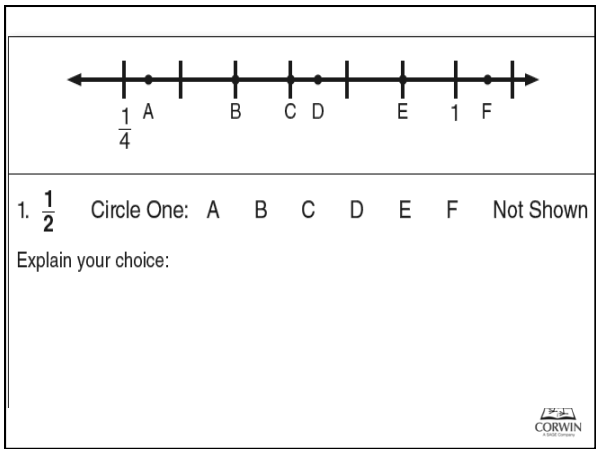
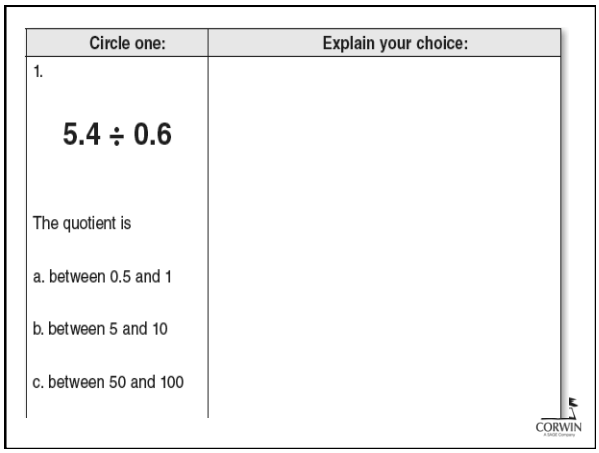
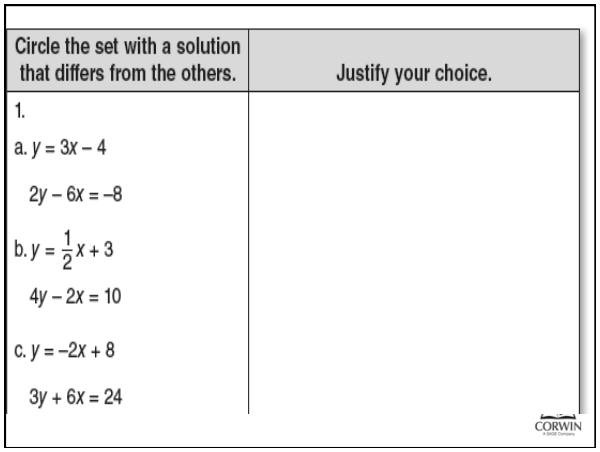
Probe Examples

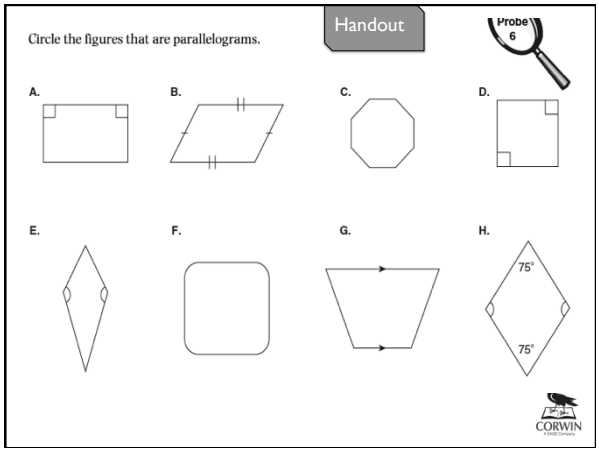
- Review 2-3 of the probes provided on handouts pp. 5-9
- What conceptual and procedural knowledge is targeted by the items?
- What conceptual misconceptions and/or procedural difficulties is targeted by the items?




1/4 A
B
C D
E
1
F
1. 1/2 Circle One: A B C D E F Not Shown
Explain your choice:
CORWIN


Circle one:
Explain your choice:
1.
5.4 ÷ 0.6
The quotient is
a. between 0.5 and 1
b. between 5 and 10
c. between 50 and 100
CORWIN


Circle the set with a solution that differs from the others.
Justify your choice.
1.
a. y = 3x – 4
2y – 6x = –8
b. y = 1/2 x + 3
4y – 2x = 10
c. y = –2x + 8
3y + 6x = 24
CORWIN


Handout
Probe 6
Circle the figures that are parallelograms.
A.
B.
C.
D.
E.
F.
G.
H.
75°
75°
CORWIN

Completing the Probe

Circle the figures that are p[illegible]grams.

A. B.

E. F.

1. INDIVIDUALLY answer the probe.
2. Write a very brief explanation about why you listed these shapes

CORWIN

Adding Confidence Level

Circle the figures that are parallelograms.

Probe 6

A. B.

E. F.

1. Fold your paper
2. Add confidence rating of 0 to 5

CORWIN

FOLD and PASS

Circle the figures that [illegible] parallelograms.

Probe 6

A. B.

E. F.

1. Fold your paper
2. When I say go: continually take and hand off papers from others
3. When I say stop: make sure you have **one** piece of folded paper

CORWIN

FACT Example: Fold and Pass

Response Card CHECK-IN

How long has it been since you have taught or taken high school geometry?

- **A: 0-5 years**
- **B: 6-10 years**
- **C: 11-15 years**
- **D: 16+ Years**

CORWIN

FACT Example: Fold and Pass

Response Card CHECK-IN

Hold up a response card if the paper you are holding includes one or more of the following:

- **Shape C, E, F OR G**

FACT Example: Fold and Pass

Response Card CHECK-IN

Hold up a response card if the paper you are holding includes one or more of the following:

- **Shape C, E, F OR G**

FACT Example: Fold and Pass

Response Card CHECK-IN

Hold up a response card if the paper you are holding includes

- **Shape A or D**

FACT Example: Fold and Pass

Response Card CHECK-IN

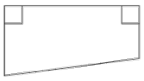
Hold up a response card if the paper you are holding includes

- **ONLY Shape B and H**

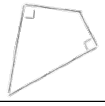
Example: Is it a Parallelogram?

The correct responses are B and H. Parallelograms are a special type of quadrilateral. A quadrilateral is a parallelogram if: both pairs of opposite sides are parallel, both pairs of opposite sides are congruent, both pairs of opposite angles are congruent, consecutive angles are supplementary, one pair of opposite sides is congruent and parallel, or diagonals bisect each other. Figure B has both pairs of opposite sides congruent. Figure H has both pairs of opposite angles congruent. (See Student 1 in *Student Responses* section.) Some students choose B and H with incorrect reasoning. They see parallelograms as quadrilaterals with two congruent obtuse angles and two congruent acute angles. (See Student 2 in *Student Responses* section.)

A.



D.



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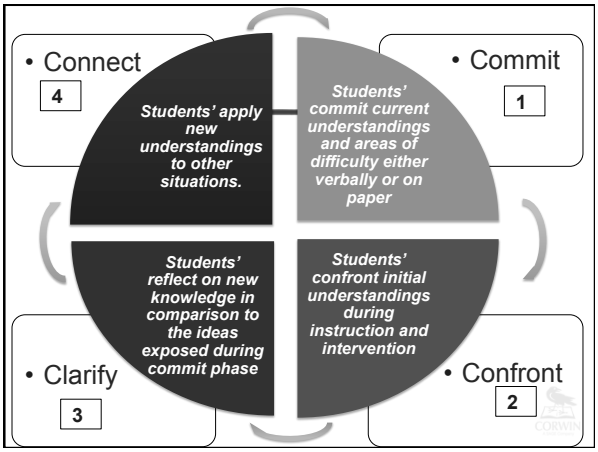
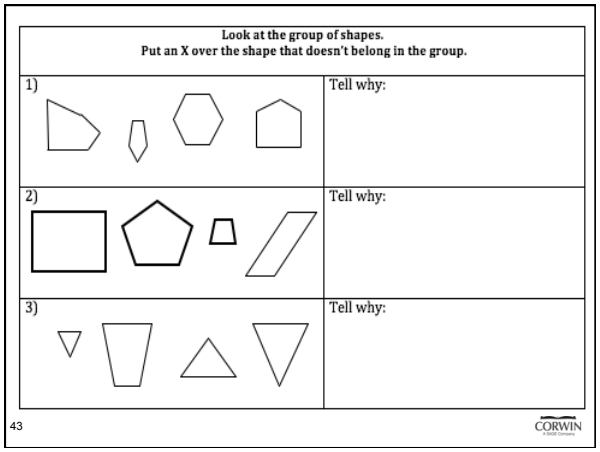


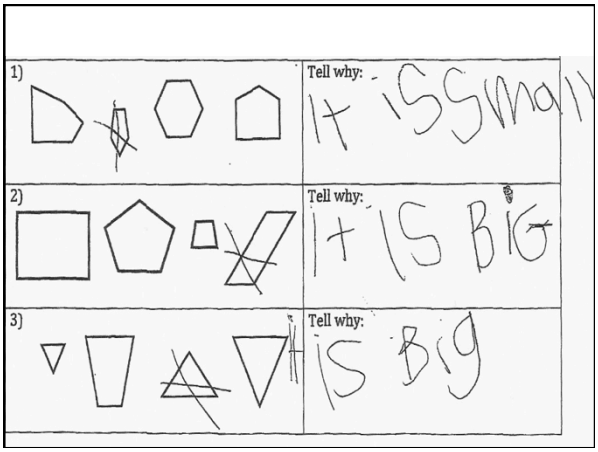


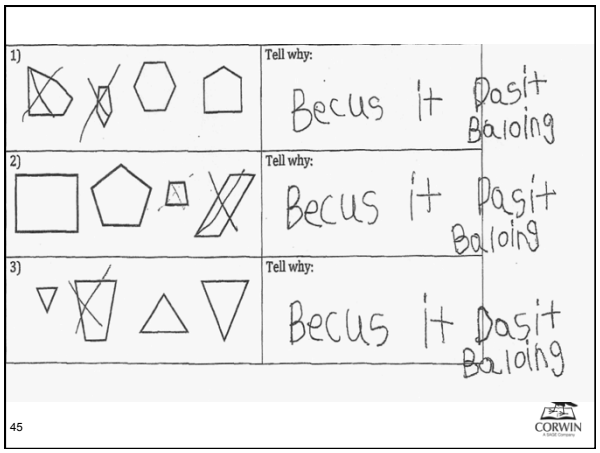
Look at the group of shapes.
Put an X over the shape that doesn't belong in the group.

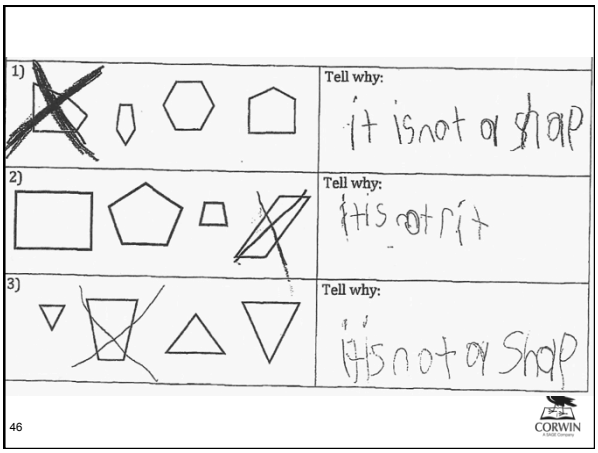
1)	Tell why:
2)	Tell why:
3)	Tell why:

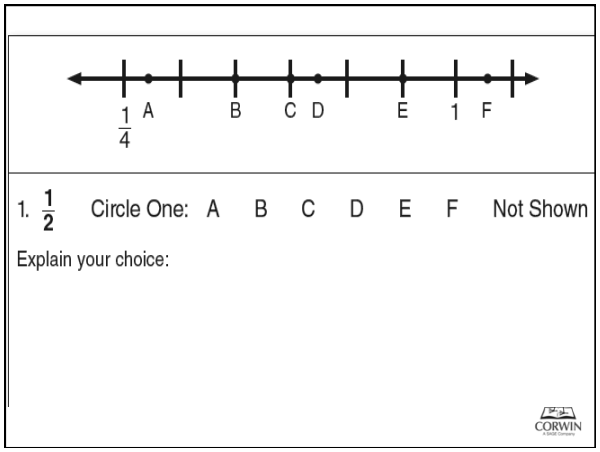
43

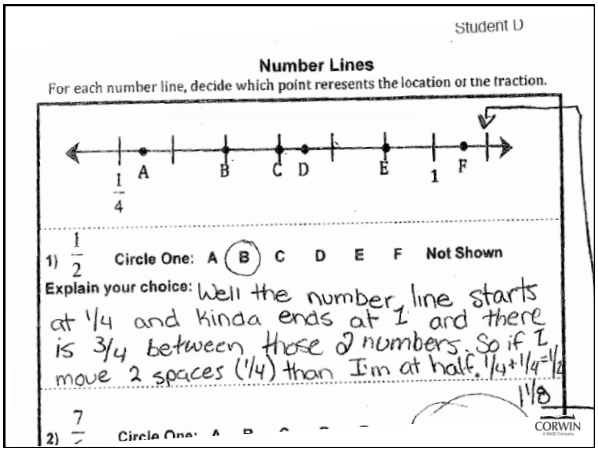
CORWIN




1)
Tell why:
Becus it Dasit Baloing
2)
Tell why:
Becus it Dasit Baloing
3)
Tell why:
Becus it Dasit Baloing
45
CORWIN

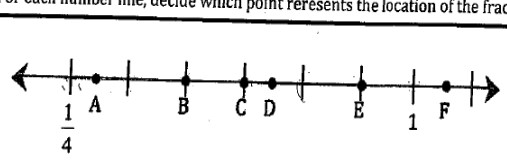

1)
Tell why:
it isnot a shap
2)
Tell why:
itis not rit
3)
Tell why:
itis not a Shap
46
CORWIN


1/4 A B C D E 1 F
1. 1/2 Circle One: A B C D E F Not Shown
Explain your choice:
CORWIN


Student D
Number Lines
For each number line, decide which point reresents the location of the fraction.
1/4 A B C D E 1 F
1) 1/2 Circle One: A B C D E F Not Shown
Explain your choice: Well the number line starts at 1/4 and kinda ends at 1 and there is 3/4 between those 2 numbers. So if I move 2 spaces (1/4) than I'm at half. 1/4+1/4=1/2
1/8
2) 7/
Circle One:
CORWIN

Number Lines

For each number line, decide which point reresents the location of the fraction.

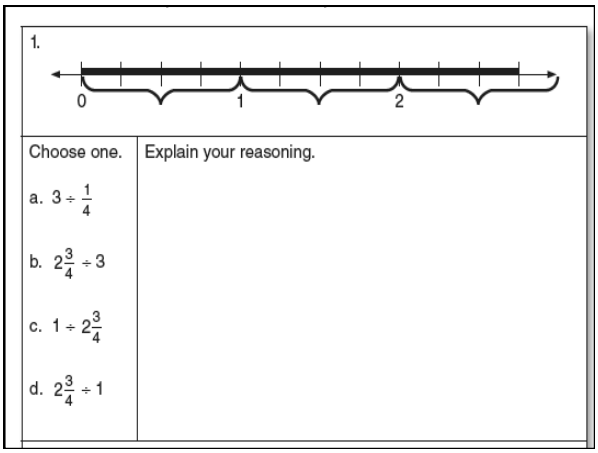


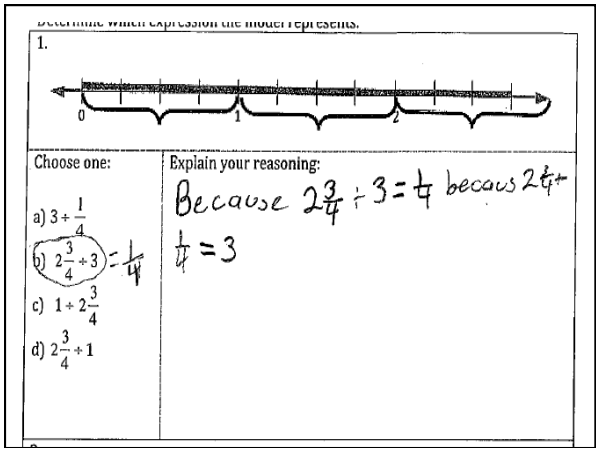
1) $\frac{1}{2}$ **Circle One:** A B C (D) E F **Not Shown**

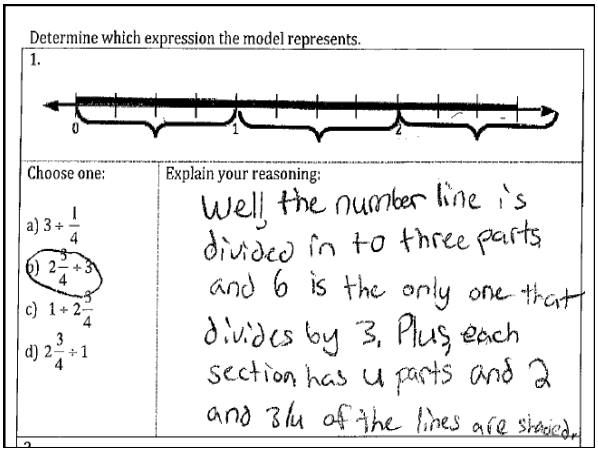
Explain your choice:

It is D because $7 \div 2 = \frac{1}{2} = 3.5$.

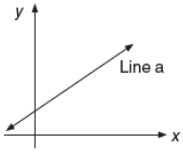
CORWIN







Determine whether each equation could represent Line a.



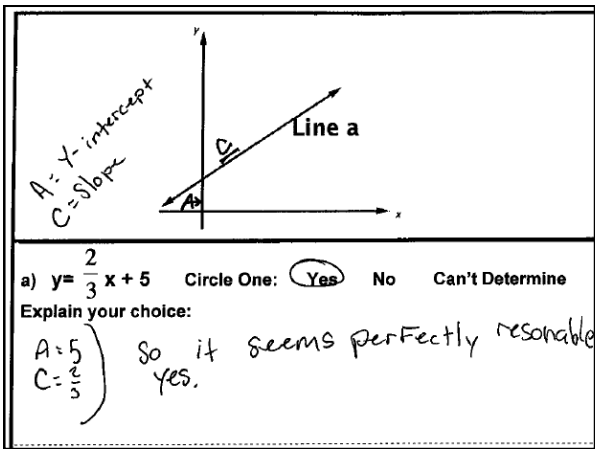
1. $y = \frac{2}{3}x + 5$ Circle One: Yes No Can't Determine

Explain your choice:

2. $y = -6x + 2$ Circle One: Yes No Can't Determine

Explain your choice:

CORWIN

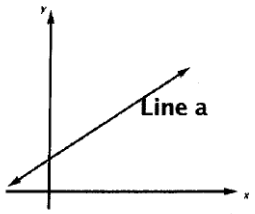


a) $y = \frac{2}{3}x + 5$ Circle One: (Yes) No Can't Determine

Explain your choice:

A = 5
C = 2/3

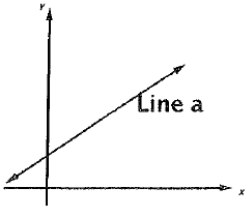
So it seems perfectly resonable yes.



a) $y = \frac{2}{3}x + 5$ Circle One: Yes (No) Can't Determine

Explain your choice:

The slope of the line goes up too fast.



a) $y = \frac{2}{3}x + 5$ Circle One: Yes No (Can't Determine)

Explain your choice:

The axes are not labeled

Look at student work on Probes

- Review probes and student work.
- 2 Rounds

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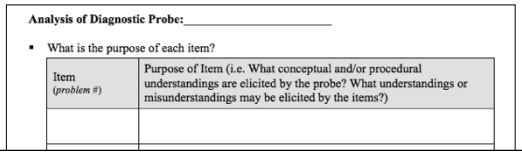
Probe Review

Handout Pp. 10-11

- Complete the Questions on the Probe Analysis Handout
- Use the student work to help with the analysis process



Analysis of Diagnostic Probe:_____

- What is the purpose of each item?

Item (*problem #*)	Purpose of Item (i.e. What conceptual and/or procedural understandings are elicited by the probe? What understandings or misunderstandings may be elicited by the items?)

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Matching Examples of Probes with FACTS

- 19-Friendly Talk Probes p.99
- 25-Justified List p.111
- 26 Justified T F p. 113
- 32-*More A-More B Probes p. 130*
- 36-*Opposing Views Probes p. 139*
- 37- *Overgeneralization Probes p. 141*
- 40-P-E-O Probes (Predict-Explain-Observe) p.147
- 48-*Same A=Same B Probes p. 165*
- 52-*Strategy Probe p.174*

FACTS Resource: Review 3 or more of the following descriptions

Time 10 min

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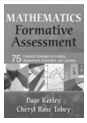
Your Turn

- Choose a Probe FACT format and create a probe of your own
- Be prepared to share

Grade Level Sharing

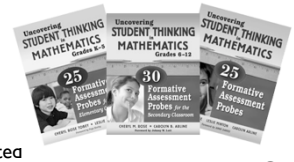
•Find the grade level sign appropriate for your probe
•Partner up to share probe ideas

Assessment Probes



Uncovering Student Thinking Series

Research-based misunderstandings
•Common Errors
•Overgeneralizations
•Pre-conceptions



Elicitation and Elaboration
•Selected Response(s)
•Explanation to support selected
• response

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Other FACTs Used

HANDOUT Page 4

47. Response Cards
18. Frayer Chart
22. Confidence Ratings (Human Scattergraph)
7.Fold and Pass (Commit and Toss)

FACTS Resource: Review 3 or more of the following descriptions

Time 5 min

What purposes do the these FACTS align with?

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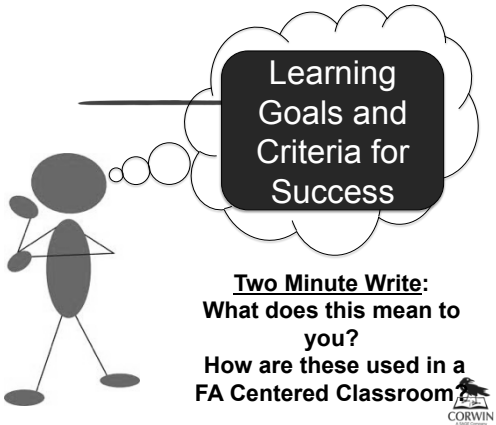
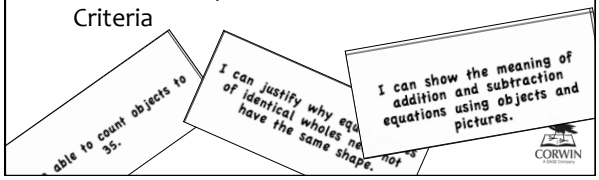


<u>Two Minute Write</u>:
What does this mean to you?
How are these used in a FA Centered Classroom

What are Success Criteria?

- In pairs, review the success criteria statements looking for similarities among the "types" of targets.
- Create categories and sort the cards into those categories
- Answer the question: What are Success Criteria



What are Criteria for Success?

Success Criteria:
•Describe something students will do, say or produce
•Are measureable
•Can be either Procedural or Process-oriented indicators
•Are written in Student Friendly Language

FACETS at EDC famath.edc.org

What are the characteristics of Learning Targets and Criteria for Success?

•Describe something students will do, say or produce
•Are measureable
•Can be either Procedural or Process-oriented indicators
•Are written in Student Friendly Language

Response Card CHECK-IN

- **A: We talked about 1-2 these features of SC**
- **B: We talked about 3 of these features of SC**
- **C: We talked about all of these features of SC**

Learning Target and Success Criteria Sets

As you review the examples and non-examples, discuss the answers to:
•What are Learning Targets?
•What is the difference between LTs and SCs?
•Why are LTs and SCs both needed?

Examples of SETS of Targets and Criteria

Example LI and SC	"Non" Example
Learning Target: To extend understanding of the place value system to include hundredths Criteria for Success #1: I can read and write decimals to the hundredth place Criteria for Success #2: I can explain why the places in a decimal with hundredths have the values they have	Today's Targets: . I can read decimals to the hundredth place . I can write decimals to the hundredth place

Examples of SETS of Targets and Criteria

Example LI and SC	"Non" Example
Essential Question: When does the mean represent the typical value in a set? *What We'll Look For:* . You can create a data set for which the mean is typical . You can create a data set for which the mean is not typical . You can explain to someone else how you knew your data set would have a mean that is (or is not) typical	Today's Essential Question: When does the mean represent the typical value in a set?

Examples of SETS of Targets and Criteria

Example LI and SC	"Non" Example
Learning Target: Understand what makes a number sentence true or false. *SC:* . I can describe at least two different strategies . I can justify whether a number sentence is true or false	Target: I can determine if a number sentence is true or false

Examples of SETS of Targets and Criteria

Example LI and SC	"Non" Example
LI: Understand strategies that will help me recall math facts. SC: o I can describe strategies that will help me recall facts o I can explain why my strategies work	LI: Begin to master my math facts SC: I will increase my score on the computer game

What are Learning Targets and Criteria for Success Sets?

•The **learning target** is:
•about Conceptual Understanding or the Key Mathematical Idea to be learned
•can target Different Levels of Understanding (understand how, how to, why, that, etc.)
•Lesson Specific but align to a larger mathematics idea
•Are written in Student Friendly Language
•Includes Success Criteria as the observable evidence of what successful learning looks like and/or sounds like
• Includes a both Procedural and Process Success Criteria that as a Collection, provide evidence that the learning target has been met

FACETS at EDC famath.edc.org

What are the characteristics of Learning Targets and Criteria for Success?

•Conceptual Understanding or the Key Mathematical Idea can target
•Different Levels of Understanding
•Lesson Specific
•Student Friendly Language
•Includes a both Procedural and Process Success Criteria that as a Collection, provide evidence that the learning target has been met

Response Card CHECK-IN

- **A: We talked about 1-2 these features of LT/SC**
- **B: We talked about 3 of these features of LT/SC**
- **C: We talked about all of these features of LT/SC**

Create a Learning Target and Paired Success Criteria

•Think about a topic you know well.
•Write two different learning targets in student friendly language that demonstrate different levels of knowledge related to understanding the topic.
•For each target write a paired set of success criteria that uses different levels of demonstration.

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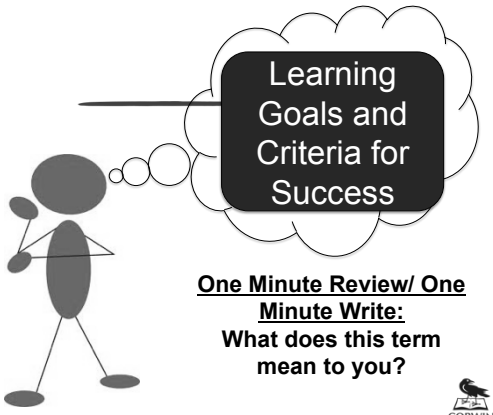

One Minute Review/ One Minute Write:
What does this term mean to you?

Formative Assessment

Council of Chief State School Officers:

Formative assessment is a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to **improve students' achievement of intended instructional outcomes.**

Formative Assessment

Definition	Characteristics
Examples:	Non-Examples:

Find your FA chart
*Anything to add?
*Anything to change?

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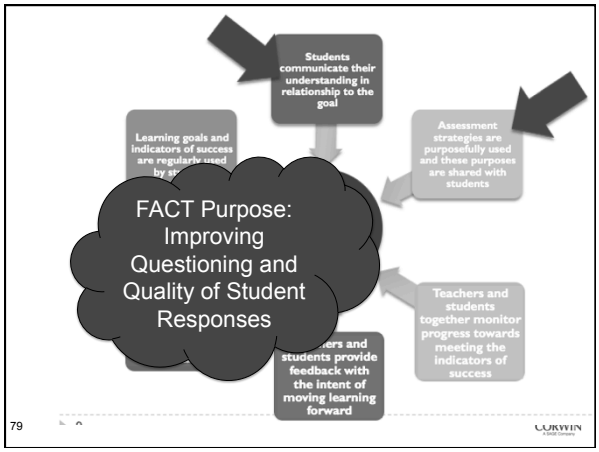

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Non-Probe Questioning FACTs

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Questions in Math Tasks

FACT: Fact-First Questioning

Before: Is this a trapezoid?

FACT First: This is a trapezoid. Why?

Questions in Math Tasks

FACT: Fact-First Questioning

Before: Is the ratio of a rational and an irrational number rational or irrational?

FACT First: The ratio of a rational and an irrational number is always irrational. Why?

Questions in Math Tasks

Fact-First Questioning

- *How:* Instead of asking for what is usually the end result or answer, provide both original problem and answer, and ask *why* or *how* questions to have students elaborate.
- *Why*: Students must draw on higher level thought processes than recalling facts and applying procedures.

Eliciting evidence: Responses provide a look into higher order student thinking.

Asking for Questions:

- ***Instead of asking questions this way:***
- "Are there any questions?"
- "Do you have any questions?"
- "You don't have any questions, do you?"
- "Would anyone like to see that again?"

- ***You might try asking questions this way:***
- "Now, ask me some questions."
- "In pairs, write two questions you have for me"
- "In pairs, write two questions you have for _____"

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FACT: Ask A Question

- Write a question on your Index Card
- Discuss the questions at your table
- Narrow it down to one question to **turn in**

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FACTs Used

HANDOUT Page 4

71. Concept Attainment
14. Fact First Questioning
Flip the Question
46. Question Generating

FACTS Resource: Review 3 or more of the following descriptions Time 10 min

What purposes do the these FACTS align with?

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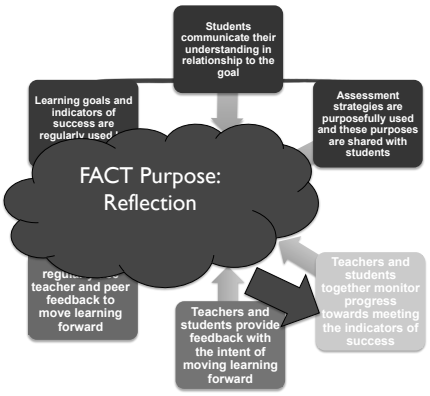

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Reflection:

- Reflect on your take-aways so far…

Choose a **Thinking Log** Stem
I didn't expect……
I need to rethink……..
I think next week I would like to try…..
I would understand this better if I……

- 60 second write

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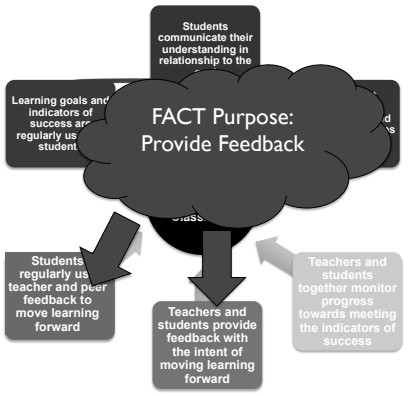
Paired Verbal Fluency (PVF)

•Find a new partner. Someone you haven't talked with much today (turn around to find someone near you)

Decide who is person A and who is person B

Paired Verbal Fluency

•Person B begins
•Talk about your reflection
•Talk for 1 full minute-Person A just listens
•Person A Talks
•Talk about your reflection
•Person B and additional ideas.
•Talk for 1 full minute-Person B just listens
•Person B Again
•Talk for 40 seconds- Person A listens
•Person A Again
•Talk for 40 seconds- Person B listens



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Elicitation

•The teachers at the Applewood School were discussing what they do with students' pre-assessments which most students complete on their own during class time. They agree that the purpose of the pre-assessment is to practice and improve their understanding of concepts that will be on a unit assessment. They each had a different idea about the best way to return their students' work so the students could make revisions. Who do you most agree with and why?

Who do you most agree with and why?

•Mr. Albee: " I think it is best mark/grade their work"
•Ms. Purrington: "I think it is best to provide only comments and not to include a grade."
•Mrs. Martinez: "I think it is best to grade their work but to also provide comments."
•Mr. Goldsmith: "I think it best to avoid grades and comments and focus on effort."

•Who do you agree with and why?

Who do you most agree with and why?

•Mr. Albee: " I think it is best mark/grade their work"
•Ms. Purrington: "I think it is best to provide only comments and not to include a grade."
•Mrs. Martinez: "I think it is best to grade their work but to also provide comments."
•Mr. Goldsmith: "I think it best to avoid grades and comments and focus on effort."
•Who do you agree with and why?

Response Card CHECK-IN

- **A: Albee**
- **B: Purrington**
- **C: Martinez**
- **D: Goldsmith**

Research Sound-bytes

•"Only Scores" and "Scores with Comments" both led to no improvement
•"Only comments" led to improvement
-Butler, 1987,1988,

"If teachers are are providing careful diagnostic comments and then putting a score or a grade, they are wasting their time." (William, 2011. p. 109)

Research Sound-bytes

•A review of 40 research reports on the effects of feedback found that what mattered the most was the degree of "mindfulness" in the students that the feedback generated.

-Wiliam, 2011, p.111

Formative Feedback

Helps students answer the following questions in relation to the learning target:

- What criteria for success have I met?
- What criteria for success haven't I met?
- What do I need to do next to reach the target?

Goldilocks Principle

- Doesn't tell the student what to do but provides a hint, model or cue that moves thinking forward.

- Just the right amount to keep the thinking in the intellectual work in the hands of the student

Model, Hint, or Cue Examples

- Model: Look at the problem we did yesterday. Think about how the solution to that problem could help you with this one.
- Cue: Go back to your Math Dictionary. How did you summarize in your own words what this word meant? Think about the definition and how this information might be helpful here.
- Hint: Try finding the cost with easier numbers such as 10 cans for $2. Use this to help you find a different way to compare the ratios.

Your Turn

- Review the Student Response 3-6 to exit ticket. In what ways did the student meet the criteria? In what ways has she/he not met the criteria?

- Determine what feedback to provide STUDENT 4

Give 1 Get 2/ Feedback Harvest

Find someone new!
•Share feedback samples

When prompted find a 2nd someone new
•Share feedback samples

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Feedback to Students FACTS

FACTS Resource: Review 2 or more of the following descriptions

•5 CCC p. 63
•6 Comments-Only Marking p. 66
•15 Feedback to Feed Forward p. 15
•41 Peer to Peer Focused Feedback p.151

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FACTs Used

HANDOUT Page 5

57. Thinking Log
45. Paired Verbal Fluency
51. Strategy Harvest

What purposes do the these FACTS align with?

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Next Steps:

Handout Page 13

Next Steps Action Plan

Formative Assessment Strategies for the Next Month

What am I going to try?	What do I need to do to prepare for this?	What additional help might I need in order to do this?	What is my goal timeline?

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Thanks for Joining Today's Session!

- Please fill out the Evaluation Form
- Contact me at cheryltobey@gmail.com

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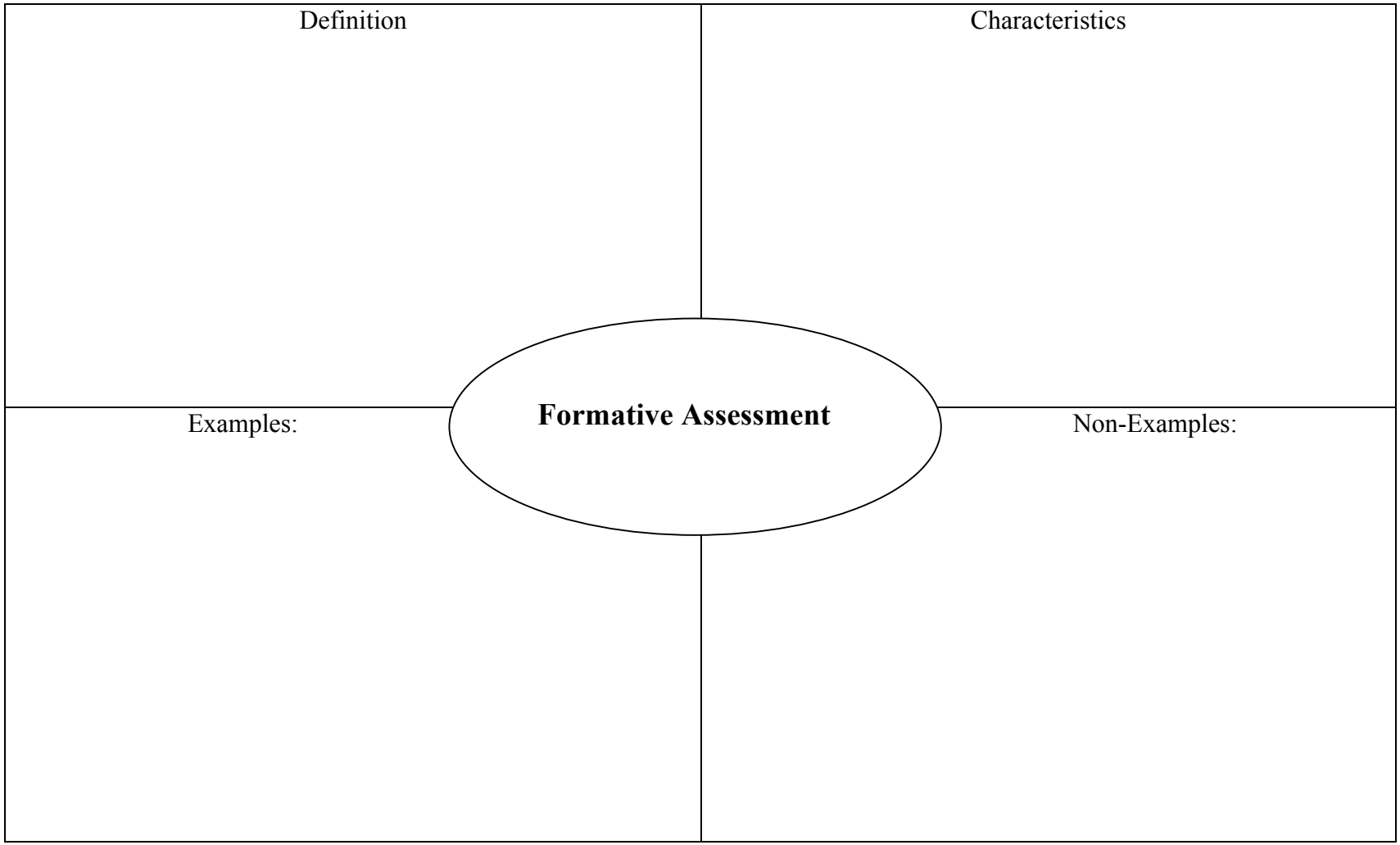
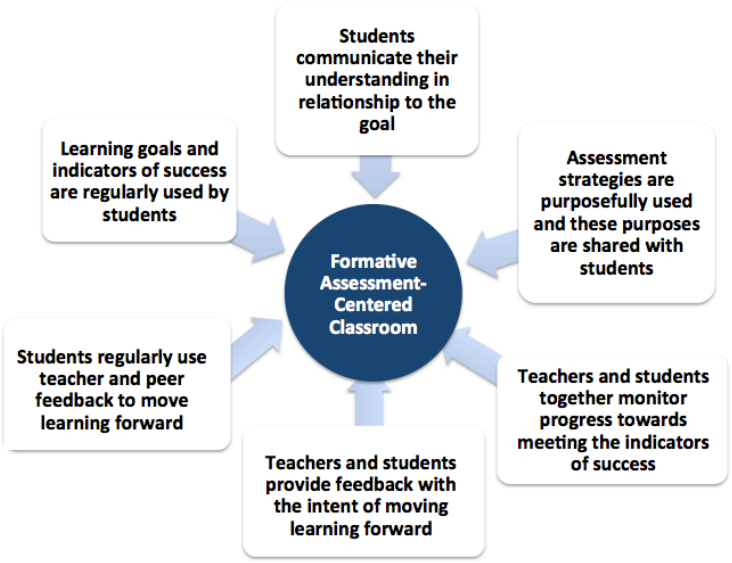


Adapted Frayer model : Fredrick, Waune C. and Klausmeier, Herbert J., April 1969, *A Schema for Testing the level of Concept Mastery* (Working Paper No. 16), University of Wisconsin Center for Educational Research

Mathematical Content Knowledge for Teaching[a]

Knowledge Category	Examples
Mathematics Content Knowledge Knowledge about mathematics concepts, processes and skills.	• Knowing how to: count, add two numbers, multiply rational numbers, display data, solve a quadratic function, etc. • Knowing why an algorithm works, showing flexibility in representing mathematical situations, justifying mathematically whether the answer makes sense, etc.
Knowledge of Mathematics and Students An understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons.[b]	• Understanding the successively more sophisticated ways of thinking about ideas within a topic that follow one another as students learn[c] • Identifying Learning Targets and Criteria for Success for a lesson • Knowledge of overgeneralizations, preconceptions, and/or conceptual misunderstandings that pose barriers to further movement within a progression of learning.
Knowledge For Teaching Mathematics Concepts, Processes and Skills Ability to understand and/or design instructional tasks both within a lesson and across a series of lessons to support students' movement within a progression of learning.	• Creating example and non-examples concept attainment cards that allow students to generalize about properties and characteristics • Using a series of tasks for using manipulatives to build towards generalization of a process (ie decomposing a number by place, need for common denominators, factoring polynomials, etc.) • Designing a series of investigatory questions around using a technology application
Knowledge of Student MetaCognition Understanding how to support students' ability to self-monitor their learning of mathematics.	• Using formative assessment strategies to help students: understand the learning target, communicate their thinking, and reflect on progress towards meeting the success criteria • Provide structures and supports that help students learn to self assess their work against the success criteria • Help students understand the purpose of feedback and provide ongoing opportunities to receive and respond to feedback provided

[a] Adapted from
Deborah Loewenberg Ball, Mark Hoover Thames, Geoffrey Phelps, Content Knowl-edge for Teaching, Journal of Teacher Education 59 (2008) 389-407.
Fennema, E. & Franke, M. (1992). Teachers' knowledge and its impact in: D.A. Grouws (Ed) Handbook of Research on Mathematics Teaching and Learning (New York: Macmillan Publishing).
[b] Shulman, L.S. (1995). Those who understand: knowledge growth in teaching in: B. Moon & A.S. Mayes (Eds) Teaching and Learning in the Secondary School (London: Routledge).
[c] Wilson, M. R., Bertenthal, M. W., & ebrary, I. (2005). *Systems for state science assessment.* Washington, DC: National Academies Press.



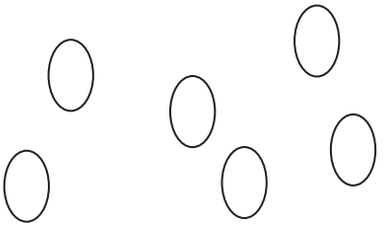
Learning goals and indicators of success are regularly used by students	• Notes
Students communicate their understanding in relationship to the goal	• Notes
Assessment strategies are purposefully used and these purposes are shared with students	• Notes
Teachers and students together monitor progress towards meeting the indicators of success	• Notes
Teachers and students provide feedback with the intent of moving learning forward	• Notes
Students regularly use teacher and peer feedback to move learning forward	• Notes

10 PURPOSES FOR EMBEDDING FORMATIVE ASSESSMENT INTO INSTRUCTION

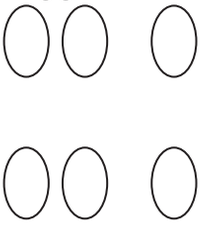
Elicit and Identify Preconceptions	**Engage and Motivate Students**
Activate Thinking and Promote Metacognition	**Provide Stimuli for Scientific or Mathematical Discussions**
Initiate Scientific Inquiry or Mathematical Ideas Exploration	**Support Formal Concept Development and Transfer**
Improve Questioning and Quality of Student Responses	**Provide Teacher to Student Feedback**
Support Peer and Self-Assessment	**Encourage Reflection**

2.1a

Carla's Eggs



Bonnie's Eggs



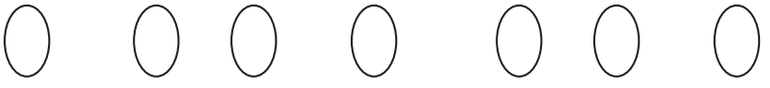
Who has more eggs? Circle the letter.

A. Carla has more eggs. B. Bonnie has more eggs.

C. Carla and Bonnie have the same number of eggs.

Penny's Eggs

Dee Dee's Eggs

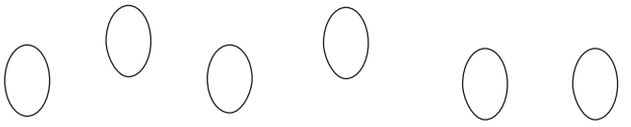


Who has more eggs? Circle the letter.

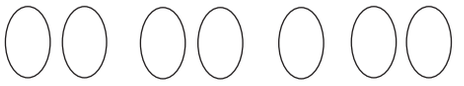
A. Penny has more eggs. B. Dee Dee has more eggs.

C. Penny and Dee Dee have the same number of eggs.

Nina's Eggs



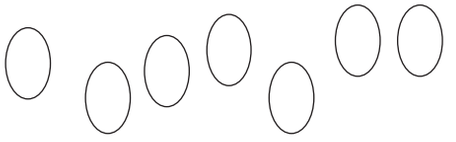
Nellie's Eggs



Who has more eggs? Circle the letter.

A. Nina has more eggs. B. Nellie has more eggs.
C. Nina and Nellie have the same number of eggs.

Tati's Eggs



Meena's Eggs

Who has more eggs? Circle the letter.

A. Tati has more eggs. B. Meena has more eggs.
C. Tati and Meena have the same number of eggs.

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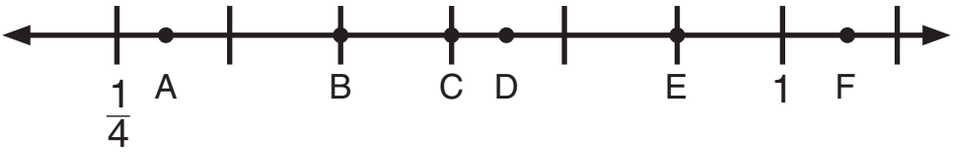
Number Lines

For each number line, decide which point reresents the location of the fraction.



1. $\frac{1}{2}$ Circle One: A B C D E F Not Shown

Explain your choice:

2. $\frac{7}{6}$ Circle One: A B C D E F Not Shown

Explain your choice:

3. $\frac{11}{16}$ Circle One: A B C D E F Not Shown

Explain your choice:

Decimal Division Estimates

Without calculating, use mental math and/or estimation to determine the estimate for each division problem.

Circle one:	Explain your choice:
1. **5.4 ÷ 0.6** The quotient is a. between 0.5 and 1 b. between 5 and 10 c. between 50 and 100	
2. **19.6 ÷ 0.05** The quotient is a. between 3 and 4 b. between 30 and 40 c. between 300 and 400	

Systems of Linear Equations

Look at the sets of systems of linear equations.

Circle the set with a solution that differs from the others.	Justify your choice.
1. a. $y = 3x - 4$ $2y - 6x = -8$ b. $y = \frac{1}{2}x + 3$ $4y - 2x = 10$ c. $y = -2x + 8$ $3y + 6x = 24$	
2. a. $y = 3x - 4$ $2y - 6x = 5$ b. $y = \frac{3}{4}x - 2$ $3y + 4x = 1$ c. $y = -\frac{5}{2}x + 3$ $5y - 2x = 8$	
3. a. $y = 6x - 4$ $y = 4x + 6$ b. $y = \frac{1}{2}x + 3$ $y = \frac{1}{2}x + 4$ c. $y = 2x + 5$ $y = -3x + 1$	

Analysis of Diagnostic Probe:_____

- What conceptual and procedural understandings does the Probe target?

- What conceptual and procedural misconceptions/difficulties does the Probe target?

- What is the purpose of each item in the Probe?

Item	Purpose of Each Answer Choice?

What combination of items would be important to review when looking at student responses? Why?

- What would you do instructionally for students who have one or more of the misunderstandings elicited by this Probe?

Analysis of Diagnostic Probe:_____

- What conceptual and procedural understandings does the Probe target?

- What conceptual and procedural misconceptions/difficulties does the Probe target?

- What is the purpose of each item in the Probe?

Item	Purpose of Each Answer Choice?

What combination of items would be important to review when looking at student responses? Why?

- What would you do instructionally for students who have one or more of the misunderstandings elicited by this Probe?

Formative Assessment – Centered Classroom and the 20 Purposes for Using FACTS

Assessment strategies are purposefully used and these purposes are shared with students	
Learning goals and indicators of success are regularly used by students	▪ Challenge students' existing ideas and encourage intellectual curiosity ▪ Provide a stimulus for discussion and mathematical argumentation ▪ Encourage social construction of ideas in mathematics
Students communicate their understanding in relationship to the goal	▪ Activate thinking and engage students in learning ▪ Make students' ideas explicit to themselves and the teacher ▪ Help students consider alternative viewpoints ▪ Provide a stimulus for discussion and mathematical argumentation ▪ Encourage social construction of ideas in mathematics ▪ Encourage and include participation of all learners ▪ Increase comfort and confidence in making one's own ideas public
Teachers and students together monitor progress towards meeting the indicators of success	▪ Encourage continuous reflection on teaching and learning ▪ Encourage students to ask better questions and provide thoughtful responses ▪ Provide starting points for mathematical inquiry ▪ Aid formal concept development and transfer ▪ Determine whether students can apply mathematics ideas to new situations ▪ Promote the use of academic language in mathematics learning ▪ Help students develop self-assessment and peer assessment skills ▪ Encourage social construction of ideas in mathematics ▪ Inform immediate or later adjustments to instruction ▪ Encourage and include participation of all learners
Teachers and students provide feedback with the intent of moving learning forward	▪ Help students consider alternative viewpoints ▪ Provide a stimulus for discussion and mathematical argumentation ▪ Evaluate the effectiveness of a lesson ▪ Give and use feedback (student to student, teacher to student, and student to teacher)
Students regularly use teacher and peer feedback to move learning forward	▪ Provide a stimulus for discussion and mathematical argumentation ▪ Provide a stimulus for discussion and mathematical argumentation ▪ Differentiate instruction for individuals or groups of students ▪ Give and use feedback (student to student, teacher to student, and student to teacher)

Next Steps Action Plan: Formative Assessment

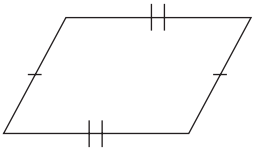
What am I going to try?	What do I need to do to prepare for this?	What additional support might I need in order to do this?	What is my goal timeline?

PARALLELOGRAMS

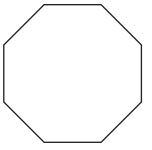
Circle the figures that are parallelograms.

A.

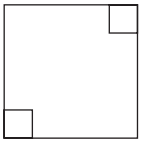
B.



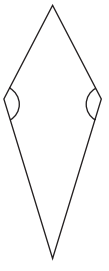
C.



D.



E.



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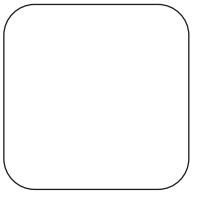

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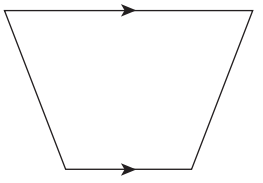

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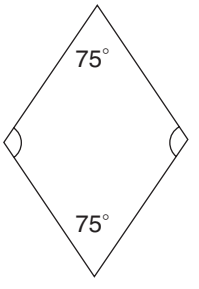

Explain your reasoning for each figure.

A.

B.

C.

D.

E.

F.

G.

H.

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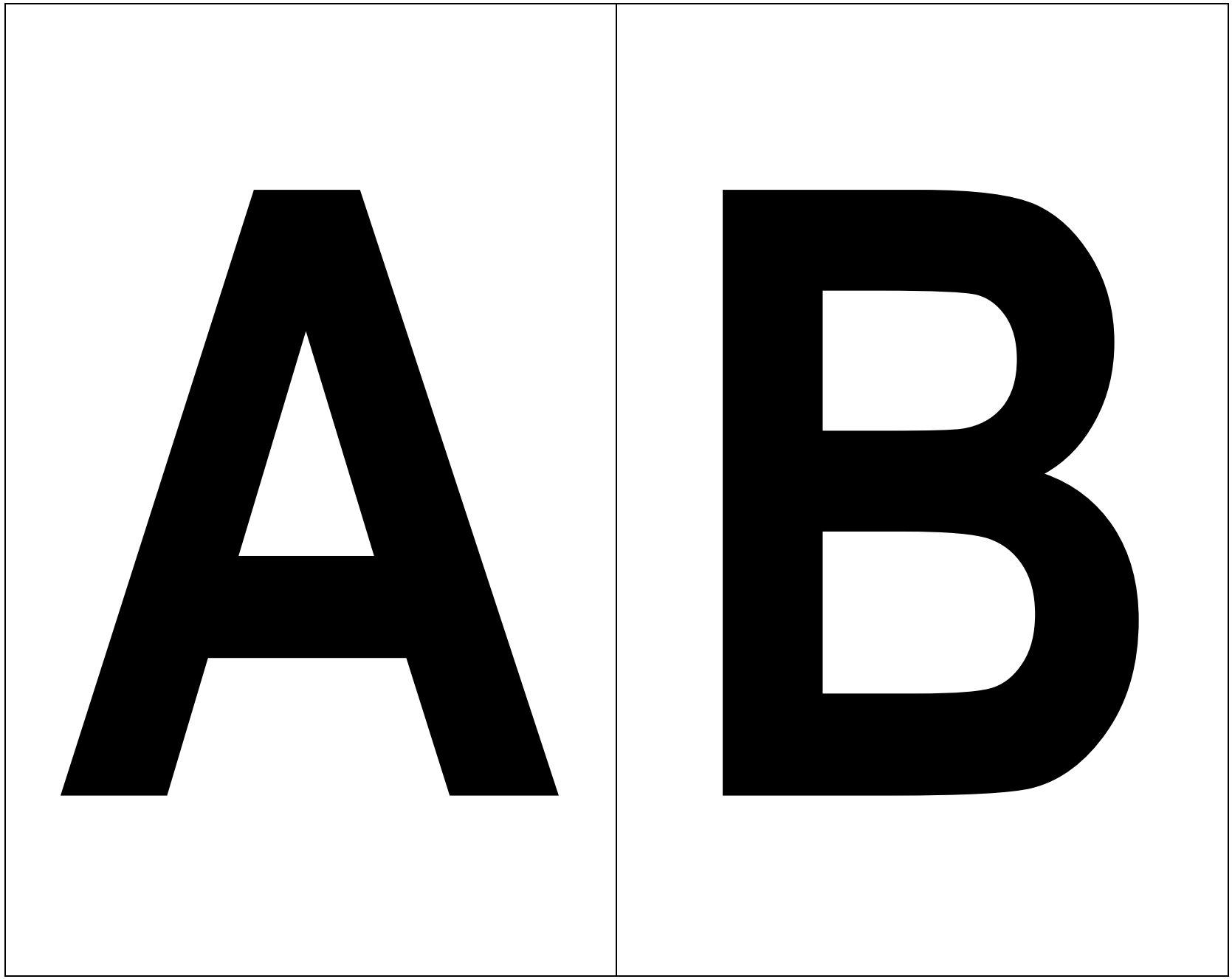
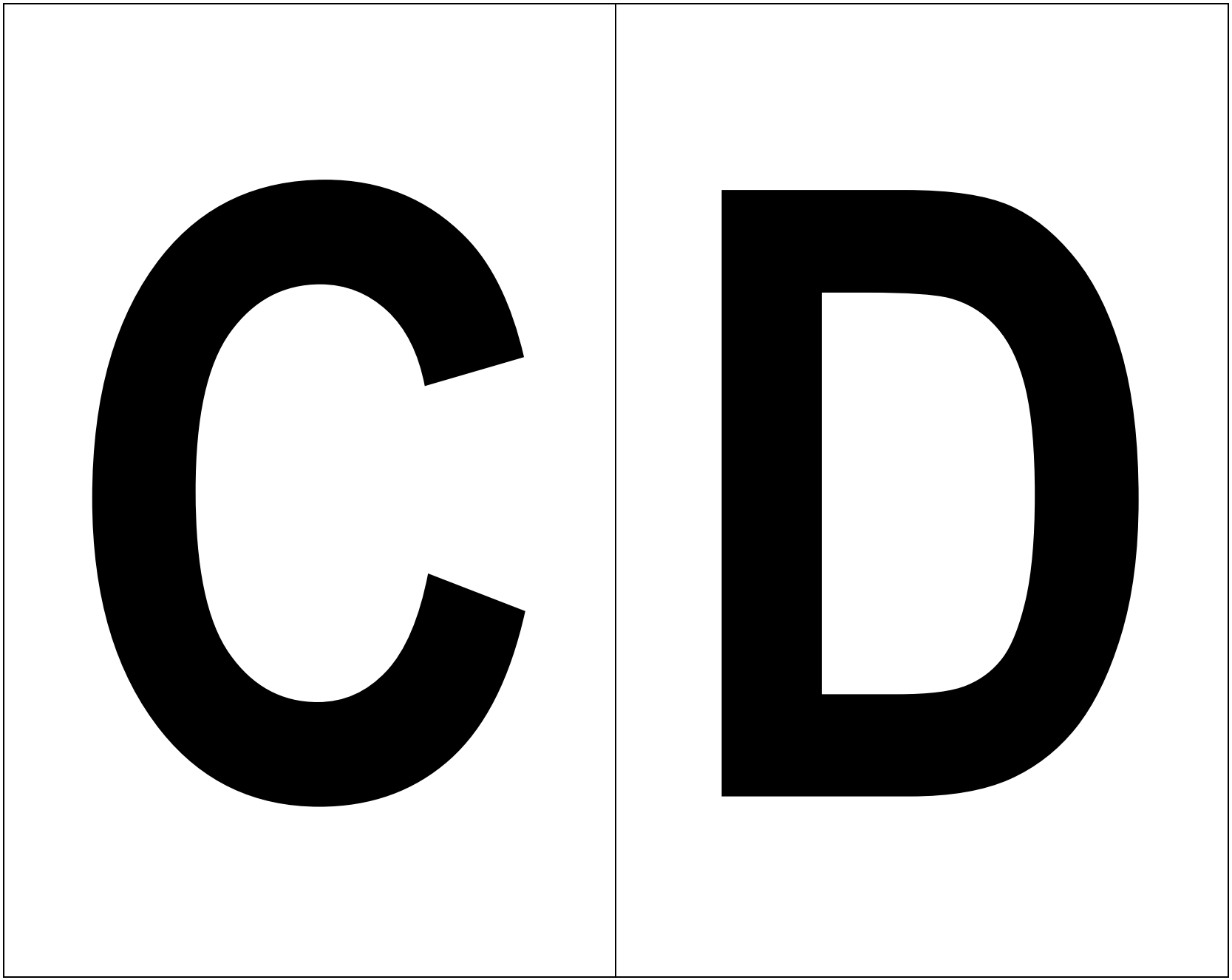

A
B


C
D