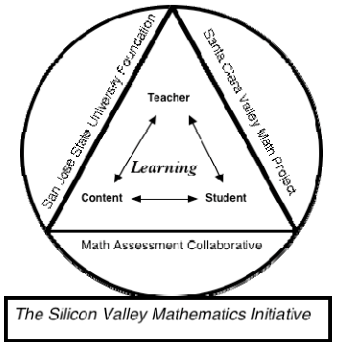
Teaching for Learning

In the Era of the Common Core Standards



David Foster
Silicon Valley Mathematics Initiative
www.svmimac.org

Optimism

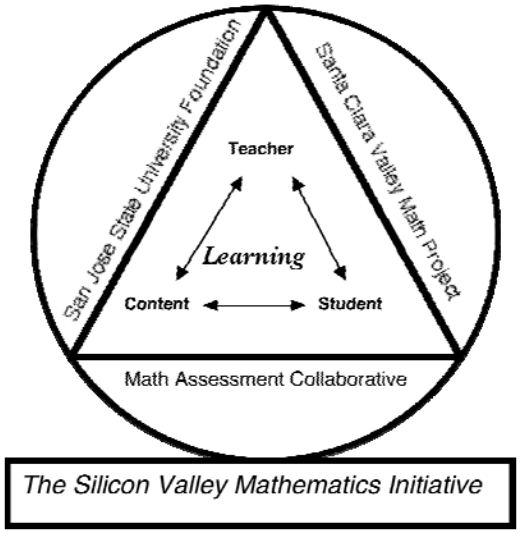
"Optimism is an essential ingredient for innovation. How else can the individual welcome change over security, adventure over staying in safe places? A significant innovation has effects that reach much further than can be imagined at the time, and creates its own uses. It will not be held back by those who lack the imagination to exploit its use, but will be swept along by the creative members of our society for the good of all. Innovation cannot be mandated any more than a baseball coach can demand that the next batter hit a home run. He can, however, assemble a good team, encourage his players, and play the odds."

Robert N. Noyce

Silicon Valley Mathematics Initiative

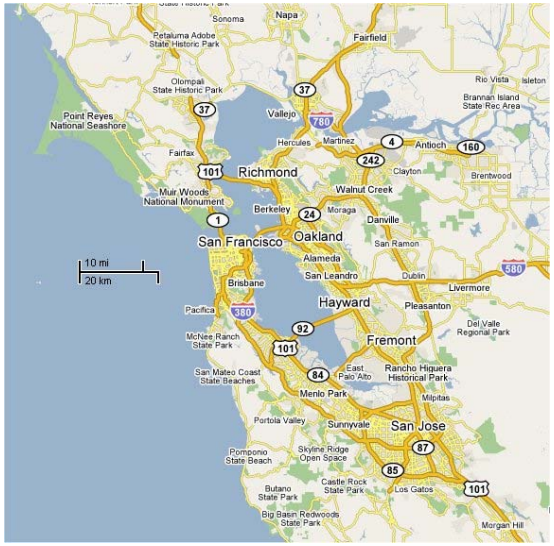
41 Members School Districts and Charter School Networks

Antioch Unified
Aspire Charter Schools
Atlanta PS
Bayshore
Belmont
Berryessa
Bolinas - Lagunitas
Brisbane
Cambrian
Cristo Rey School Network
Cupertino
Discovery Charter School
Emery
Franklin - McKinley
Hamilton County, Tn
Hayward
Jefferson
Los Altos
Los Gatos
Menlo Park
Moreland



Morgan Hill Charter School
Mt Pleasant
National Council of La Raza
New York City
Oakland Military Institute
Oakland Unified
Pacifica
Pajaro Valley
Palo Alto

Portola Valley
Ravenswood
Salinas City Schools
San Carlos
San Ramon Valley
Santa Clara
Santa Cruz City
Saratoga
SMCOE County Court Schools
South San Francisco
Walnut Creek



Supporting Teaching and Learning of Mathematics Since 1996

COMMON CORE
STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

Mathematical Practice

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

Welcome to the Inside Mathematics Website

Welcome to Inside Mathematics, a professional resource for educators passionate about improving students' mathematics learning and performance.
This site features classroom examples of innovative teaching methods and insights into student learning, tools for mathematics instruction that teachers can use immediately, and video tours of the ideas and materials on the site.
Several allied initiatives dedicated to improving math teaching have contributed to this resource.





http://www.insidemathematics.org

Formative Assessment

Formative Assessment is:

Students and teachers
Using evidence of learning
To adapt teaching and learning
To meet immediate learning needs
Minute-to-minute and day to day

Dylan Wiliam, University of London

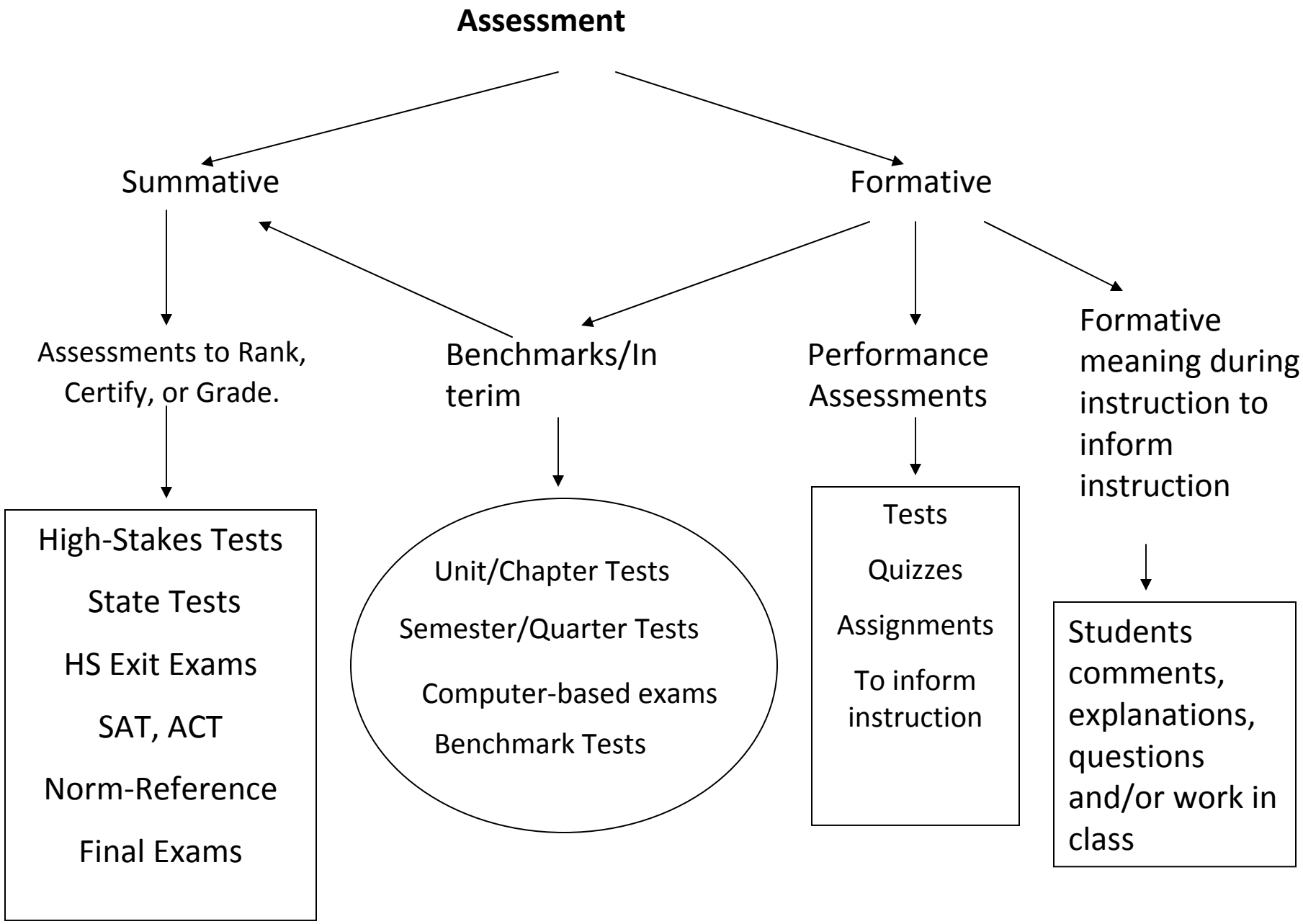
Looking at Student Work

The process of studying student work is a meaningful and challenging way to be data-driven, to reflect critically on our instructional practices, and to identify the research we might study to help us think more deeply and carefully about the challenges our students provide us. Rich, complex work samples show us how students are thinking, the fullness of their factual knowledge, the connections they are making. Talking about them together in an accountable way helps us to learn how to adjust instruction to meet the needs of our students.

Annenberg Institute of School Reform

Educational Research:
Formative Assessment and Student Work to Inform Instruction

- *Assessing Student Outcomes*; Marzano, Pickering, McTighe
- *Inside the Black Box*; Black,Wiliams
- *Understanding by Design*; Wiggins, McTighe
- *Results Now*; Schmoker
- *Professional Learning Communities at Work*; Dufour, Eaker
- *Accountability for Learning*; Reeves
- *Math Talk Learning Community*; Fuson, et al
- *Normalizing Problems of Practice*; Little, Horn
- *Change the Terms for Teacher Learning*; Fullan
- *Working toward a continuum of professional development*; Loucks-Horsley, et al.


Assessment
Summative
Formative
Assessments to Rank, Certify, or Grade.
Benchmarks/In terim
Performance Assessments
Formative meaning during instruction to inform instruction
High-Stakes Tests
State Tests
HS Exit Exams
SAT, ACT
Norm-Reference
Final Exams
Unit/Chapter Tests
Semester/Quarter Tests
Computer-based exams
Benchmark Tests
Tests
Quizzes
Assignments
To inform instruction
Students comments, explanations, questions and/or work in class

Inside the Black Box

by Paul Black and Dylan Wiliam, *Phi Delta Kappan*, copyright 1998
http://blog.discoveryeducation.com/assessment/files/2009/02/blackbox_article.pdf

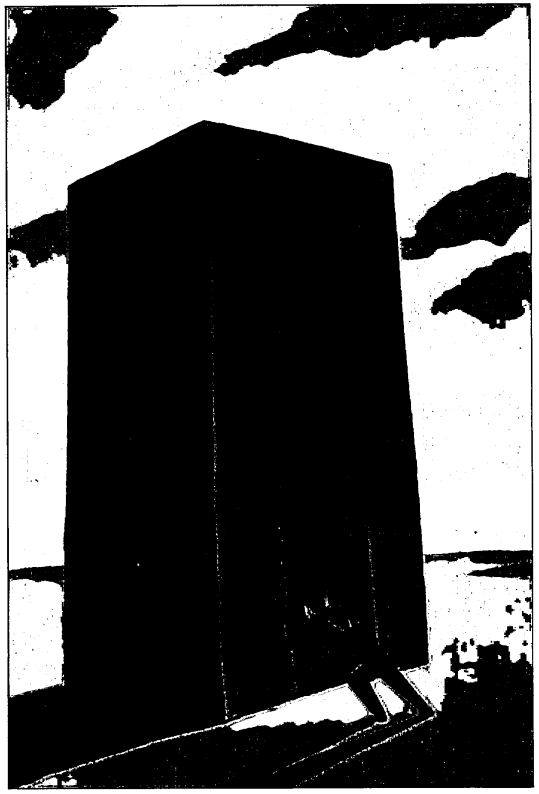
Follow up research:

Working Inside the Black Box

Inside the Black Box

Raising Standards Through Classroom Assessment

BY PAUL BLACK AND
DYLAN WILIAM



Firm evidence shows that formative assessment is an essential component of classroom work and that its development can raise standards of achievement, Mr. Black and Mr. Wiliam point out. Indeed, they know of no other way of raising standards for which such a strong prima facie case can be made.

RAISING the standards of learning that are achieved through schooling is an important national priority. In recent years, governments throughout the world have been more and more vigorous in making changes in pursuit of this aim. National, state, and district standards; target setting; enhanced programs for the external testing of students' performance; surveys such as NAEP (National Assessment of Educational Progress) and TIMSS (Third International Mathematics and Science Study); initiatives to improve school plan-

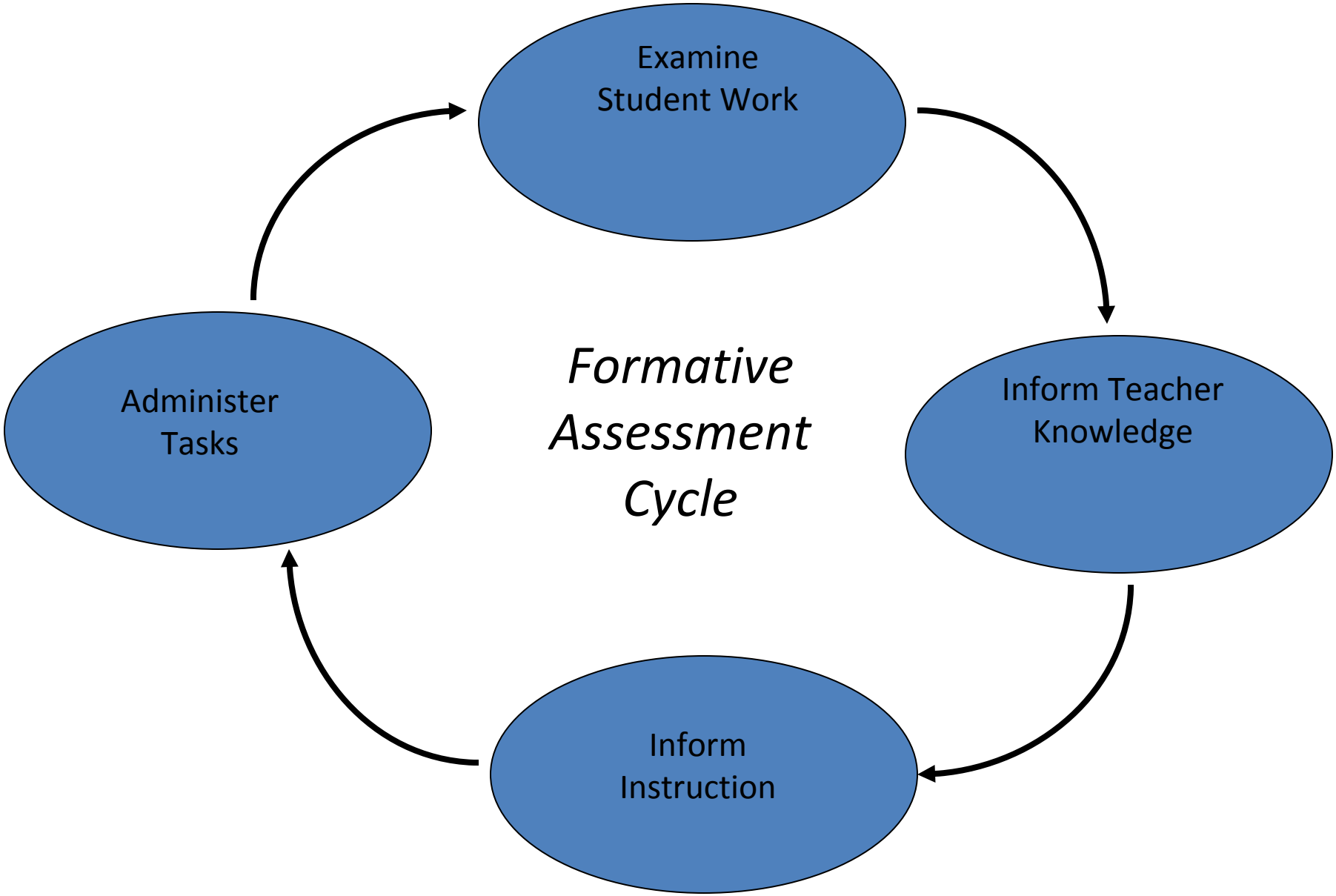
PAUL BLACK is professor emeritus in the School of Education, King's College, London, where DYLAN WILIAM is head of school and professor of educational assessment.

Illustration by A. J. Garces

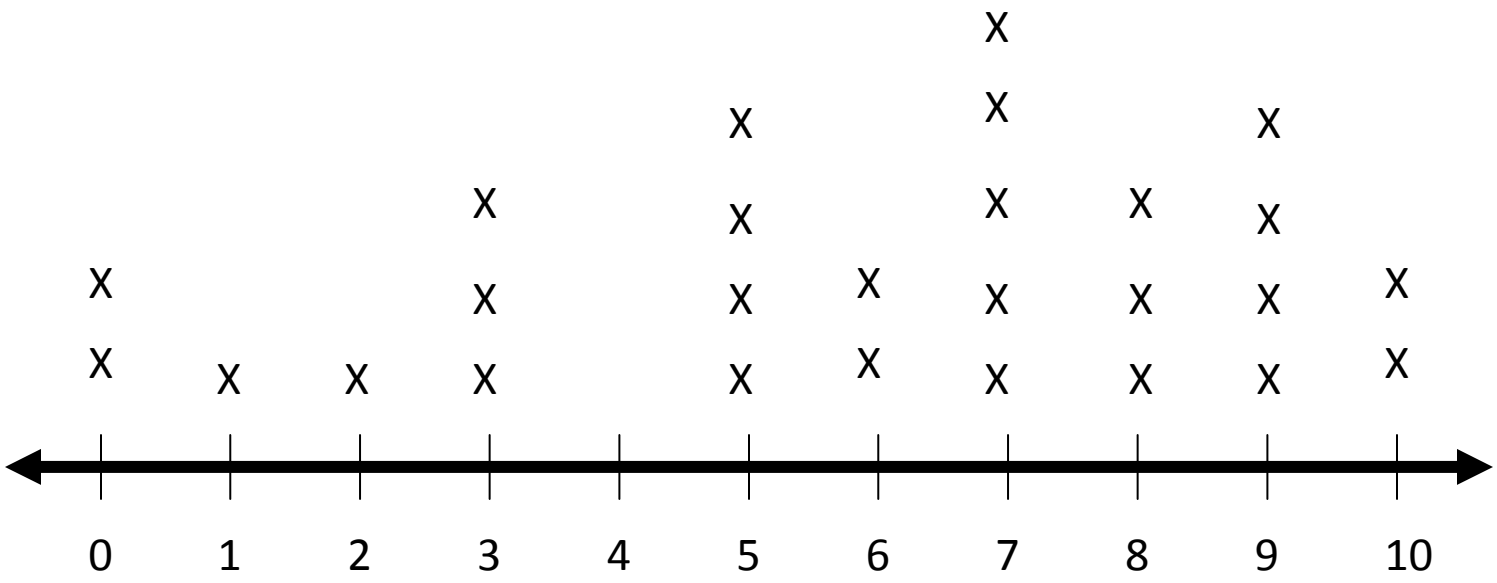
Effective Formative Assessment Strategies

- Clarifying learning intentions and sharing criteria for success
- Engineering effective classroom discussions.
- Providing feedback that moves learners forward.
- Activating students as the owners of their own learning.
- Activating students as instructional resources for one another.

Dylan Wiliam, University of London


Examine
Student Work
Inform Teacher
Knowledge
Inform
Instruction
Administer
Tasks
Formative
Assessment
Cycle

The Results from an Assessment



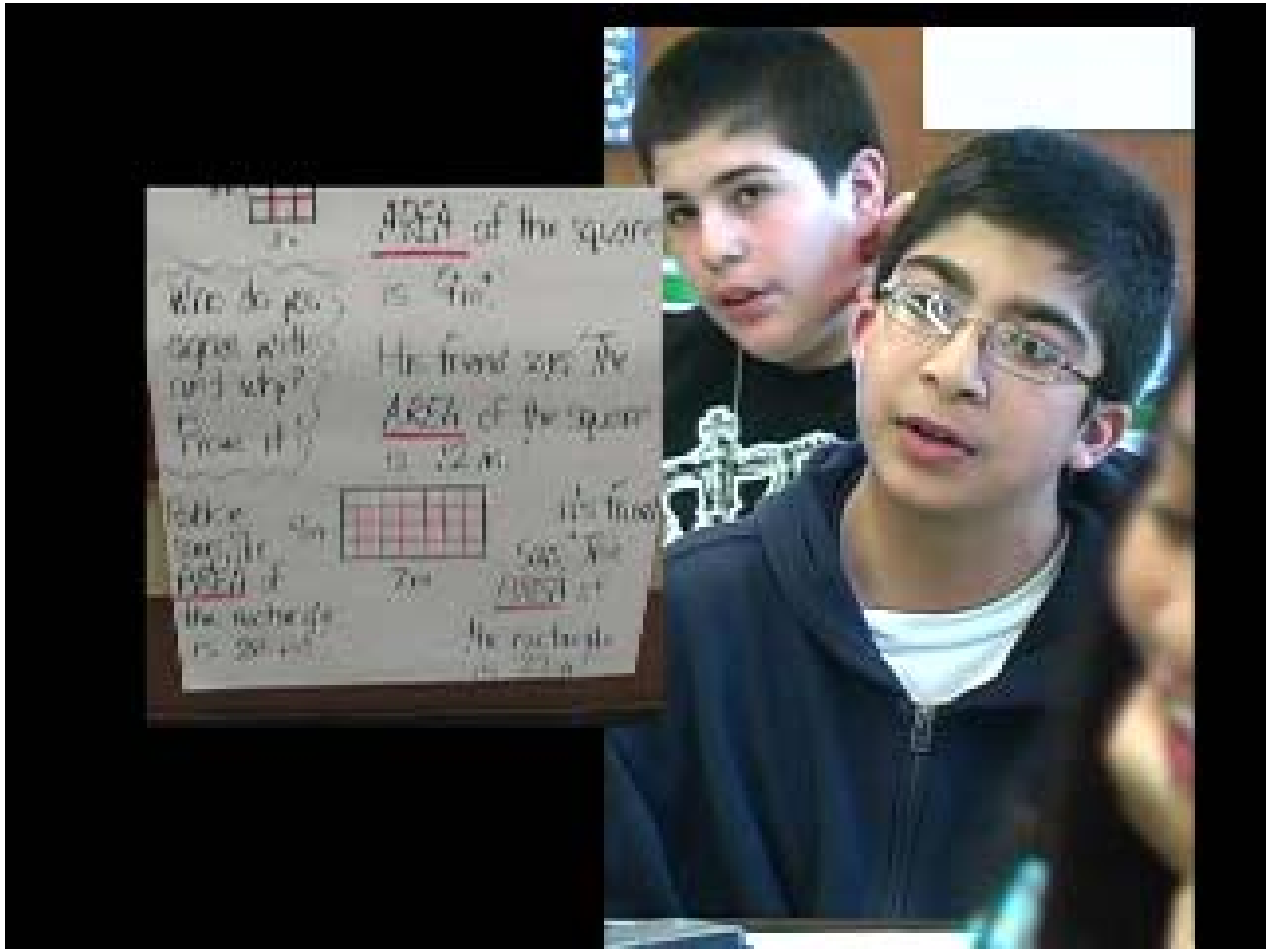
Students' performances are across the continuum

Traditionally Teachers Choose One of Three Options

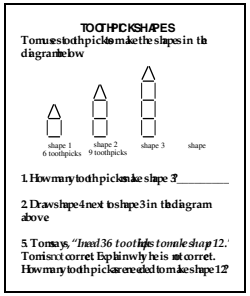
- Go back and re-teach the topic with the entire class.
- Identify the students needing remediation and find some time/opportunity to re-teach the topic while the rest of the class continues on.
- Feeling the pressure of the over packed curriculum the teacher ventures on to the next topic.

Re-engagement:

Completing the Formative Assessment Cycle



MARS Tasks



TOOTHPICK SHAPES

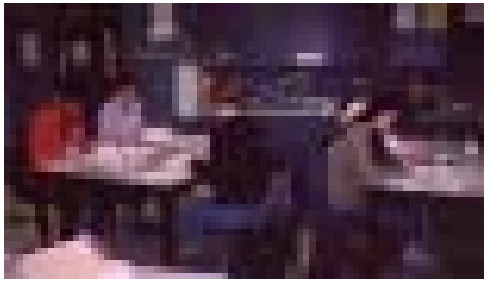
Tom uses toothpicks to make the shapes in the diagram below

1. How many toothpicks make shape 3? _____

2. Draw shape 4 next to shape 3 in the diagram above

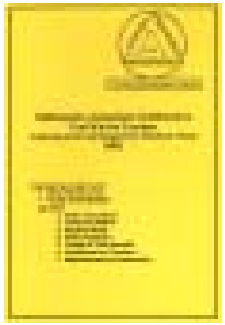
5. Tom says, *"I used 36 toothpicks to make shape 12."* Tom is not correct. Explain why he is not correct. How many toothpicks are needed to make shape 12?

Examine Student Work



Scoring and Student Works Protocols

Inform Teacher Knowledge



Tools for Teachers and PD Materials

Inform Instruction

Re-engagement Lessons

Administer Tasks

Formative Assessment Cycle

Common Core Standards

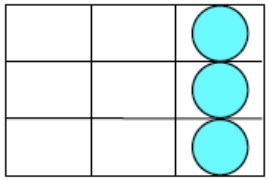
The MAC/MARS
Math Performance Assessments

- The Mathematics Assessment Resource Service (MARS) is an NSF funded collaboration between U.C. Berkeley, Michigan State and the Shell Centre in Nottingham England.
- The Assessments target grades 2- Geometry and are aligned with the State and NCTM National Math Standards.

Candies

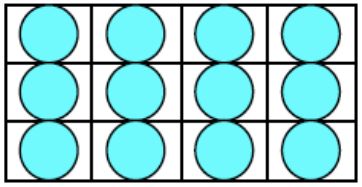
This problem gives you the chance to:
- work with fractions and ratios

1. This is Amy's box of candies.
   She has already eaten 6 of them.



   What fraction of the candies has Amy eaten? _____

2. Valerie shares some of the 12 candies from this box.
   She gives Cindy 1 candy for every 3 candies she eats herself.



   How many candies does she give to Cindy? _____
   Show how you figured this out.

3. In a packet of mixed candies there are 2 fruit centers for every 3 caramel centers.
   There are 30 candies in the packet.

   How many caramel centers are there? _____
   Show how you figured this out.

4. Anthony makes candies.
   First, he mixes 1 cup of cream with 2 cups of chocolate.
   In all, he uses 9 cups of these two ingredients.
   How many cups of chocolate does he use in this candy recipe? _____

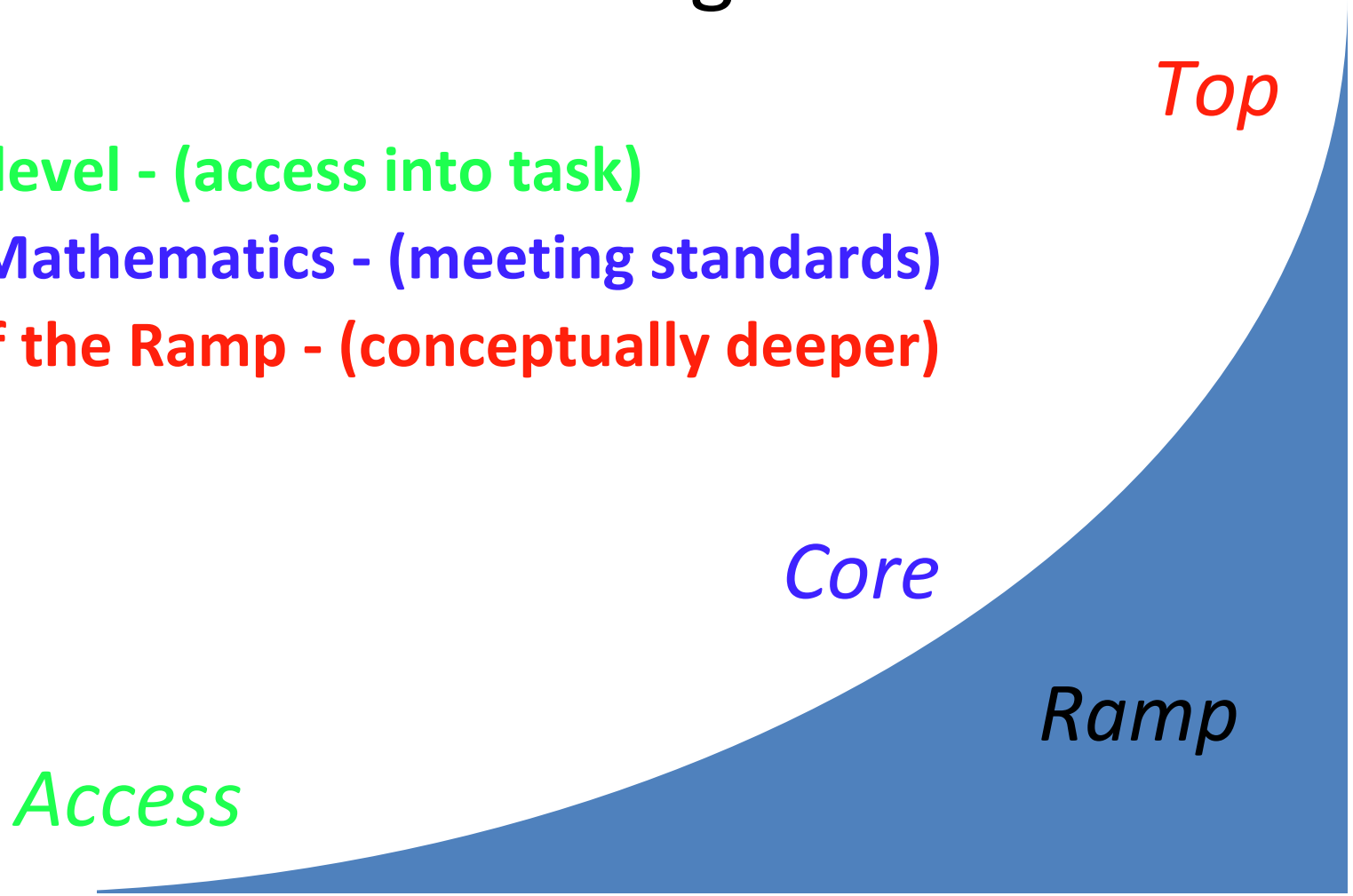
   Explain how you figured this out.

MARS Performance Assessments
Task Design

Entry level - (access into task)

Core Mathematics - (meeting standards)

Top of the Ramp - (conceptually deeper)



Designing Re-engagement

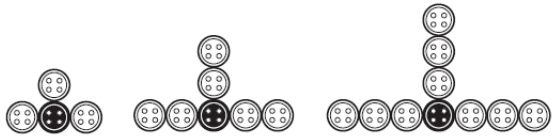
The Mathematics Assessment Collaborative uses a process of formative assessment that use student work and assessment results to inform instruction and design lesson to re-engage students in learning the mathematics.

Buttons

This problem gives you the chance to:

- describe, extend, and make generalizations about a numeric pattern

Gita plays with her grandmother's collection of black and white buttons.
She arranges them in patterns.
Her first 3 patterns are shown below.



Pattern 1 Pattern 2 Pattern 3 Pattern 4

1. Draw Pattern 4 next to Pattern 3.

2. How many **white** buttons does Gita need for Pattern 5 and Pattern 6?

   Pattern 5 _____ Pattern 6 _____

Explain how you figured this out.

3. How many buttons in all does Gita need to make Pattern 11?

   _____

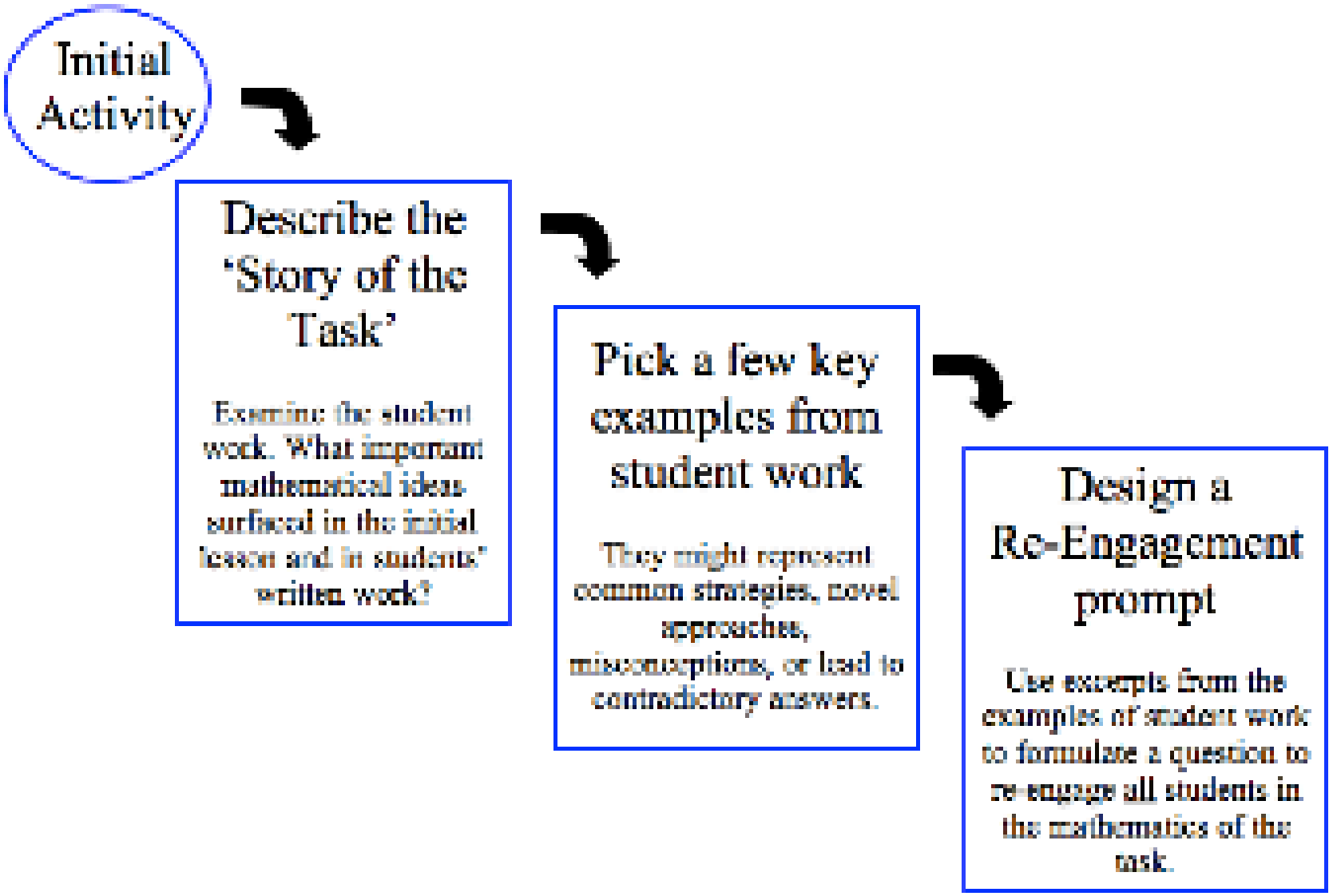
Explain how you figured this out.

4. Gita thinks she needs 69 buttons in all to make Pattern 24.

   How do you know that she is **not** correct?

How many buttons does she need to make Pattern 24? _____

Re-Engagement Protocol



Examine Learner A's Work

Learner A

3. How many buttons in all does Gita need to make Pattern 11?

34 Buttons

Explain how you figured this out.

I x (11 x 3) + 1 = 34 buttons
I added one for the black button in the middle

How is Learner A making sense of the mathematics?

Examine Learner B's Work

Learner B

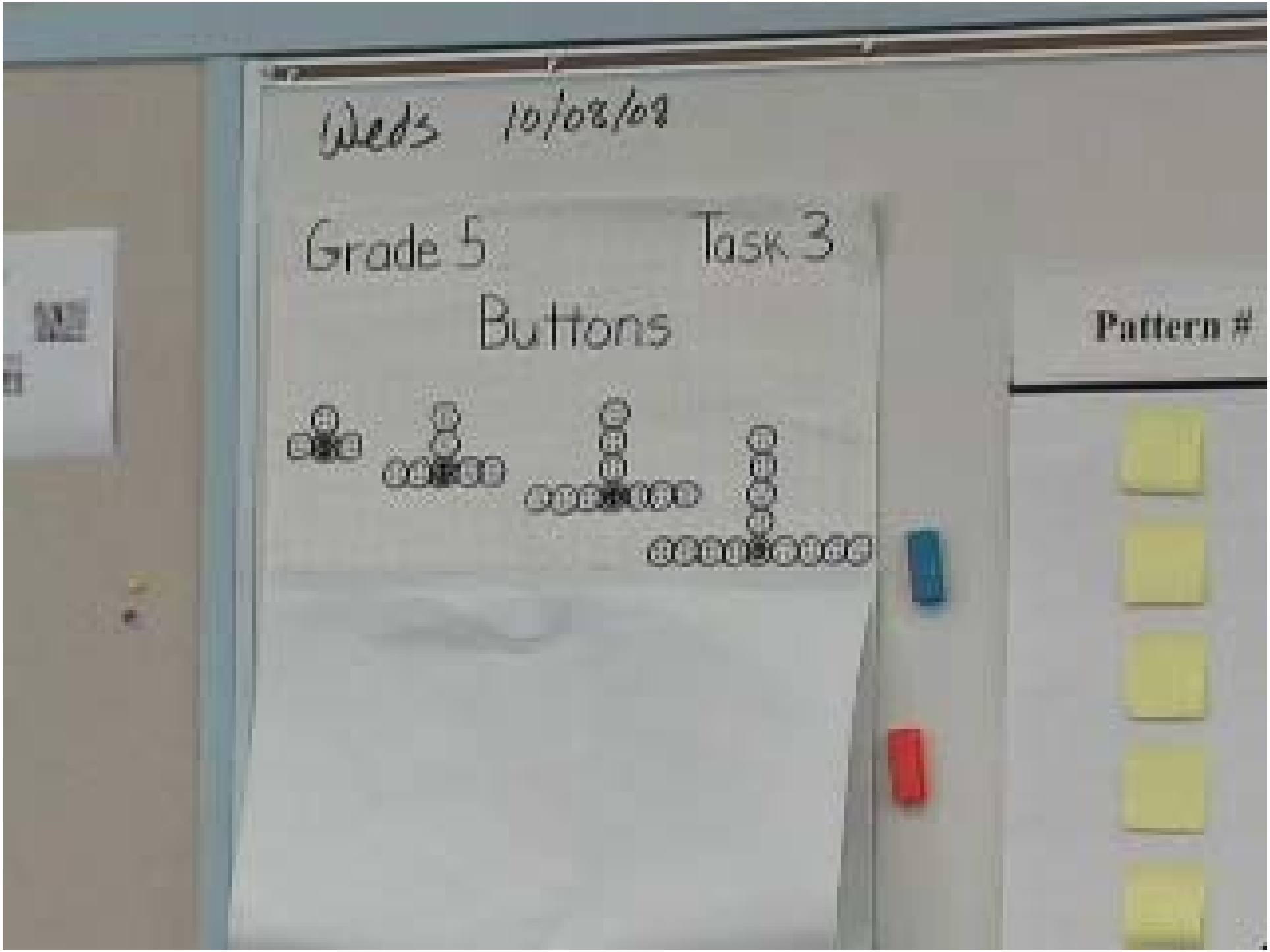
3. How many buttons in all does Gita need to make Pattern 11?

34

Explain how you figured this out.

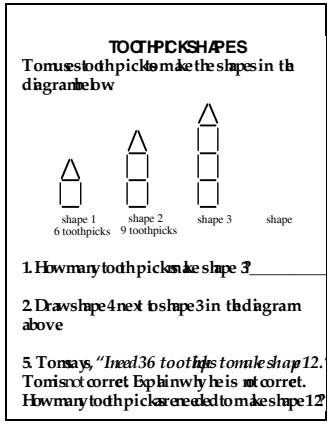
I added 4 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3
= 34 which is the # of buttons.

How is Learner B making sense of the mathematics?


Weds 10/08/08
Grade 5
Task 3
Buttons
Pattern #

Collectively score and analyze student work

Administer high-quality assessment tasks



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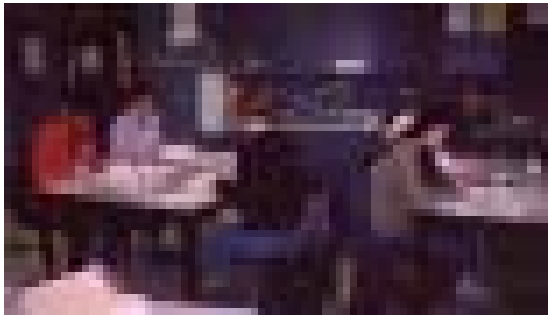
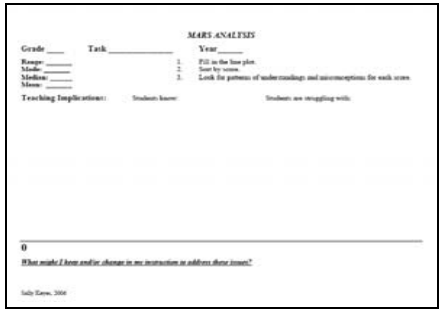




MARS ANALYSIS

Grade ____ Task _____ Year _____

Range: _____
Mode: _____
Median: _____
Mean: _____

1. Fill in the line plot.
2. Sort by score.
3. Look for patterns of understandings and misconceptions for each score.

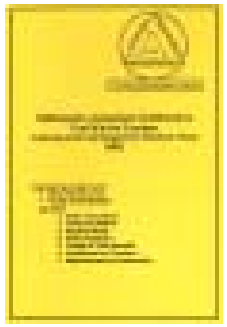
Teaching Implications: Student knows: Student are struggling with:

0

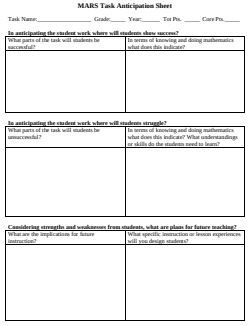
What might I have and/or change in my instruction to address these issues?

Sally Ekroe, 2006

Cycle of Formative Assessment to Inform and Improve Learning



Leads to improved teaching and learning in the classroom (re-engagement)



MARS Task Anticipation Sheet

Task Name:_____ Grade:_____ Year:_____ Tot Pts. _____ Core Pts._____

In anticipating the student work where will students show success?

What parts of the task will students be successful?	In terms of knowing and doing mathematics what does this indicate?

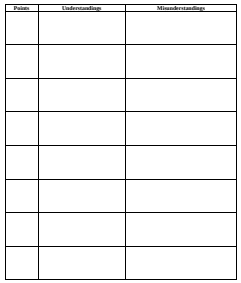
In anticipating the student work where will students struggle?

What parts of the task will students be unsuccessful?	In terms of knowing and doing mathematics what does this indicate? What understandings or skills do the students need to learn?

Considering strengths and weaknesses from students, what are plans for future teaching?

What are the implications for future instruction?	What specific instruction or lesson experiences will you design students?

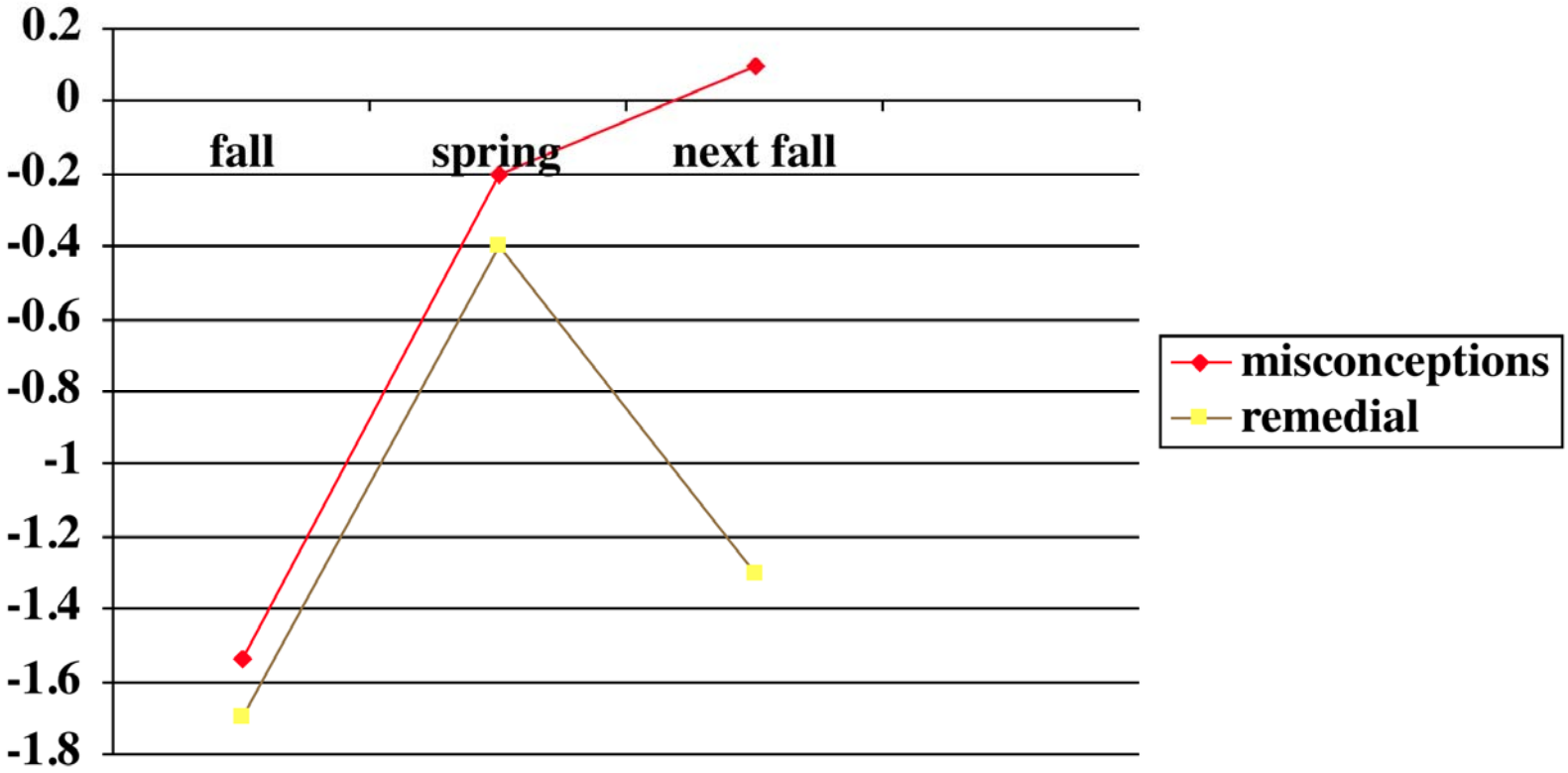
Drives the professional development experiences of the teachers to plan experiences focused on their students.



Points	Understandings	Misunderstandings

Document student thinking to inform instruction.

Bell and Swan study



Re-teaching vs. Re-engagement

- Teach the unit again.
- Address basic skills that are missing.
- Do the same or similar problems over.
- Practice more to make sure student learn the procedures.
- Focus mostly on underachievers.
- Cognitive level is usually lower.

- Revisit student thinking.
- Address conceptual understanding.
- Examine task from different perspective.
- Critique student approaches/solutions to make connections.
- The entire class is engaged in the math.
- Cognitive level is usually higher.

Teaching for Meaning

George Polya, (1887 - 1985)
Father of Problem Solving;
"*How to Solve It*", 1945

Mathematics, you see, is not a spectator sport. To understand mathematics means to be able to do mathematics. And what does it mean doing mathematics? In the first place it means to be able to solve mathematical problems.

Why a Problem of the Month?

- George Polya, said, “A problem is not a problem if you can solve it in 24 hours.”
- Doing math is solving non-routine problems.
- Perseverance and learning from mistakes are important attributes of good mathematicians.

How are the POM be used?

- The POM are used school wide to promote problem solving.
- Each problem is divided into five levels, A-E, to meet the learning development needs of all students.
- A great tool for *Differentiated Instruction*.
- Students, teachers and parents learn to ask questions and persevere in solving non-routine problems.
- The whole school celebrates doing mathematics at school.

Problem of the Month

Party Time

Level C

Mia, Jake, Carol, Barbara, Ford and Jeff are all going to a costume party. Figure out which person is wearing what costume and when they arrived at the party.

- The person that arrived fourth was wearing bathing suit.
- Barbara was the last to arrive.
- Jake and Mia arrived and stayed together.
- The first person was dressed as a French Maid.
- Superman arrived right before Barbara.
- The Potato Heads were always together at the party.
- Ford was a Surfer Dude.
- The French Maid was not Carol.
- The Vampire arrived after Superman.

Second Grade - Working on Party Time Level C

Problem of the Month

Party Time

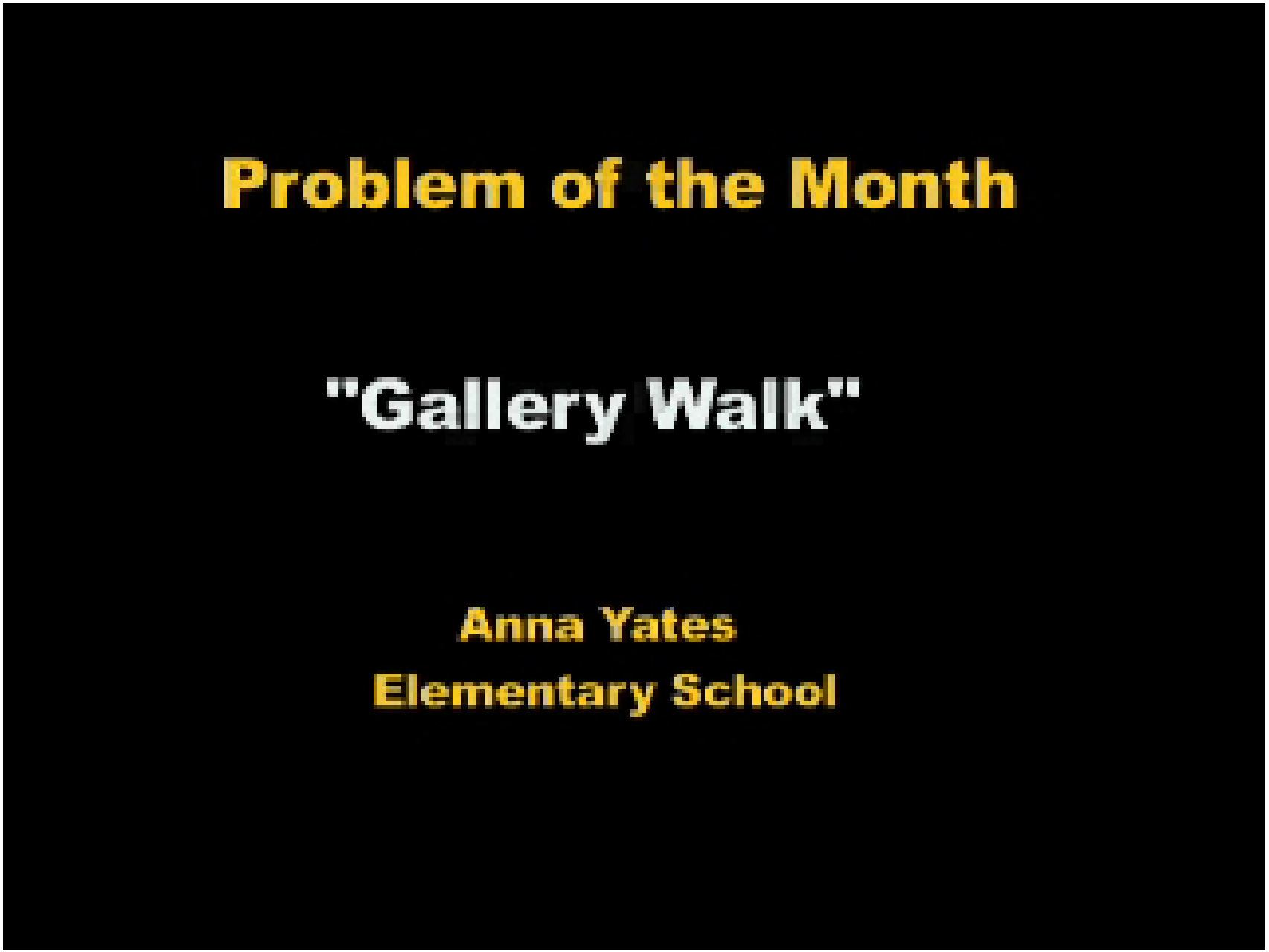
Level E

A man and his wife invite 5 other couples to a dinner party. As the guests arrive for drinks before dinner, they shake hands. Not everybody shakes everybody's hands, and of course no one shakes hands with his own spouse. Later, as they sit down to dinner, the host asks each other person, including his wife, "how many hands you shake?" He notices, to his surprise, that each respondent shook a different number of hands.

How many did his wife shake?

Explain your solution and justify your reasoning.

Gallery Walk for Party Time



Anna Yates Elementary School

Principal Lathan

Leslie Thornley, Math Coach

April 2009

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Several allied initiatives dedicated to improving math teaching have contributed to this resource.





http://www.insidemathematics.org

"Don't be encumbered by history-- go off and do something wonderful."

Dr. Robert N. Noyce

Inventor of the Silicon Chip
Co-founder of Intel