Routines, Lessons, Problems, and Projects: Mastering the Elements of Math Instruction

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Strong student culture
Collaborative staff norms

Rubrics aligned with college and career attributes for success

Project and Problem Based Learning

1:1 Student to computer ratio

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Common questions Geoff gets:

- How are we supposed to cover all our content and incorporate inquiry?
- How many projects should we do a year?
- How do we get kids caught up if they’re behind in certain areas?
- How do we get kids excited about math?
- When do we actually, like, teach?
“If you master these four elements you can make anything taste great.” — Samin Nosrat
The Classroom Chef

Sharpen Your Lessons
Season Your Classes
Make Math Meaningful

John Stevens & Matt Vaudrey

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The Fantastic Four: But Not the Terrible Marvel Movies that Everyone Pretends Didn’t Happen

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Earth Wind Fire Water: How I Applied What I Thought The Elements Were When I Was Eight to Math Instruction

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You down with

Routines
Lessons
Problems
Projects

Yeah you know me

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Routines

Lessons

Problems

Projects

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Problem: Will it Topple?
Right Triangle Trigonometry
The Leaning Tower of Pisa is expected to collapse once its angle of slant is less than 83°. Currently, the top of the seventh story is 50 meters above the ground. In addition, when a weight is dropped from the edge of the seventh floor, it lands 5 meters from the base of the tower. Your task is to determine how close this structure is to collapse.
PROBLEMS

Problems are complex tasks, not immediately solvable without further knowhow, research or decoding of the prompt. Problems can take anywhere from one class period to three or four class periods.
PROTIP 1: Make Problems the “cornerstone" of your class.

* Assessment materials
* Spark engagement and excitement
* A good representation of the work of mathematics
* Use for student portfolios
* Allow for lots of opportunities to celebrate student ingenuity
Knows / Need-to-knows / Next Steps
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Routines

Routines are well-understood structures that encourage discourse, sensemaking, and equity in the classroom. A teacher may have many different types of routines in her toolbelt and utilizes them daily.
 PROTIP 2: Develop a few, broadly applicable routines that you can teach in two minutes, especially ones that encourage discourse.

* “Turn and Talk”
* “Notice and Wonder”
* “Know / Need-to-Know / Next Steps”
* Gallery Walks
Prompt: Your task is to determine how close this structure is to collapse.

Please include:
- Describe and model the situation
- Goals, givens, and definitions
- Math you’re using and why
- Correct and complete work
- Clearly stated results, what they mean, and why they make sense
Lessons

Lessons include any activity that involves transmitting or practicing content knowledge. Lessons can vary from whole class lectures to hands-on manipulative activities.
Lessons

PROTIP 3: Broaden your definition of a lesson.

* Small Workshops
* Writers workshops
* Peer editing
* Debrief collaboration
Agenda

Math Talk: Notice & Wonder  
Pose Today’s Problem
Know/Need-to-Know
Groupwork
Workshop (Small Group)
Share out solutions
Agenda Rewind

Routine
Problem
Routine
Lesson
Lesson
Problem
Routine
Discussion Prompt: These are some examples of Problems, Lessons, and Routines. After reviewing these cards, share what other formats these may take?
Projects

Projects apply mathematical knowhow to an in-depth, authentic experience. A project occurs over the course of two to four weeks. Ideally, projects are outward facing, community based, and/or personally relevant to students.
OFFICIAL BALLOT, GENERAL ELECTION
Palm Beach County, Florida
November 7, 2000

Electors for President and Vice President
(A vote for the candidates will actually be a vote for their electors.)
(Vote for Group)

(Republican)
George W. Bush - President
Dick Cheney - Vice President

(Democratic)
Al Gore - President
Joe Lieberman - Vice President

(Libertarian)
Harry Browne - President
Art Olivier - Vice President

(Green)
Ralph Nader - President
Winona LaDuke - Vice President

(Socialist Workers)
James Harris - President
Margaret Trove - Vice President

(Natural Law)
John Haggelin - President
Nate Goldhaber - Vice President

(Reform)
Pat Buchanan - President
Ezola Foster - Vice President

(Socialist)
David McReynolds - President
Mary Cal Hollis - Vice President

(Constitution)
Howard Phillips - President
J. Curtis Frazier - Vice President

(Workers World)
Monica Moorehead - President
Gloria LaRiva - Vice President

Write-in Candidate
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.
To the students of Akins New Tech High School,

The US presidential election of November 7, 2000, was one of the closest in history. As returns were counted on election night it became clear that the outcome in the state of Florida would determine the next president. When the roughly 6 million Florida votes had been counted, Bush was shown to be leading by only 1,738, and the narrow margin triggered an automatic recount. The recount, completed in the evening of November 9, showed Bush’s lead to be less than 400.

Meanwhile, angry Democratic voters in Palm Beach County complained that a confusing “butterfly” ballot in their county caused them to accidentally vote for the Reform Party candidate Pat Buchanan instead of Gore. See the ballot above.

We have provided you the county-by-county results for Bush and Buchanan. We would like you to assess the validity of these angry voters’ – and therefore Al Gore’s - claims. Based on these data, is the “butterfly” ballot responsible in some part to the outcome of the 2000 election? What other questions do the data drum up for you? And what can we do to ensure this doesn’t happen again?

We look forward to reading your analysis and insight, no later than May 5.
Project-Based Learning

Give students a real-world scenario in which to apply mathematical content. Over the course of weeks, students use and learn content and non-content skills to solve an authentic problem, potentially addressing a community need.

WHY?

Project-Based Learning (PBL) allows students to practice skills beyond merely mathematical content knowledge. Students also utilize and learn skills about communication, collaboration, and other essential know-how that will yield postsecondary success. Also, an authentic project can engender excitement and engagement as well as more permanent learning.

Good for SMPs 1, 2, 4, 5

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Example - Are we ADA compliant?

Dear Ridgeland Students,

As you know, our school buildings were reconstructed and remodeled five years ago. As the principal of Ridgeland High School, I strive to ensure that our school buildings are healthy, safe, and secure physical environments for learning. The administrative team does this by continuously creating effective learning spaces and improving the function of our school.

As I plan for retirement, I hope to ensure that all students can access the wonderful opportunities our school provides. In my effort to improve our space and make it functional for all students, I am conducting research into the wheelchair accessibility at Ridgeland. And I need your help!

In pairs, please research any legislation with which we may need to comply when supporting disabled students. Based on your research, then determine if our school’s wheelchair ramps are appropriate and compliant. Please individually prepare a formal report organizing your findings for review by Ms. Christine and our administrative team. Your work will help us inform how we use our funds to best maintain and further update the Ridgeland High School buildings.

Sincerely,

Principal Donna, Ridgeland High School

Do now: identify mathematical content that potentially pairs well with PBL.

Extend: Seek out opportunities to work with organizations outside of school that utilize math to advance their work.
Projects

PROTIP 4: Save your projects for the content where it’s most appropriate, authentic, and exciting.

* Statistics
* Area / Volume
* Exponential growth / decay

Turn and Talk Prompt: What are some memorable projects you’ve seen, facilitated or experienced as a student?
The “dessert” project

A learning project

Project Based Learning

The material
Project

Project
The material
Final Product
Prompt: After looking at these measures of task quality, which might you want to implement at your classroom or your school site?
How I oriented my class

Routines: Daily

Lessons: 2-3 times a week

Problem: 1-2 times a week

Projects: Once a semester

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Active Caring

Active caring involves demonstrating kindness and finding heartfelt value for each student. It involves a two-way relationship and potential disruption of social and academic status.
**Concept: Stereotype Threat**

Stereotype threat occurs when people in a situation where they feel at risk of confirming a stereotype about their group(s) based on gender, race, and job status (Krall 2018). This occurs often in secondary school students.

Seminal research
- "Stereotype Threat and Women's Mathematics Performance" (Spencer, Steele and Quinn 1999)
- "Parents' Influence on Children's Achievement Perceptions" (Fromme and Eccles 1998)
- "Gender Role Stereotypes, Expectancies, and Socialization of Gender Differences" (Kukla and Harold 1990)
- "Stereotype Threat and the Intellectual Performance of African Americans" (Steele and Aronson 1995)
- "The Development of Implicit Attitudes" (Greenwald and Banaji 2006)
- "Black students face more discipline, report lower grades" (Steele and Aronson 2012)

**Assign academic status**

Offer academic praise to students. Praise must be public, specific, mathematical, and true.

**Why?**
Offering public, authentic praise to students help flatten the air of the classroom. Rather than students being elevated above the rest, offer insights into all students as if a mathematician.

**Practice active caring**

Active caring demonstrate unique care for each individual student on a personal level. It demands a two-way relationship wholly independent of a students' academic proficiency or social standing.

**Why?**
Most teachers demonstrate passive caring, in that they care generally about their students. They don't actively dislike students, and may even have positive relationships with a few (often those who are hard working or have a magnetic personality).

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