CAGT, October 2017

The Role of Mindset in Developing Mathematical Talent

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I notice…

I wonder…

0	none
1	0
2	1
3	10
4	2
5	100
6	11
7	1000

8	3
9	20
10	101
11	10000
12	12
13	100000
14	1001
15	110

adapted from *Advanced Common Core Math Explorations:Factors and Multiples*
by Jerry Burkhart, Prufrock Press, 2014

Every child deserves an equal opportunity to struggle.

Mary Slade

Do you know talented math students who…

are perfectionists?

give up quickly when they get stuck?

have meltdowns on difficult tasks?

rush to finish their work?

"show off" their knowledge and speed?

underperform in order to avoid challenge?

know answers but don’t explain their process?

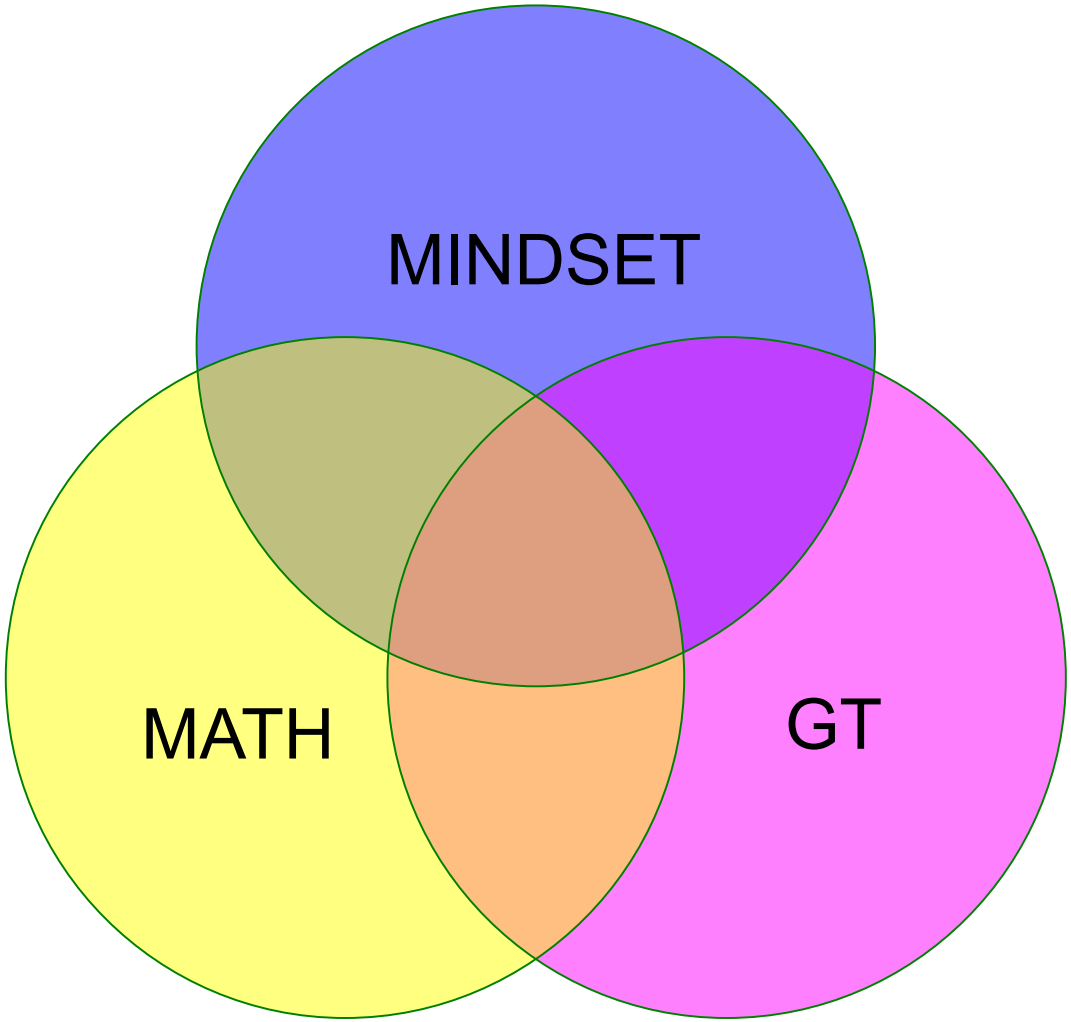
Goals

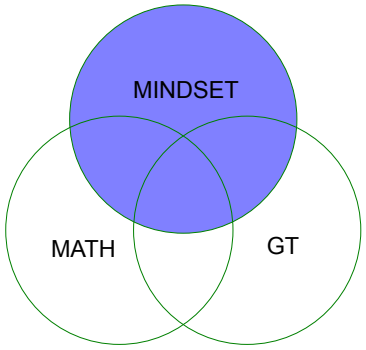
Explore relationships between mindset, giftedness, and math.

Apply this knowledge to support advanced learners:

- Develop growth mindset.
- Select problems and activities.
- Introduce problems and activities.
- Support students with problems and activities.
- Assess students' work.

The Big Picture



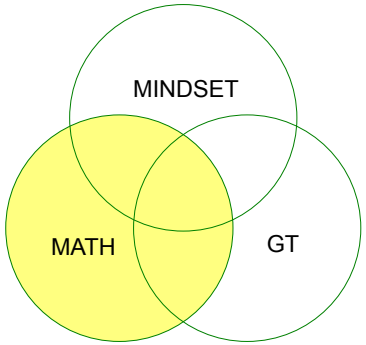


Mindset

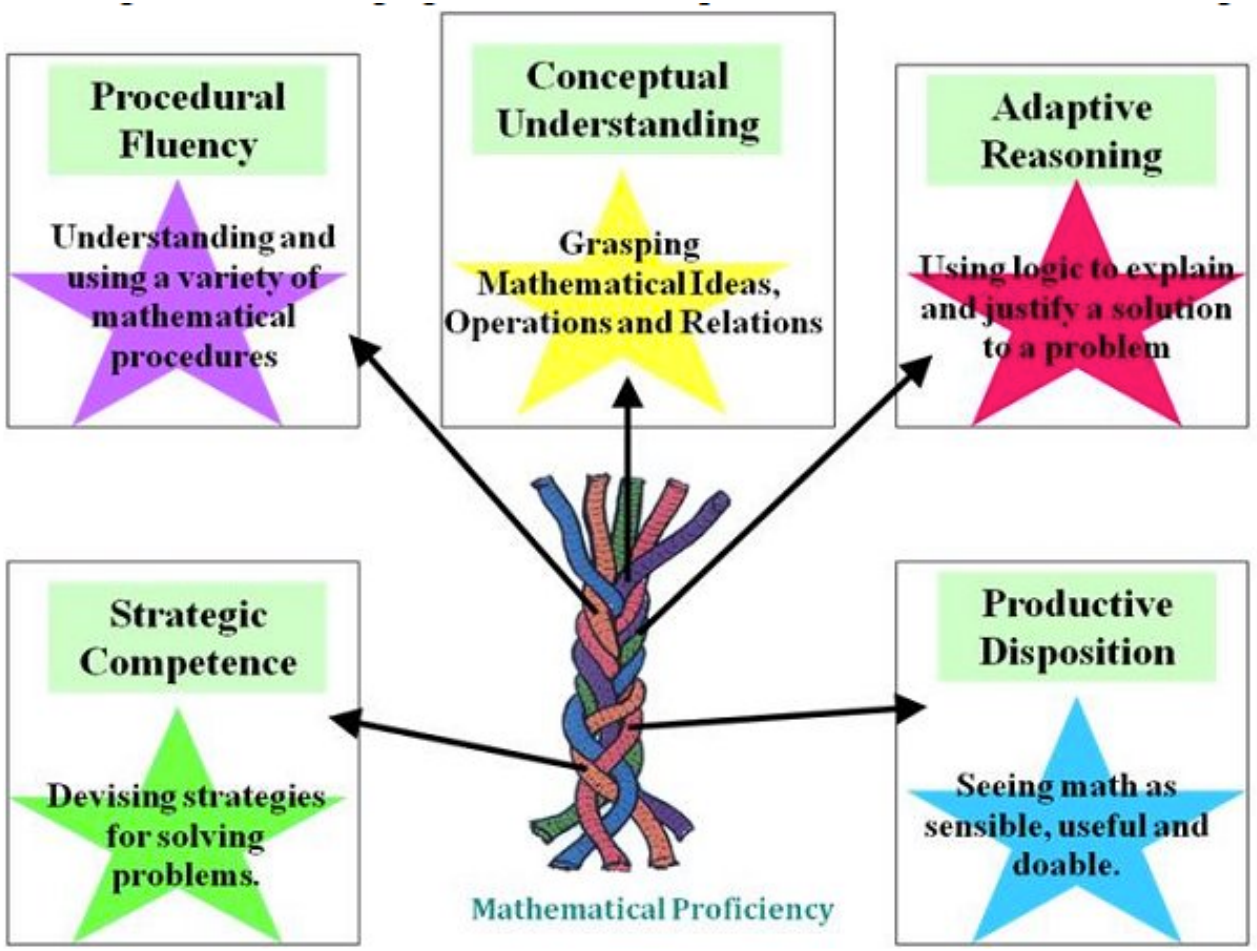
Carol Dweck, 2008

Fixed mindset Intelligence is static. Therefore, I…	Growth mindset Intelligence can change. Therefore, I…
avoid challenges.	embrace challenges.
give up easily.	persist in the face of setbacks.
see effort as fruitless or worse.	see effort as a path to mastery.
ignore negative feedback.	learn from criticism.
feel threatened others' success.	find lessons and inspiration in others' success.

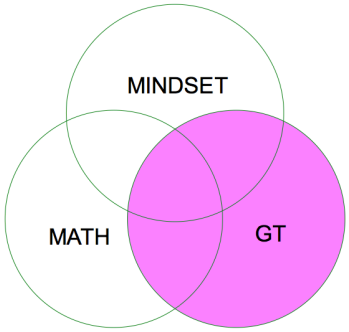
text adapted from a graphic by Nigel Holmes, see nigelholmes.com



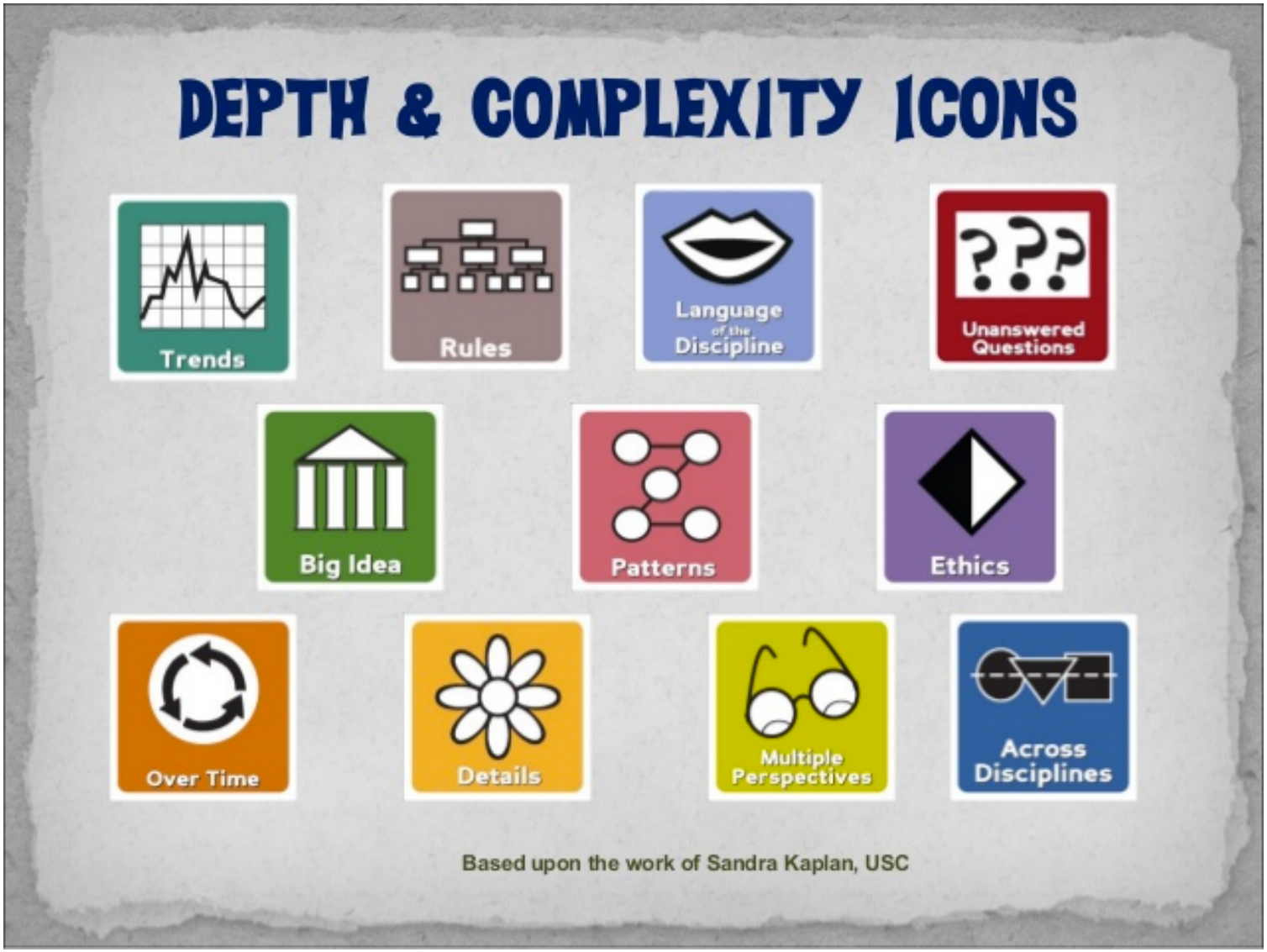
Mathematical Proficiency

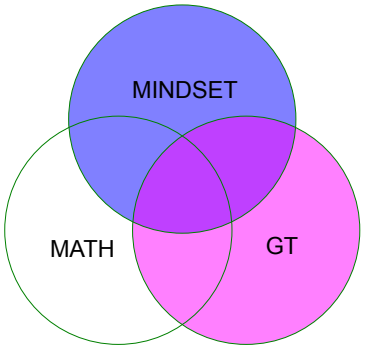


Adding It Up, National Research Council, 2001 (Penn-Delco School district website, www,pdsd.org/Page/138)



Kaplan's Icons

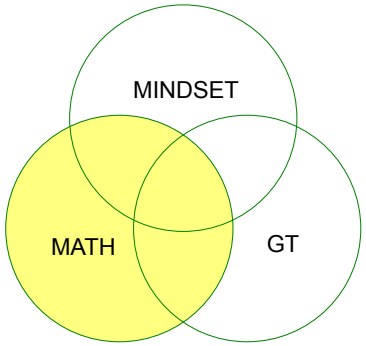




Mindset and Giftedness

"It is important to note that even students who have always gotten good grades may have a fixed mindset. These higher-achieving students are often concerned about how smart they appear to be, so they prefer tasks that they can already do well and try to avoid tasks in which they may make mistakes."

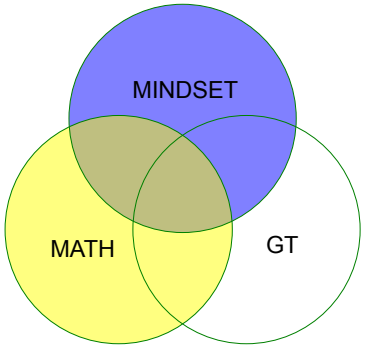
Principles to Actions: Ensuring Mathematical Success for All
National Council of Teachers of Mathematics, 2014



What do you believe?

The subject of math is…

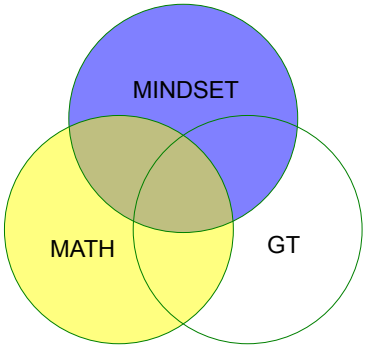
about learning procedures.
about getting correct answers.
about thinking logically.
linear / step-by-step.
skills-based.
left-brain.
concrete.
hard.



The Special Case of Math

"Informally, we have noted in our research that students tend to have more of a fixed view of math skills than of other intellectual skills."

Mindsets and Math/Science Achievement, Dweck, 2008

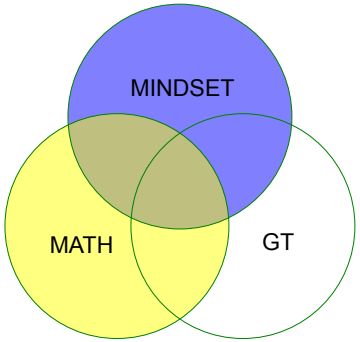


Personal statements about math ability

”I was never good at math.”

"I'm a _____ person, not a math person.”

“I used to be good…”



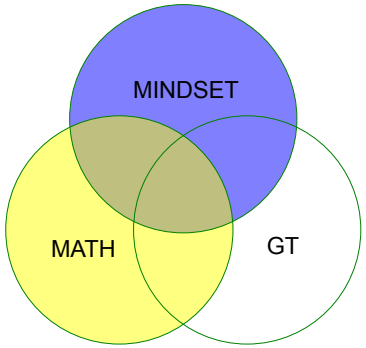
Personal statements while doing math

“I can’t remember how to do this kind of problem.”

”I understand the concept. I just don’t know what the problem is asking.”

"I can do the steps if you just show me how.”

"I know the answer, but I don't know how I got it.”



Research

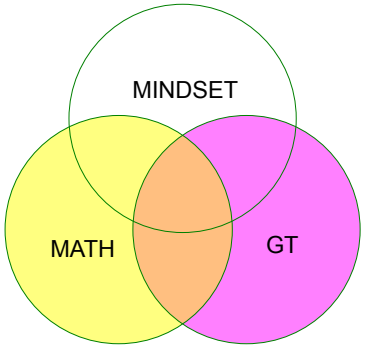
Mindsets can predict math/science achievement over time.

Mindsets can contribute to math/science achievement discrepancies for women and minorities.

Interventions that change mindsets can boost achievement and reduce achievement discrepancies

Educators play a role in shaping students' mindsets.

Mindsets and Math/Science Achievement, Dweck 2008



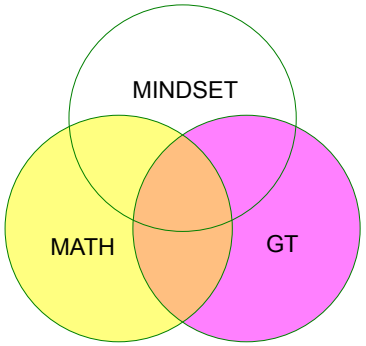
Images of giftedness in math

Does complex calculations quickly/accurately/mentally

Gets ‘A’s in math

Doesn’t have to work hard in math

Social, gender, race, stereotypes



Research on giftedness in math

Loves to explore patterns

Organizes and categorizes information

Has a deep understanding of simple concepts

Thinks logically and develops convincing arguments

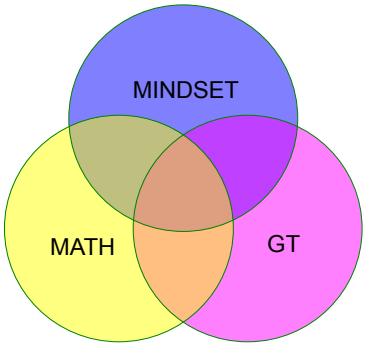
Processes information flexibly

Digs beyond the surface of a problem

Wants to know “why” and “what if”

Generalizes structure from few examples

selected and adapted from *Extending the Challenge in Mathematics*, Linda J Sheffield, 2003



Mindset-Oriented Strategies for Developing Mathematical Talent

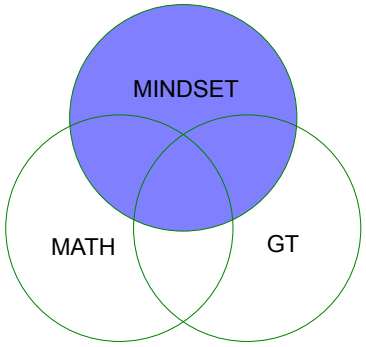
Developing a growth mindset

Choosing activities

Introducing activities

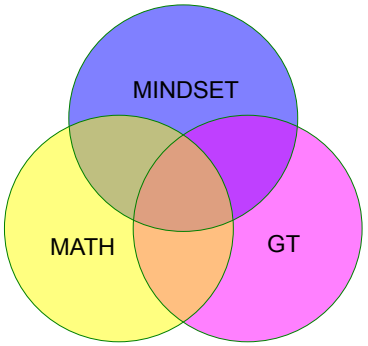
Supporting the problem solving process

Assessing student work



Developing a Growth Mindset

1. Learn to hear your fixed mindset “voice.”
2. Recognize that you have a choice.
3. Talk back with a growth mindset voice.
4. Take the growth mindset action.



Choosing Activities

Activities that promote growth mindset…

take time to solve.

are open-ended.

have multiple points of entry and exit.

have multiple solution or strategies.

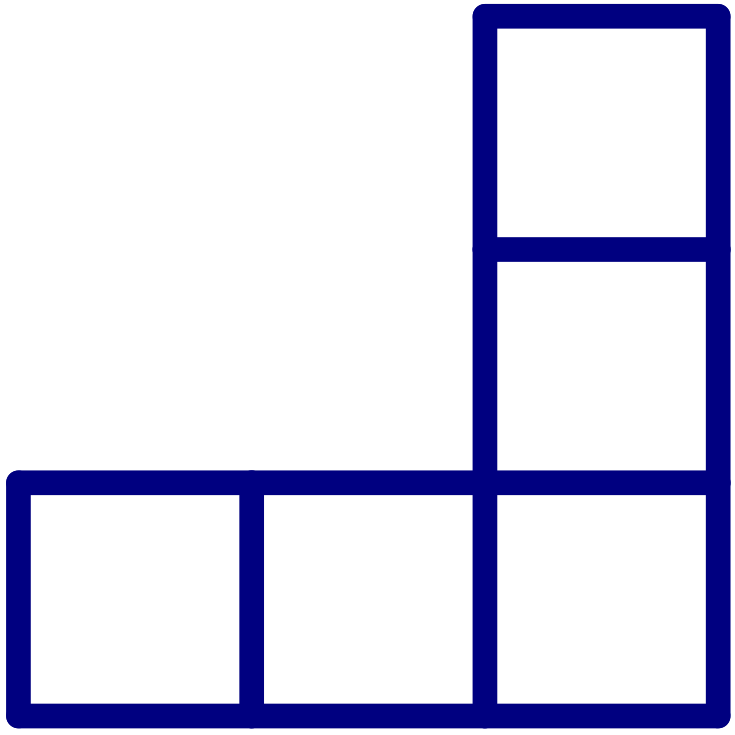
involve mathematical communication.

create "productive frustration."

have possibilities for further exploration.

I notice… *I wonder…*

1, 2, 3, 4, 5

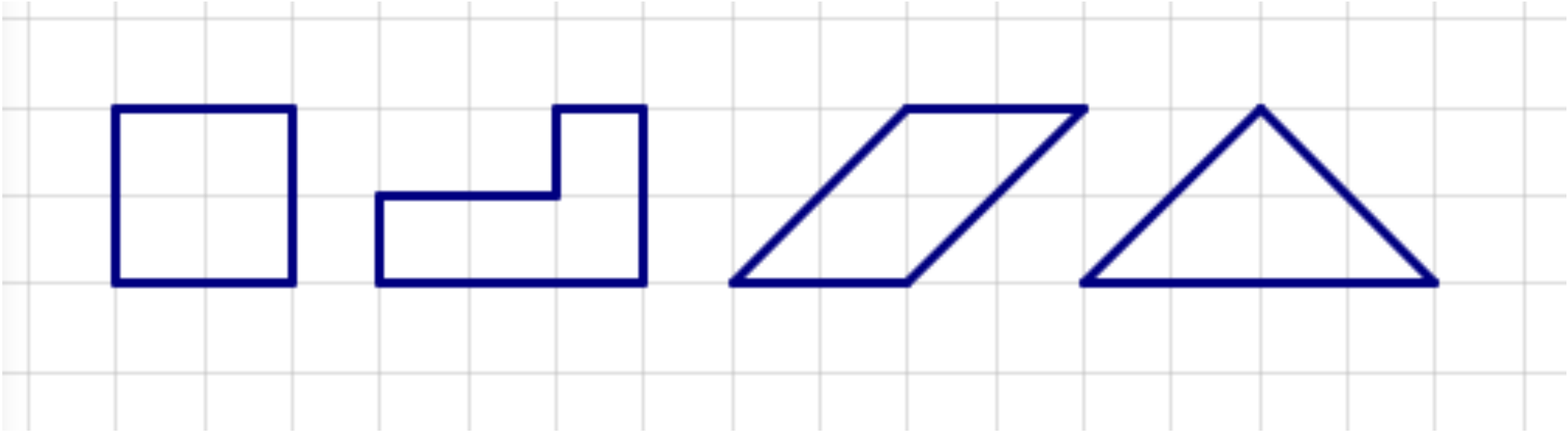


rom *Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Students*
by Linda Jensen Sheffield, Corwin Press: 2003

I notice… *I wonder…*

x 4 ÷ 8

I notice… *I wonder…*



I notice… *I wonder…*

·	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

I notice… *I wonder…*

$$\frac{3}{5} \quad \frac{11}{18} \quad \frac{8}{13} \quad \frac{13}{21} \quad \frac{5}{8}$$

Advanced Common Core Math Explorations: Ratios, Proportions, and Similarity by Jerry Burkhart. Prufrock Press, 2016. Used by permission.

I notice… *I wonder…*

Bristlecone School District data

Mountain Heights Middle School:

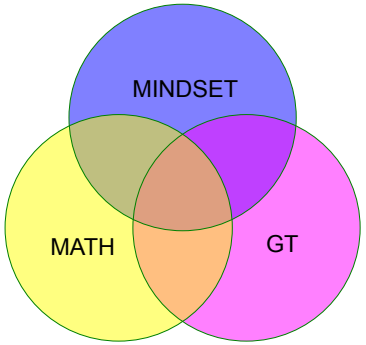
51,600 square feet of floor space

470 students

North Star Middle School:

118,300 square feet of floor space

725 students



Introducing Activities
Overview

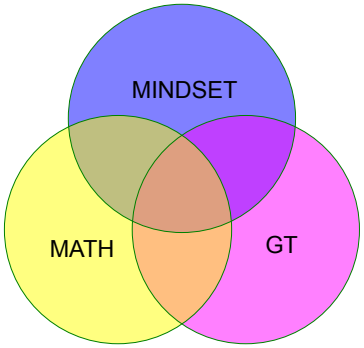
Let students know what to expect in advance.

Make it clear what you value.

Tell students how you will support them.

Ensure that students have the background knowledge.

Doing this in advance is more effective than reacting later.



Introducing Activities

Let students know what to expect.

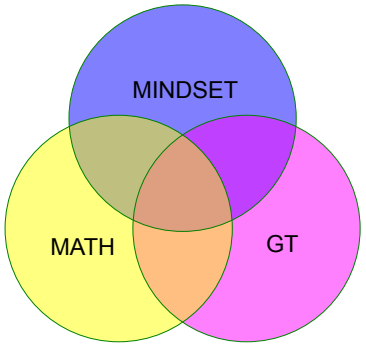
It will take a long time.

You will probably get stuck.

You may not get everything right.

You may not finish.

Showing progress matters more than perfection.



Introducing Activities

Make it clear what you value.

exerting effort

making progress

producing creative ideas

thinking of new questions to ask

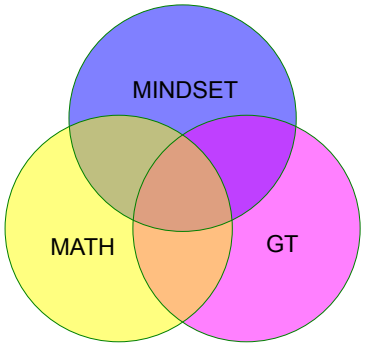
justifying your answers

clear explanations

making connections

using math vocabulary precisely

These expectations give more control to students!



Introducing Activities

Tell students how you will support them.

Tell them when they may approach you.

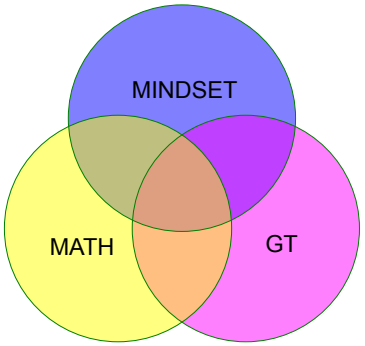
Encourage them to collaborate.

Help them clarify questions.

Help them put their thoughts into words.

Help them manage frustration.

Offer guiding questions or hints (sometimes).



Supporting the Problem Solving Process

Create conversation around *students*' ideas.

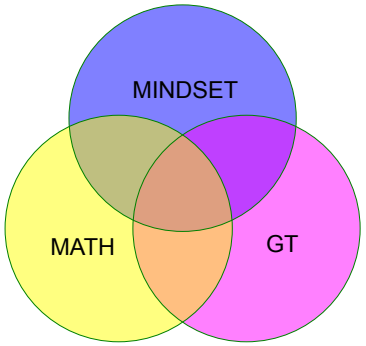
Talk about errors and how to learn from them.

Ask students to critique each other's ideas.

Talk about mindset, feelings.

Give strategies for managing frustration.

Do not rescue students when they get stuck.



Assessing Student Work

Praise *effort (*not ability).

Praise *process* (not answers).

Assess *process* goals—not just answers.

Write specific, thoughtful comments.

Focus your comments on *growth* and *progress*.

Suggest new questions to think about.

Ask students to reflect on their experience.

A final quote

"It is very important to give process feedback to the most able students, who as suggested above, have often coasted along, gotten good grades, and been praised for their intelligence. These may be the very students who opt out when the work becomes more difficult. They may not know how to exert effort or they may not want to start exerting effort, since it threatens their sense of their giftedness. Thus it is essential for educators to put the emphasis on process for students who are used to relying on their talent or gift."

Dweck, *Mindsets and Math/Science Achievement*, 2008, www.opportunityequation.org

Resources

- *Mindset: How You Can Fulfill Your Potential* by Carol Dweck. Robinson, 2006.
- *Mathematical Mindsets* by Jo Boaler Jossey-Bass, 2016.
- *Advanced Common Core Math Explorations* book series by Jerry Burkhart. Prufrock Press, 2014-2017

Supporting each other's work

Share questions, ideas, and/or classroom experiences.

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