

High School Math Pathways Symposium

Mathematical Modeling and Reasoning: An Advanced Quantitative Reasoning Course



Nov. 9-10, 2021

What is Quantitative Reasoning?

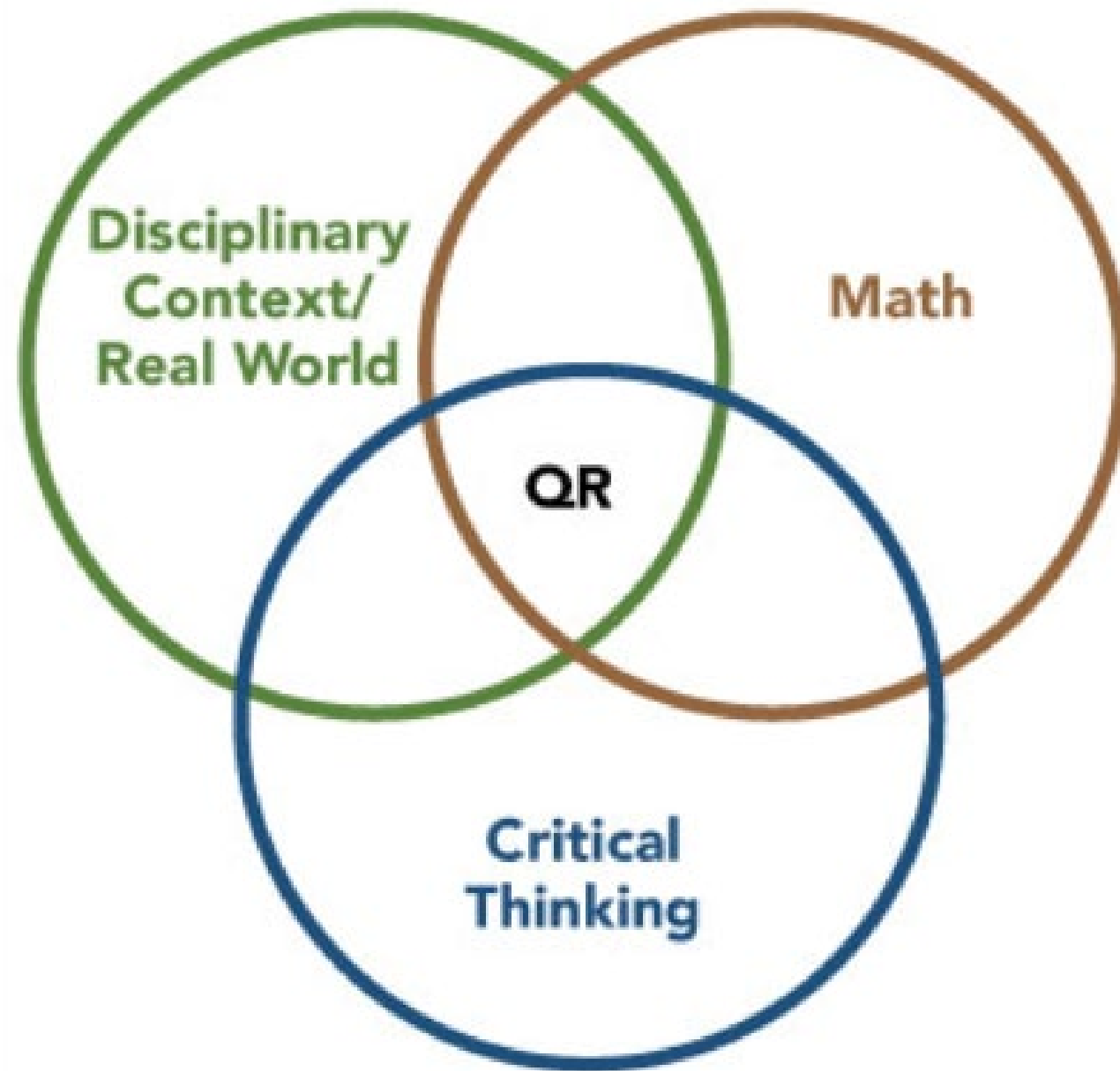


Definition of QR

“Quantitative reasoning (QR) is the application of basic mathematics skills, such as algebra, to the analysis and interpretation of real-world quantitative information in the context of a discipline or an interdisciplinary problem to draw conclusions that are relevant to students in their daily lives. It is not just mathematics.”

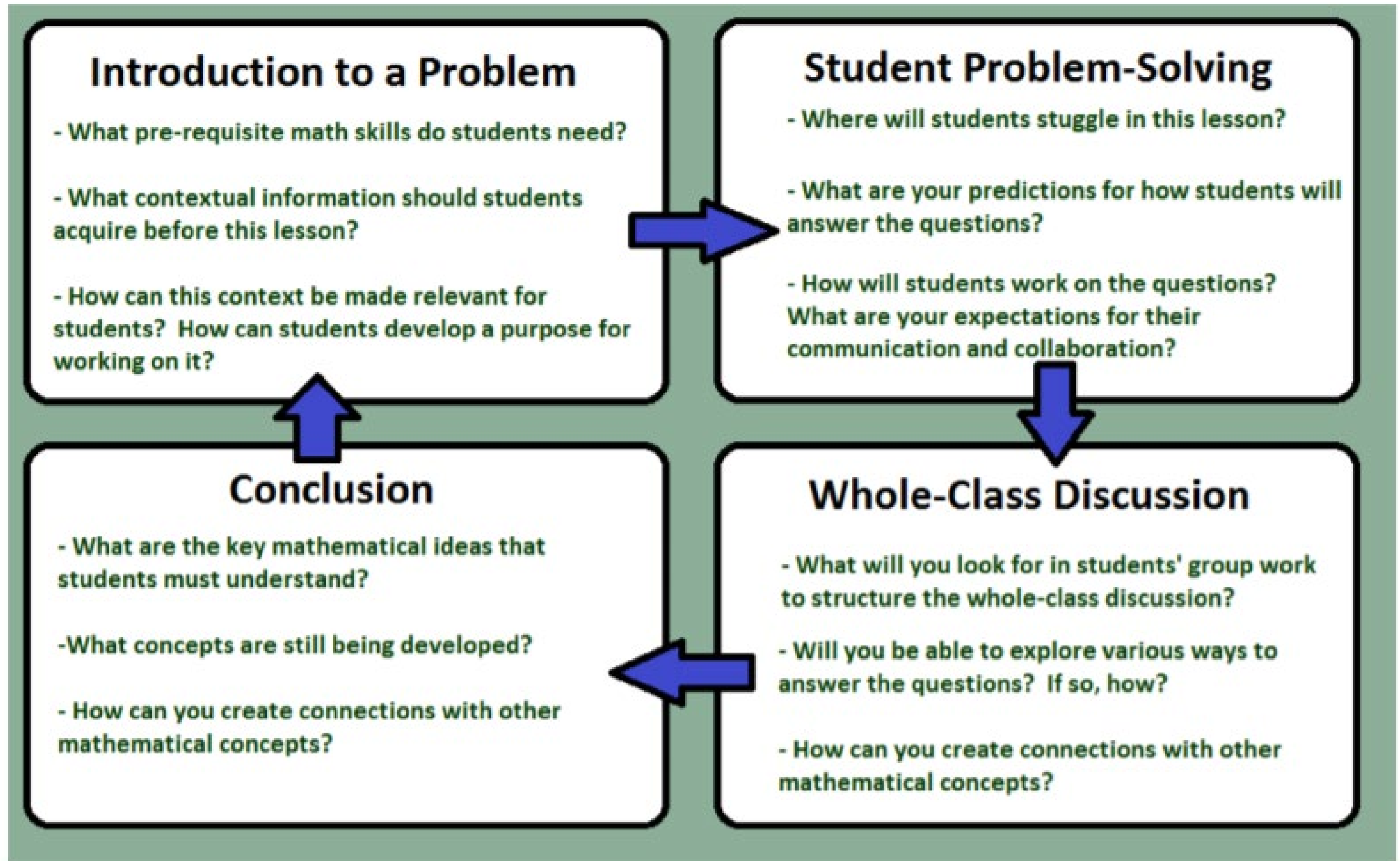
From Susan Elrod, “Quantitative Reasoning: The Next “Across the Curriculum” Movement,” Peer Review, Summer 2014, 16, 3: Retrieved from: <https://www.aacu.org/peerreview/2014/summer/elrod>

Figure 1. QR within the Undergraduate Curriculum

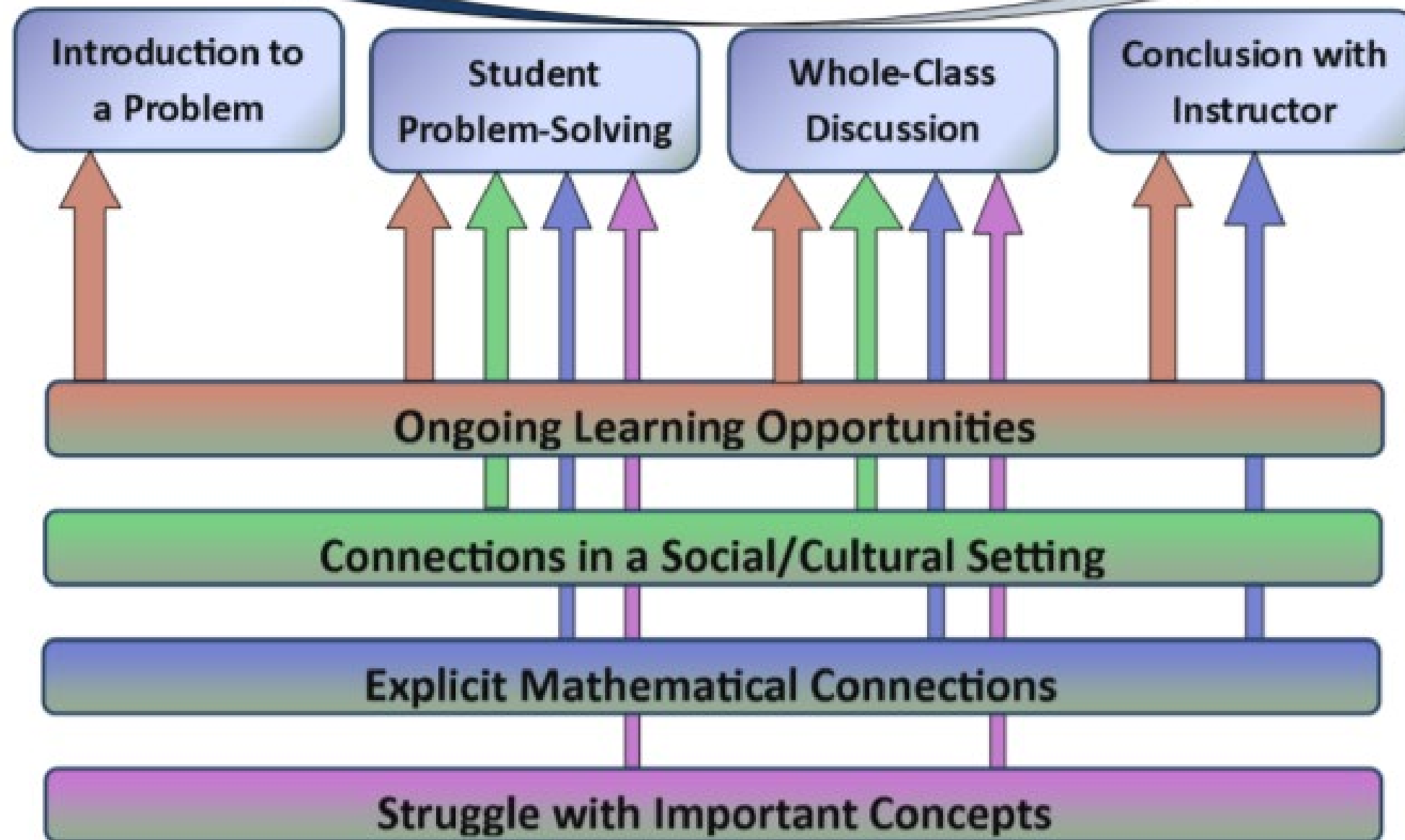


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Quantitative Reasoning



In-Class Learning



Quantitative Reasoning

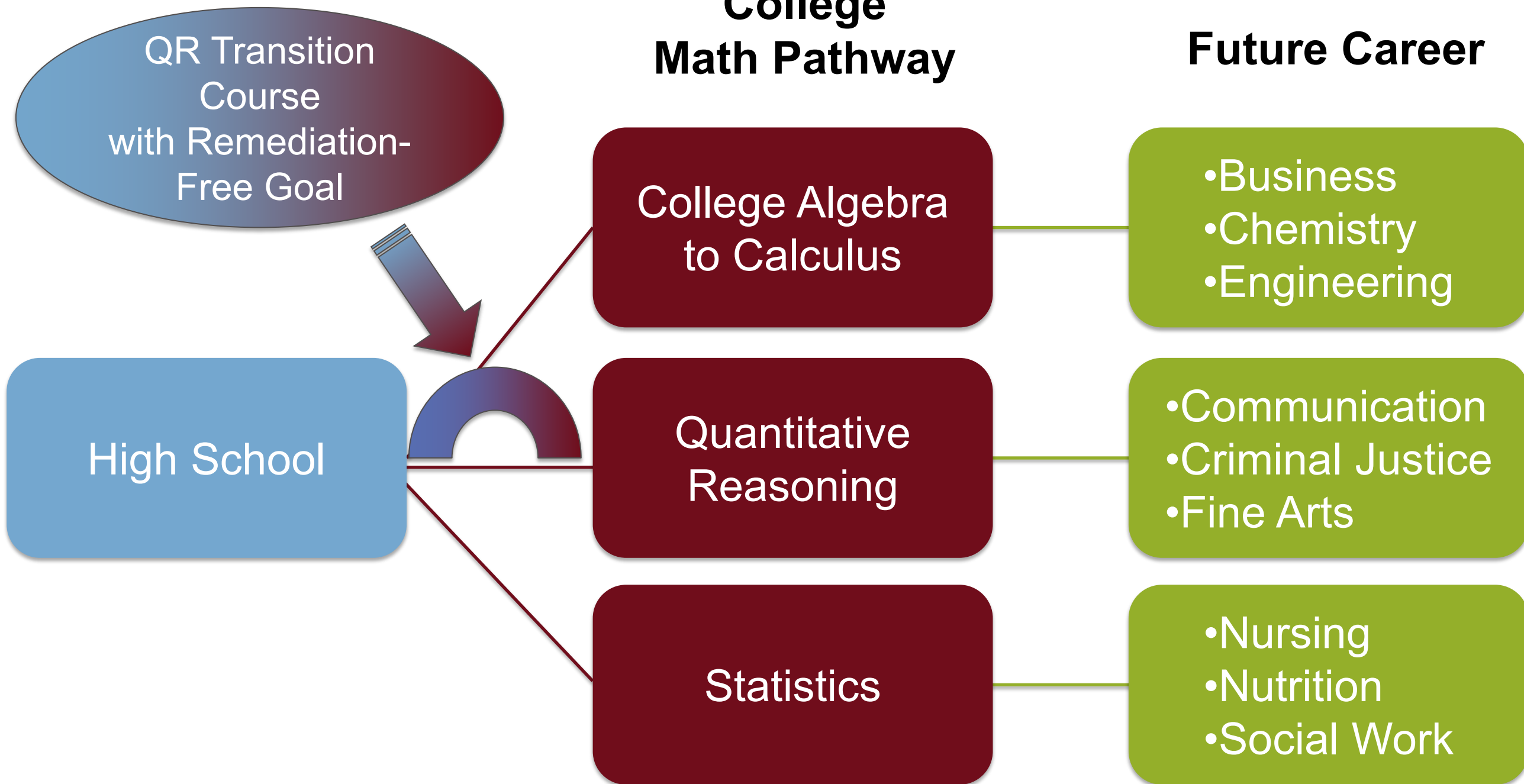
Traditional Mathematics Class	Quantitative Reasoning Class
Skill driven with concepts applied	Concept driven with skills applied
Practice and then apply	Apply and then practice
Context removed, solve problem, insert context	Problem cannot be solved without context
Behaviorist approach	Inquiry based
Teacher-centered	Student-centered
Individual-centered	Team-centered
Communication optional	Communication essential
Objects of study are abstract	Objects of study are data
For specific, high-level STEM careers	For all careers, and essential for good citizenship and personal finance decisions

Description of Course

This course is designed to promote **reasoning**, **problem-solving** and **modeling** through thematic units focused on the mathematical practices while reinforcing and extending content in Number and Quantity, Algebra, Functions, Statistics and Probability, and Geometry.

Math Practices

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.



Follow-on Courses

- CCP Quantitative Reasoning
- AP Statistics
- CCP Introductory Statistics
- CCP Technical Mathematics I
- CCP Mathematics in Elementary Education I
- CCP Introduction to Data Science
- Algebra 2
- Another Math Pathways Course



Equity

For purposes of **equity**, the **rigor** of this course must be maintained! This is a more relevant pathway with a different type of pedagogy, not a “less than” pathway.

Rigor

“Students use mathematical language to communicate effectively and to describe their work with clarity and precision. Students demonstrate how, when, and why their procedure works and why it is appropriate. Students can answer the question, ‘How do we know?’”

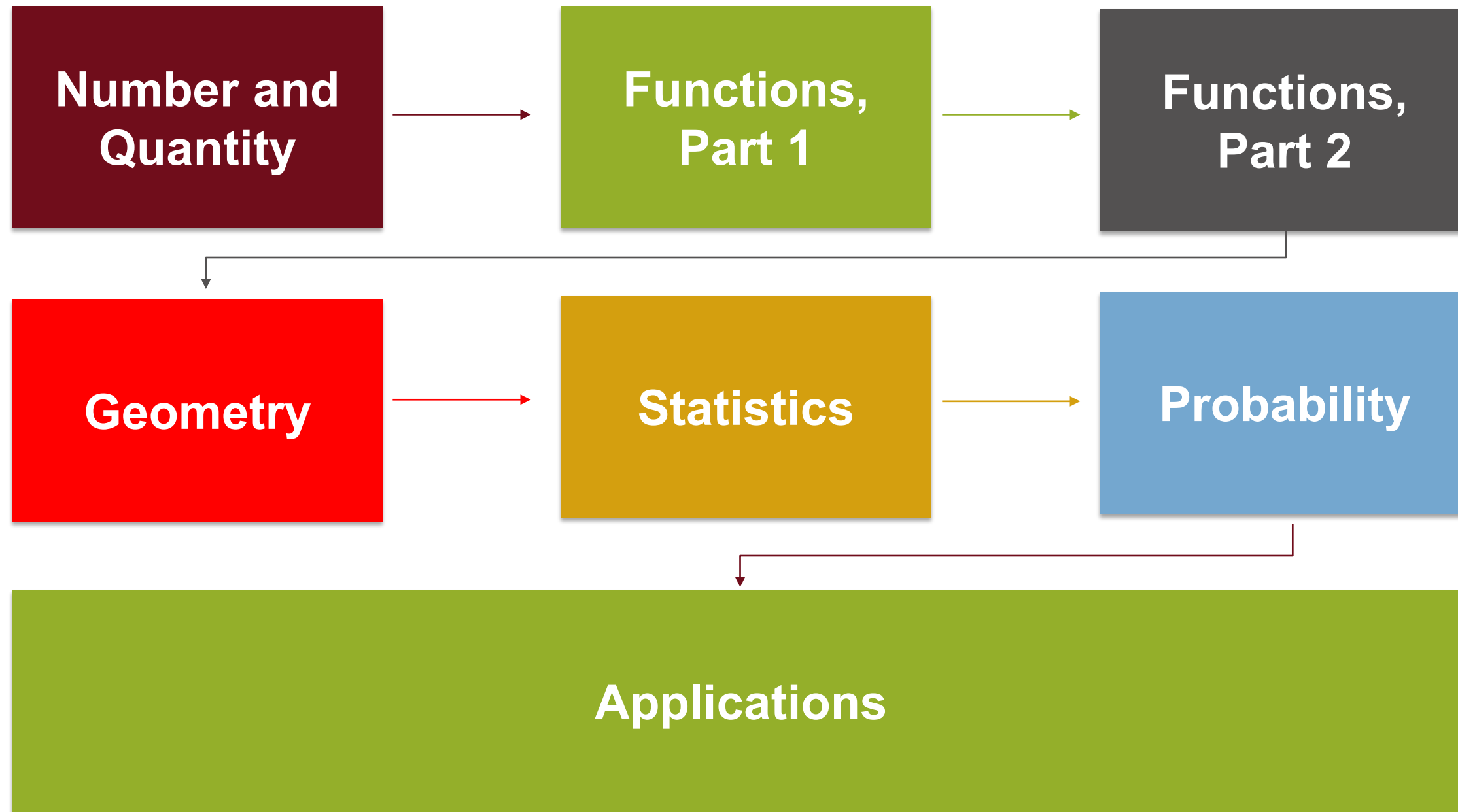


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Rigorous courses are...	Rigorous courses are not...
Defined by complexity, which is a measure of the thinking, action, or knowledge that is needed to complete the task	Characterized by difficulty, which is a measure of effort required to complete a task
Measured in depth of understanding	Measured by the amount of work
Opportunities for precision in reasoning, language, definitions, and notation that are sufficient to appropriate age/course	Based on procedure alone
Determined by students' process	Measured by assigning difficult problems
Opportunities for students to make decisions in problem solving	Defined only by the resources used

Rigorous courses are...	Rigorous courses are not...
Opportunities to make connections	Taught in isolation
Supportive of the transfer of knowledge to new situations	Repetitive
Driven by students developing efficient explanations of solutions and why they work, providing opportunities for thinking and reasoning about contextual problems and situations	Focused on getting an answer
Defined by what the student does with what you give them	Defined by what you give the student

Themes



Theme 0

- Growth Mindset
- Launching Lessons
- Mindsets
- Math Practices
- Routines
- Convincing, defending, proof



Overview of Numbers and Quantity

1

Farm Swap

2

Remodeling
the
Classroom

3

Gears

4

Driving for
Gas

5

Planning a
Road Trip

6

Credit
Cards

Functions-Part 1



Functions-Part 2

14

Catapult
Project

15

Modeling
Cancer
Cells

16

Buying a
House

17

Skid
Mark Trial

18

Big Fish
Story



Overview of Geometry

19

Design Logo

20

Working with
Triangles

21

Designing a
Mini-gold
course

22

Unraveling
the Unit
Circle



Overview of Statistics

24

Misusing
Statistics

25

Flinging
Frogs

26

M&Ms
Sampling
Distributions

27

What Does
Normal
Distribution
Sound Like?

28

Colors
Challenge

29

Double-Stuf
Oreos



Overview of Probability

30

Taste Test
Challenge

31

Random
Babies

32

Thinking
about False
Positives

33

Carnival
Games

Applications

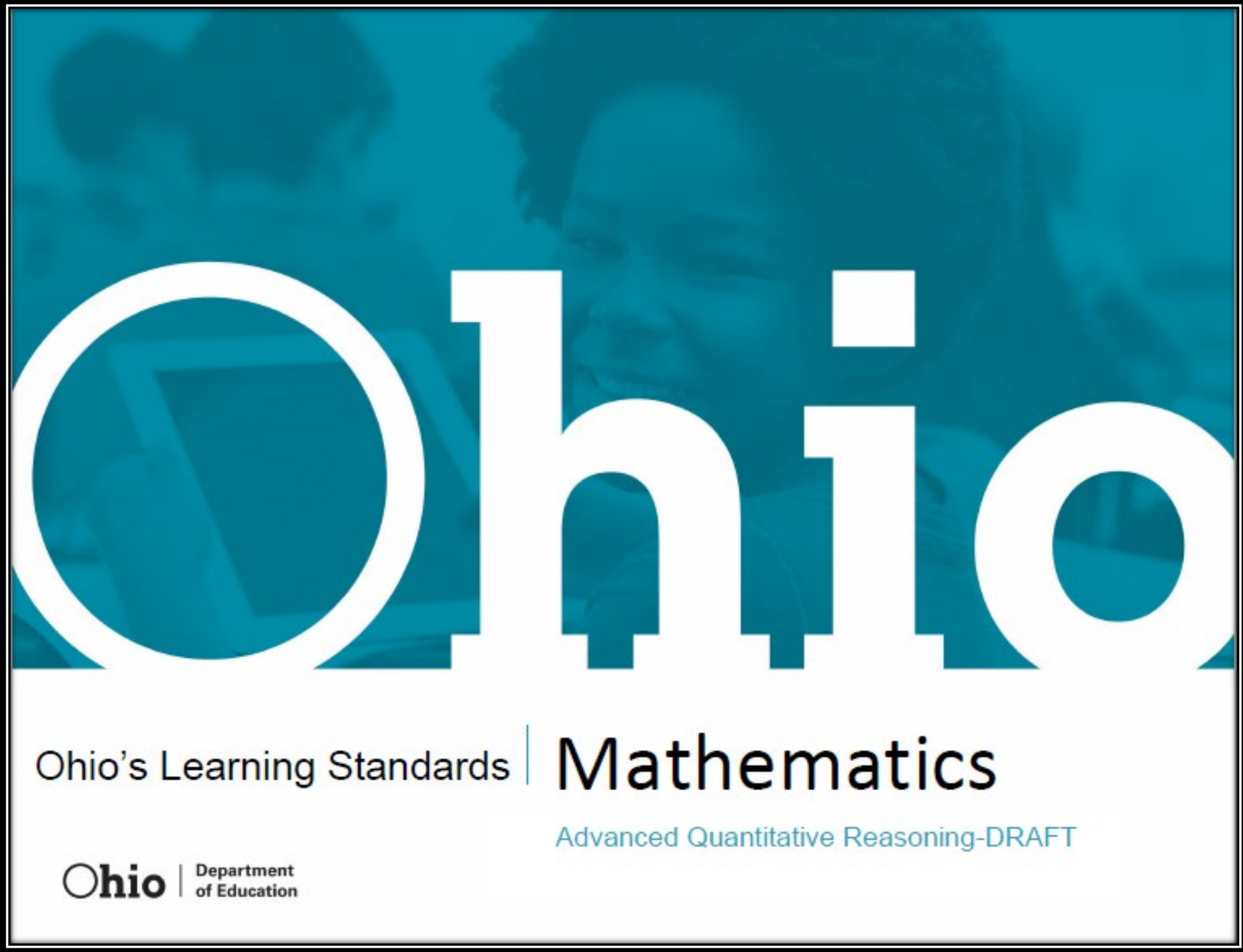
34

Inflation and Consumer Price Index

35

Public Policy





Advanced Quantitative Reasoning Standards

Act Blueprint

Reporting Category	Reporting Subcategory	# of Items	% of Test
Integrating Essential Skills (topics learned before 8 th grade using higher complexity)		24-26	40-43%
Preparing for Higher Mathematics		34-36	57-60%
	Number & Quantity	4-6	7-10%
	Algebra	7-9	12-15%
	Functions	7-9	12-15%
	Geometry	7-9	12-15%
	Statistics and Probability	5-7	8-10%
Modeling		<u>≥16</u>	<u>≥27%</u>
Total		60	100%

As our group did an analysis, most ACT standards in the 28-32 range are below A2.

Students said...

“This is the first time—
...math isn’t my problem class.”
...I understand.”
...math makes sense.”
...I like math.”

A student said...

“I have been able to use my debate skills and have had a better improvement in my chemistry grade because of learning the same problems in this class.”

Another teacher said...

“What’s DY* doing at the board? He’s actually doing work for you! He always sleeps in my class. Any class that makes DY* work must be good, so I need to be in this class.”

Pilot Teacher said...

“The class is more rigorous and engaging and thought-provoking than my pre-calculus class.”

Pilot Teacher said...

“Although I always knew this was the way I was supposed to teach, I didn’t realize that it would make such a huge difference. My students are now excited and eager to try new things and remembering things that they try.”

Pilot Teacher said...

“My kids can read the problem or task now, know what questions they want to answer and know what information they need to find and are able to work independently.”

Student Voices

Teacher Voices



@OHEducation



**Share your learning
community with us!**

#MyOhioClassroom



Celebrate educators!

#OhioLovesTeachers