

# High School Pathways and Data Science

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Draft California Mathematics Framework 2021

June 1, 2021

*Hosted by the California Mathematics Council*

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2021 Framework  
Writing Team:



## Today's Session: *High School Pathways and Data Science*

- Brief Framework overview
- Designing instruction around big ideas (briefly)
- Explore high school pathways guidance
- Introducing Data Science for K-12

# Framework Revision and Adoption Process and Timeline

Phase 1: (Aug – Dec. 2019) Focus groups, approval of Framework Guidelines, recruitment of CFCC, draft outline of entire framework

Phase 2: (Jan. 2020 – Dec. 2020) Writing team drafts chapters to CFCC for review and direction for revision, revisions re-submitted for CFCC approval

Phase 3: (Jan. 2021 – Nov. 2021) Instructional Quality Commission, Math Subject Committee, Public Comment Periods

- First public comment period: Feb 8 – April 8, 2021
- Revisions based on Public Comment Period 1
- Second public comment period: late June–August, 2021

Phase 4: State Board Discussion and Approval: November 3–4, 2021

Phase 5: Roll-out -- Statewide Launch Webinar in Feb/March; anticipated local roll-out to follow (needs your advocacy :) )

# Proposed CA Math Framework 2021 Table of Contents

Chapter 1. Introduction

Chapter 2. Teaching for Equity and Engagement

Chapter 3. Number Sense, TK-12

Chapter 4. Exploring, Discovering, and Reasoning With and About Mathematics (SMPs 3/7/8), TK-12

Chapter 5. Data Science, TK-12

Chapter 6. Mathematics: Investigating and Connecting, TK–5

Chapter 7. Mathematics: Investigating and Connecting, 6–8

Chapter 8. Mathematics: Investigating and Connecting, 9–12

Chapter 9. Supporting Equitable and Engaging Mathematics Instruction

Chapter 10. Technology and Distance Learning

Chapter 11. Mathematics Assessment in the 21<sup>st</sup> Century

Chapter 12. Instructional Materials to Support the CA CCSSM

Chapter 13. Glossary: Acronyms and Terms

# 2021 California Mathematics Framework - “The Sophomore Album”

## Major emphases:

- Ch 2 Teaching for Equity and Engagement
  - Instruction planned around big ideas, not individual content standards
  - Students must experience mathematics for a purpose
- Progressions of learning across TK-12
  - Ch 3 Number Sense through TK-12
  - Ch 4 Standards for Mathematical Practice 3, 7, 8
  - Ch 5 Data Literacy through TK-12 and Data Science High School Pathway
- Focus throughout on Mathematics as Investigating and Connecting
  - Grade-banded chapters (Chs 6-8) emphasize flow of topics through consecutive grades
  - Emphasis on access and depth
- Big Ideas via SMPs, Content Connections, and Drivers of Investigation
- Fluency: Ability to select and flexibly use appropriate strategies to explore and solve problems
- MAA/NCTM statement on the push to high school calculus

# Teaching to “Big Ideas”—Just a taste

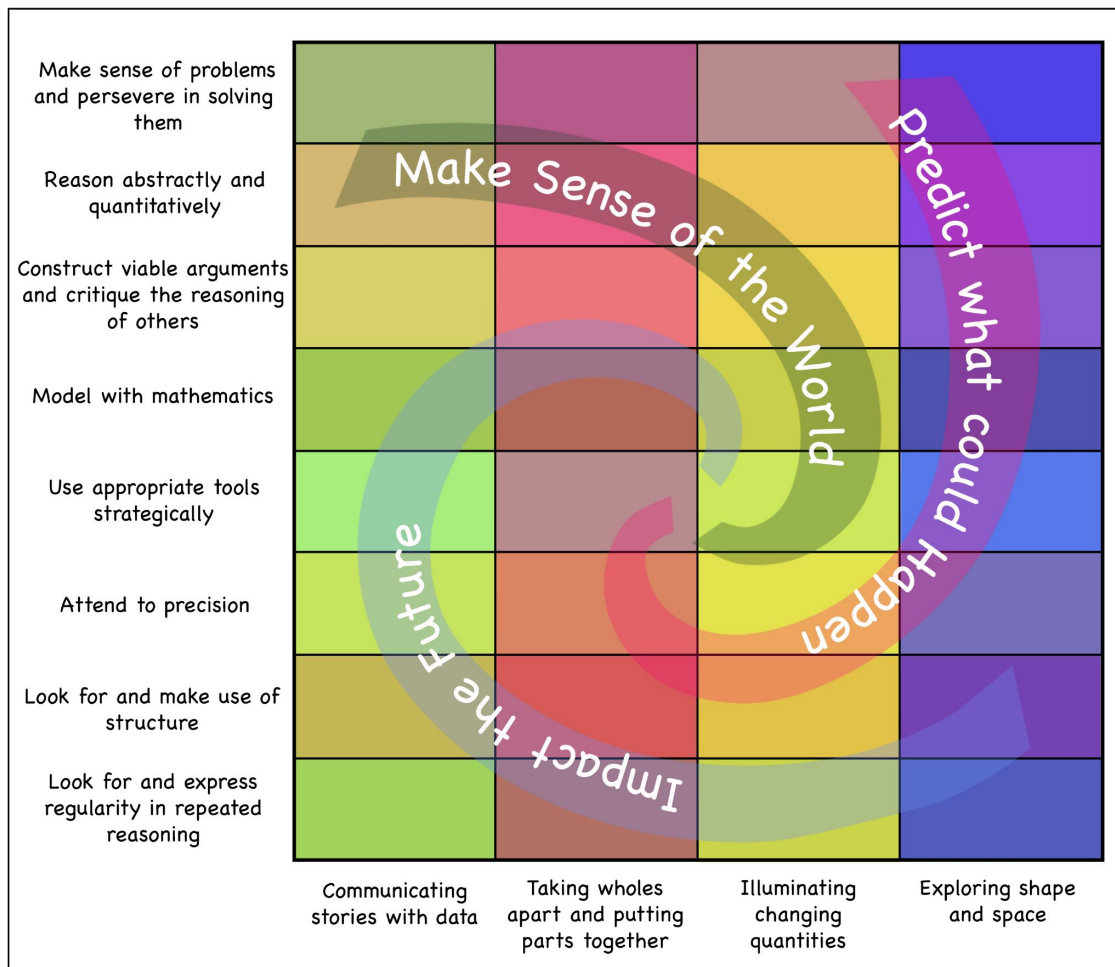
- Rather than organizing teaching at the individual standards level, teaching to Big Ideas highlights important concepts and the ways concepts are connected more fully.
- Using well-designed big idea-based activities, students with widely varied backgrounds and experiences are able to connect with the mathematical work of the lesson
- Approaching instruction through Big Ideas and connections allows time for students to more deeply explore fundamental ideas which can link multiple practice and content standards.
- The same content is actually taught and learned but the organization into Big Ideas allows for a more coherent approach.

(adapted from *What is Mathematical Beauty?* Boaler, Munson, Williams, 2017)

# Component 1: Plan Teaching Around Big Ideas

Big Ideas Motivate and  
Connect

Teach via *big ideas* by pairing content with mathematical practices in the context of an authentic investigation.

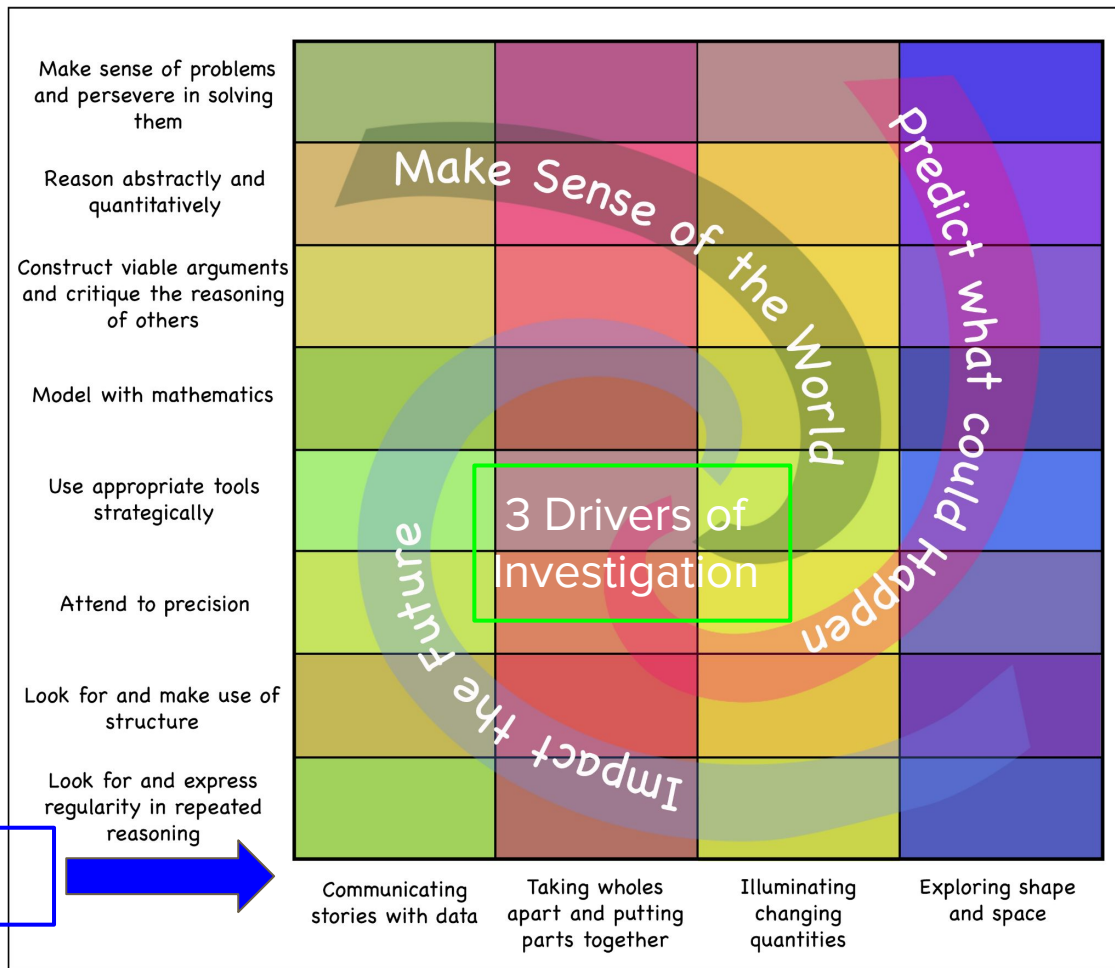
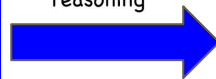


# Component 1: Plan Teaching Around Big Ideas

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4 Content Connections





# Planning instruction around big ideas



<b>Standards for Mathematical Practice</b> “The How”	<b>Content Connections</b> “The What”	<b>Drivers of Investigation</b> “The Why”
<b>Students will...</b> <ol style="list-style-type: none"><li>1. Make Sense of Problems and Persevere in Solving Them</li><li>2. Reason Abstractly and Quantitatively</li><li>3. Construct Viable Arguments and Critique the Reasoning of Others</li><li>4. Model with Mathematics</li><li>5. Use Appropriate Tools Strategically</li><li>6. Attend to Precision</li><li>7. Look for and Make Use of Structure</li><li>8. Look for and Express Regularity in Repeated Reasoning</li></ol>	<b>while...</b> <p>CC1: Communicating Stories with Data</p> <p>CC2: Exploring Changing Quantities</p> <p>CC3: Taking Wholes Apart, Putting Parts Together</p> <p>CC4: Discovering Shape and Space</p>	<b>In order to...</b> <ol style="list-style-type: none"><li>1. Make Sense of the World (Understand and Explain)</li><li>2. Predicting What Could Happen (Predict)</li><li>3. Impacting the Future (Affect)</li></ol>

# Distance Learning Guidance Project

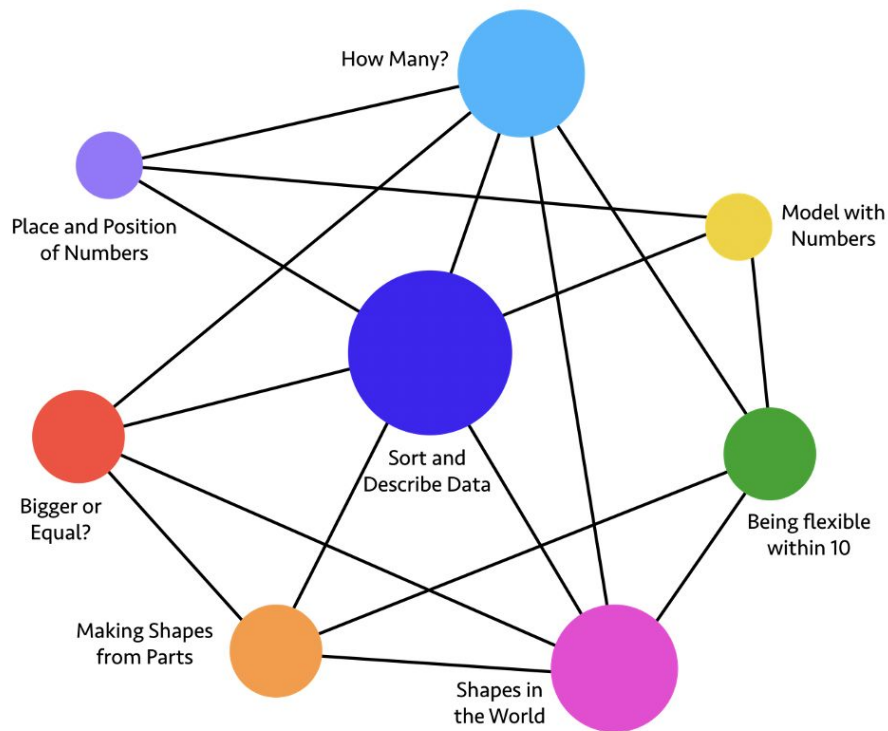
- Approved by the State Board of Education on May 12, 2021
- Three Sections
  - Section A Implementing Research-Based Digital Learning
  - Section B: Standards Guidance for Mathematics (Boaler and Williams)
  - Section C: Standards Guidance for English Language Arts, Literacy, and English Language Development

<https://www.youcubed.org/resource/california-maths/>

# Grade K

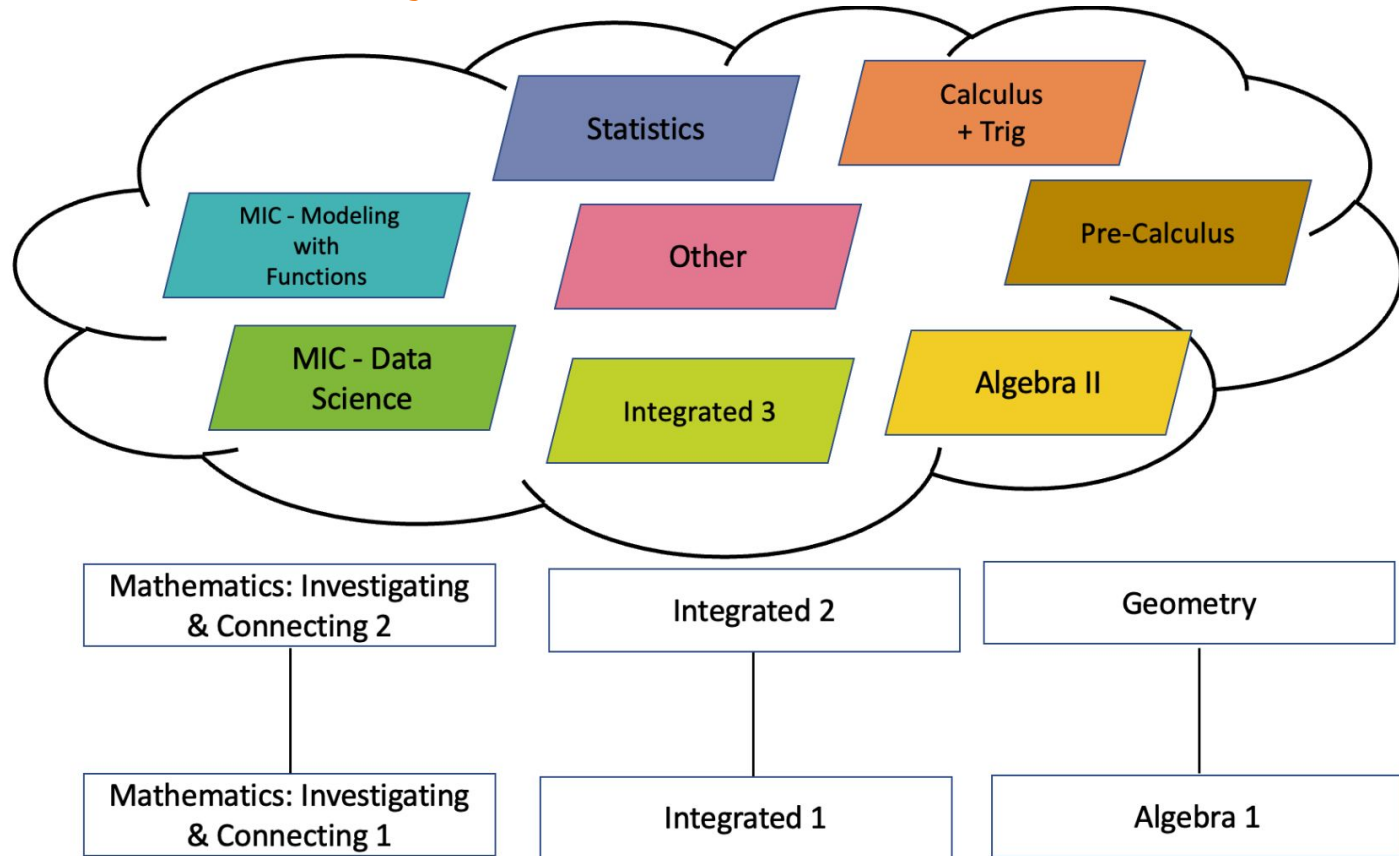
Content Connection	Big Idea	Standards
Communicating Stories with Data	Sort & Describe Data	<b>MD.1, MD.2, MD.3, CC.4, CC.5, G.4:</b> Sort, count, classify, compare, and describe objects using numbers for length, weight, or other attributes.
Exploring Changing Quantities	How Many?	<b>CC.1, CC.2, CC.3, CC.4, CC.5, CC.6, CC.7, MD.3:</b> Know number names and the count sequence to determine how many are in a group of objects arranged in a line, array, or circle. Fingers are important representations of numbers. Use words and drawings to make convincing arguments to justify work.
Exploring Changing Quantities	Bigger or Equal?	<b>CC.4, CC.5, CC.6, MD.2, G.4:</b> Identify a number of objects as greater than, less than, or equal to the number of objects in another group. Justify or prove your findings with number sentences and other representations.
Taking Wholes Apart, Putting Parts Together	Being Flexible within 10	<b>OA.1, OA.2, OA.3, OA.4, OA.5, CC.6, G.6:</b> Make 10, add and subtract within 10, compose and decompose within 10, (find 2 numbers to make 10). Fingers are important.

etc.



**Note: Nodes unpack the Content Connections**

# High School Pathways



# Mathematics: Investigating and Connecting, 9–12

Critique the effectiveness of your lesson, not by what answers students give, but by what questions they ask. —Fawn Nguyen

- Next iteration of *Integrated*
- Designed around big ideas and investigations
- Branching after MIC 2
- Opportunity for *depth* rather than speed
- Broaden high-prestige courses

“Mathematics is never developed in order to answer questions about which the explorer is not curious; and learning mathematics is not much different”

# Defining Integrated

Integrated means both:

- connecting mathematics with students' lives and their perspectives on the world, and
- connecting mathematical concepts to each other—
  
- **not** just interspersing chapters of algebra and geometry

This can result in a more coherent understanding of mathematics. Integrated tasks, activities, projects, and problems are those which invite students to engage in both of these aspects of integration.

# Designing Integration

Common MIC 1 and MIC 2 courses

- Implementations of Integrated I and Integrated II outlines in CA CCSSM

**Branching** after MIC 2

- MIC—Data Science
- MIC—Functions and Modeling

MIC–Data and MIC–Modeling emphasize different types of investigations and allocate student effort differently between the various Content Connections.

# Designing Integration

## Design principles

- Exploration and question-posing *precede* teacher-imposed questions or methods or solution paths
- Elicit, rather than prevent, common mis- or alternative conceptions
- Explicitly interrogate connections with students' experiences or interests
- Content developed through investigation in **authentic contexts**
  - An authentic activity or problem is one in which students investigate or struggle with situations or questions about which they actually wonder.
  - Not an inherent characteristic of a context or task: student-, time-, and implementation-dependent



# Designing Integration: Content connections

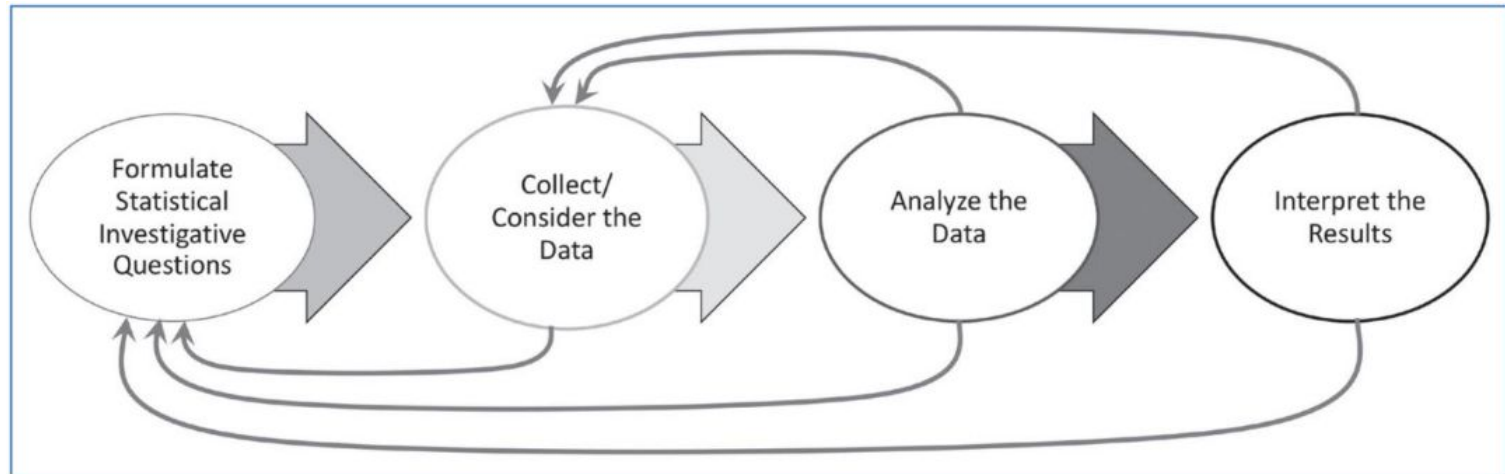
MIC courses are described via Content Connection progressions through the courses, e.g. *Communicating Stories with Data*:

- MIC 1:
  - repeated random processes, keeping track of outcomes, to begin to develop a sense of the likelihood of certain types of events
  - generating authentic questions that data might help to answer
  - opportunities to gather some data to attempt to answer
  - plot data on scatter plots, informally fit linear and exponential functions, use to predict or decide
- MIC 2:
  - build understanding that probability is the basis for statistical claims
  - strength of fit for functions modeling relationships: how much of variability is explained by model?
  - Many types of questions: Interrogating data, Statistical investigative questions, data-gathering questions, etc.

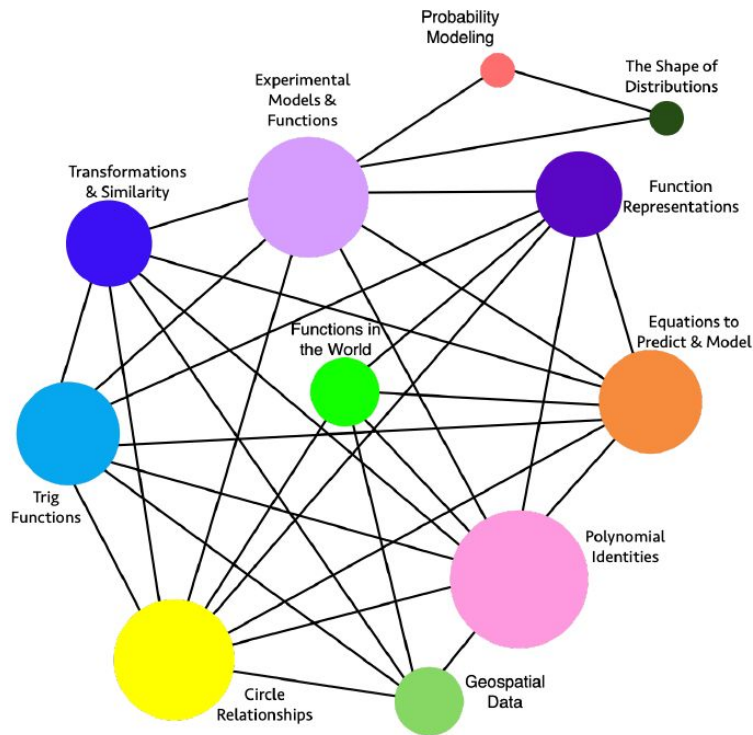
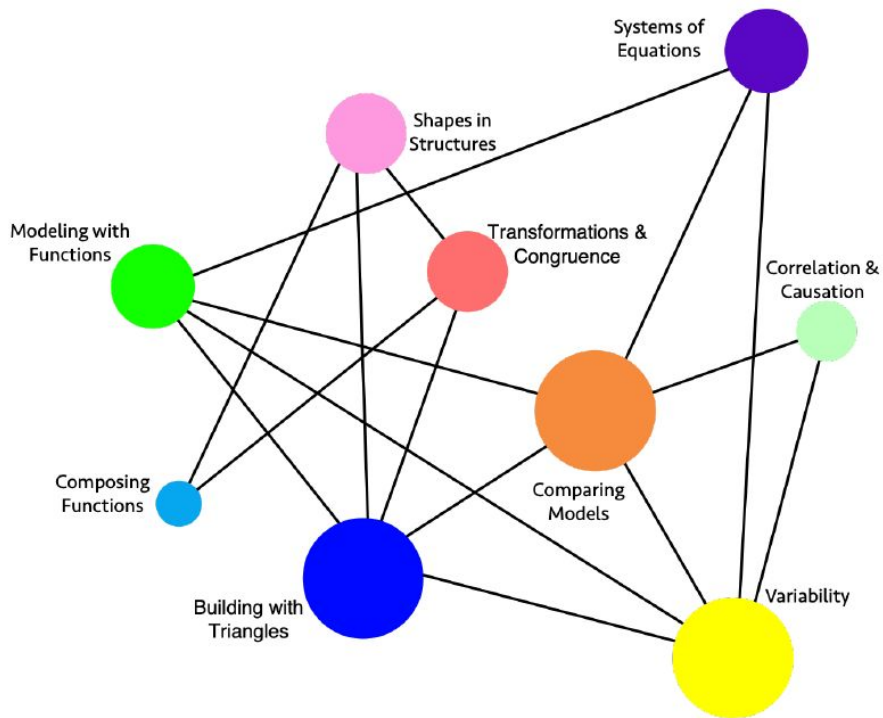
# Designing Integration: Content connections

## *Communicating Stories with Data:*

- MIC-Data:
  - almost all investigations driven by data
  - extensive use of probability to make decisions
  - generate investigative questions, design data collection, construct analysis questions
  - (see GAISE 2, ASA & Framework chapter 5)



# MIC 1 & 2 Big Idea diagrams



# Designing Pathways

Design principles for *pathways*

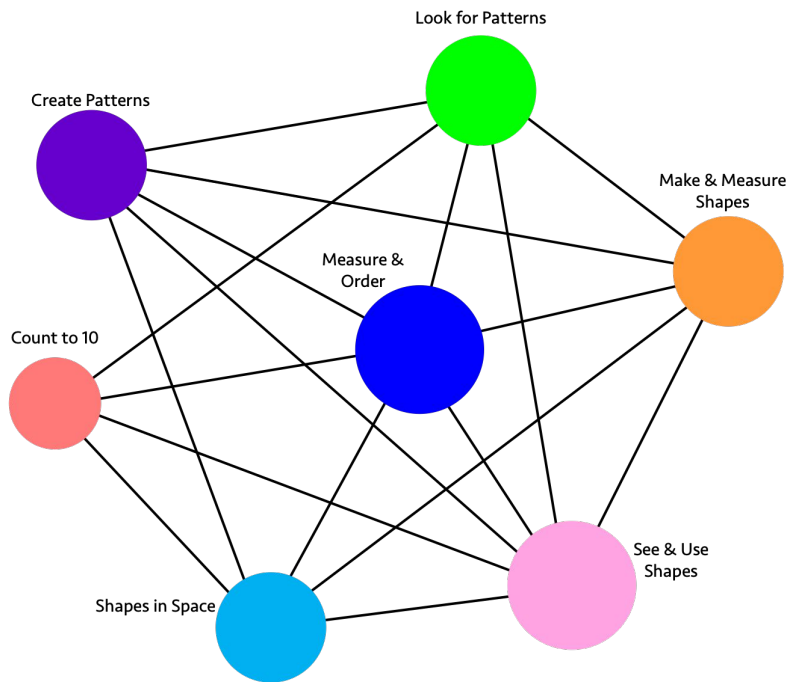
- Common experience for first two HS courses (consistent with *Branching Out: Designing High School Math Pathways for Equity*)
- Flexibility: MIC–Data and MIC–Modeling both provide sufficient preparation for 4th year advanced courses such as Calculus and Statistics
  - No student should be “locked into” (or locked out of) any career/college path after 10th or 11th grade

# Depth, Flexibility, Sense-Making vs More “Advanced” Content

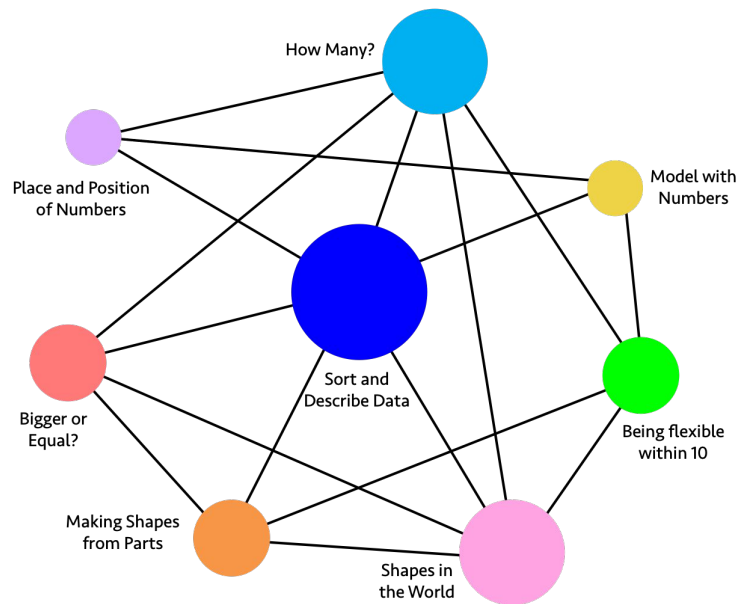
- Mismatches between
  - HS teachers expectations’
  - College admissions expectations
  - Family beliefs about college admissions expectations
  - College instructors’ expectations
- Most-needed math skills all middle school or earlier content
- MAA/NCTM statement on HS calculus
  - Too much push for acceleration at the expense of depth and fluency
  - <http://bit.ly/maa-hs-calc>
- Sense-making: students experience mathematics as a set of tools to explore authentic questions

**High School questions?**

# Other grade level Big Idea diagrams

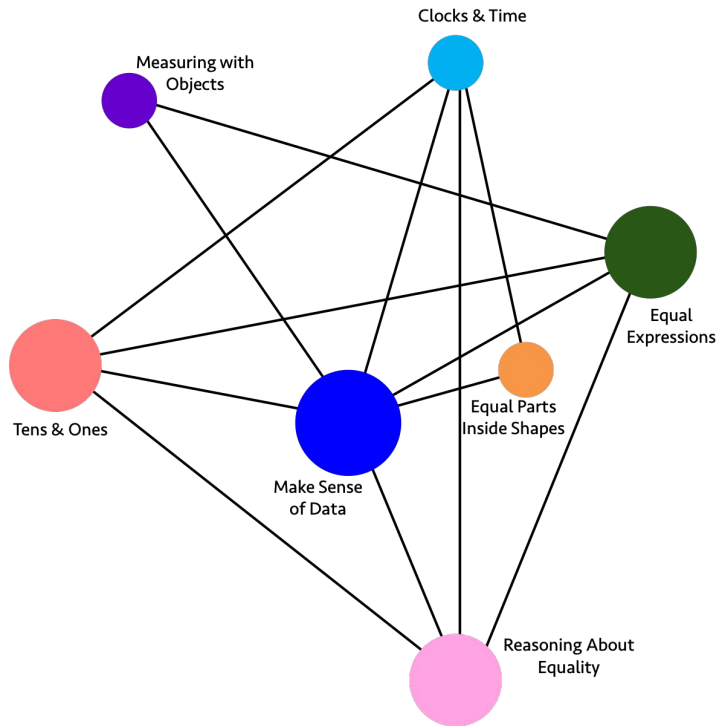


Transitional Kindergarten

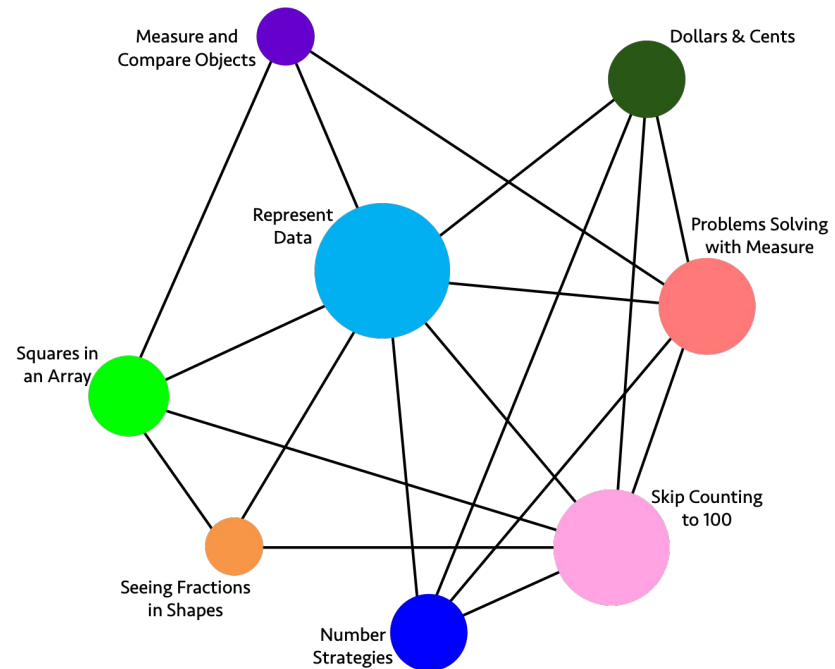


Kindergarten

# Grade 1 & 2



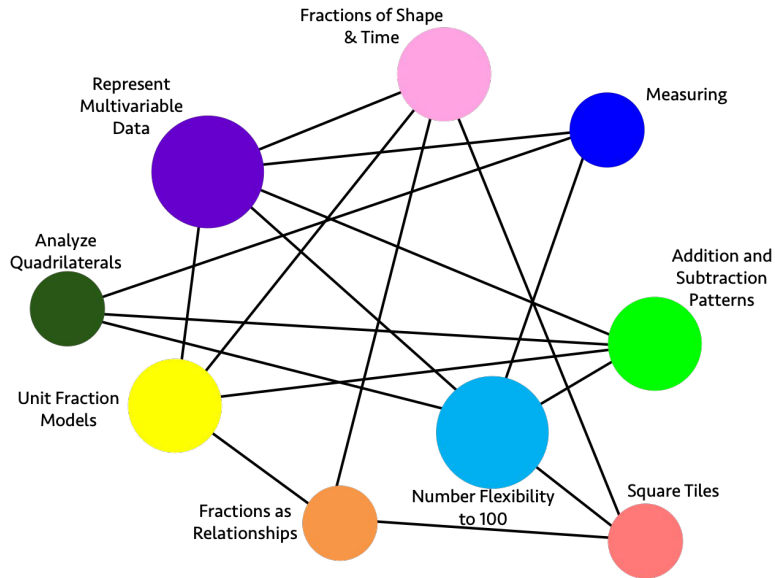
First Grade



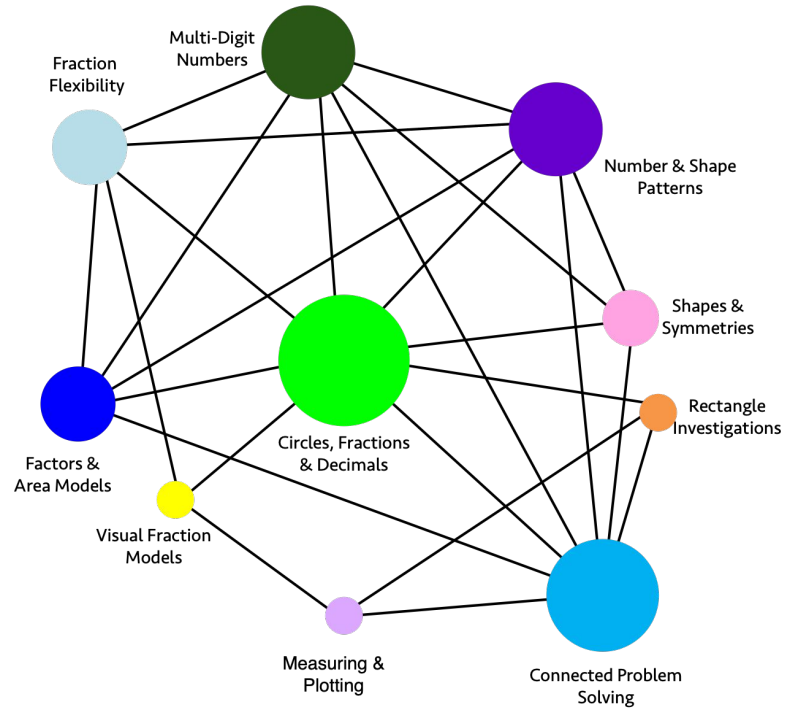
Second Grade



# Grade 3 & 4

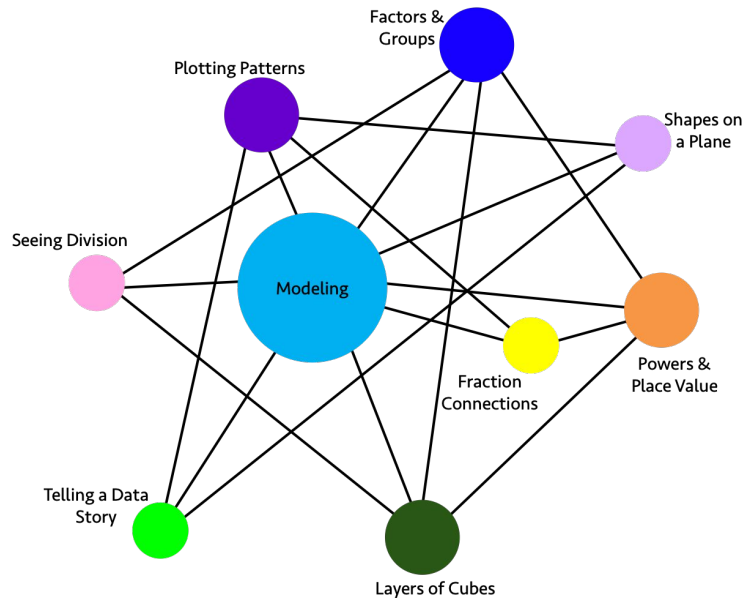


Third Grade

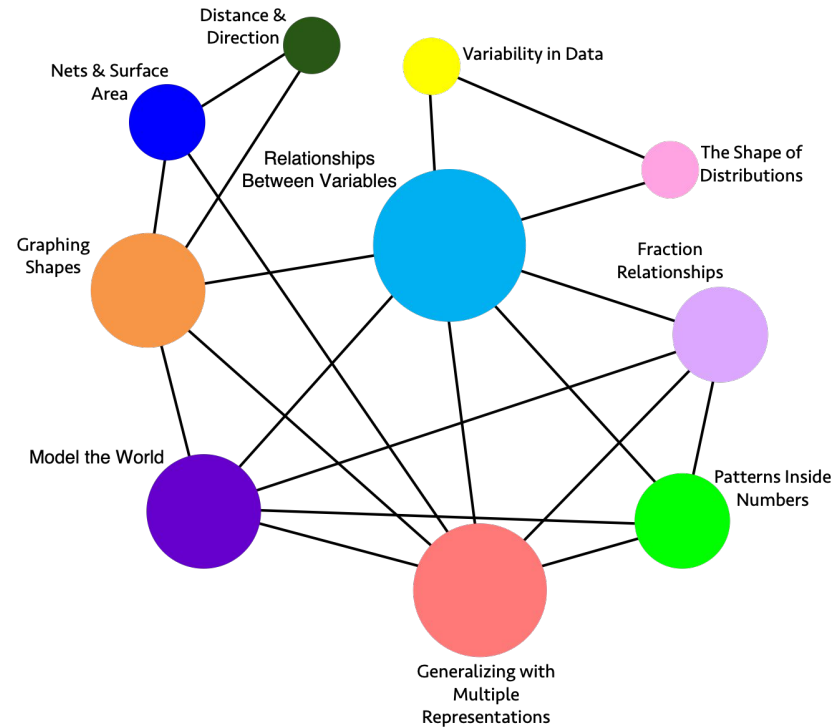


Fourth Grade

# Grade 5 & 6

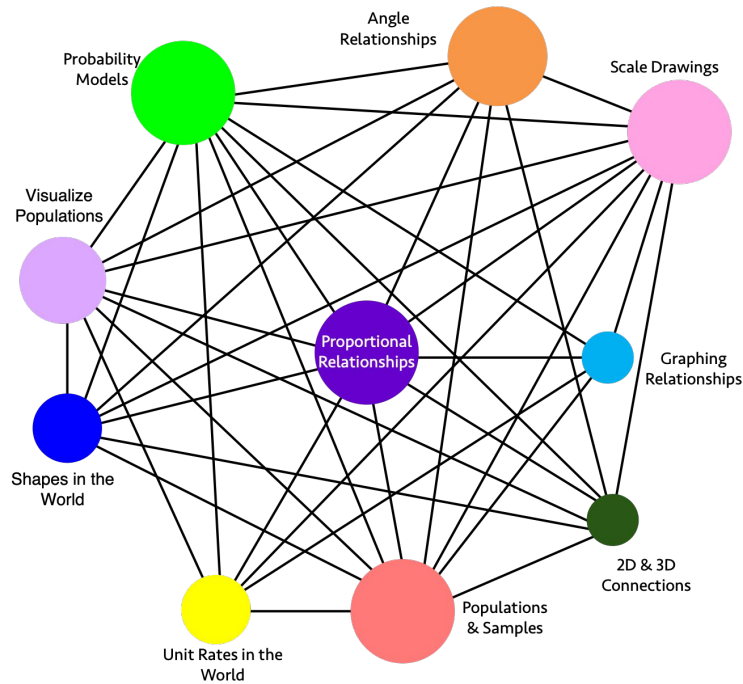


Fifth Grade

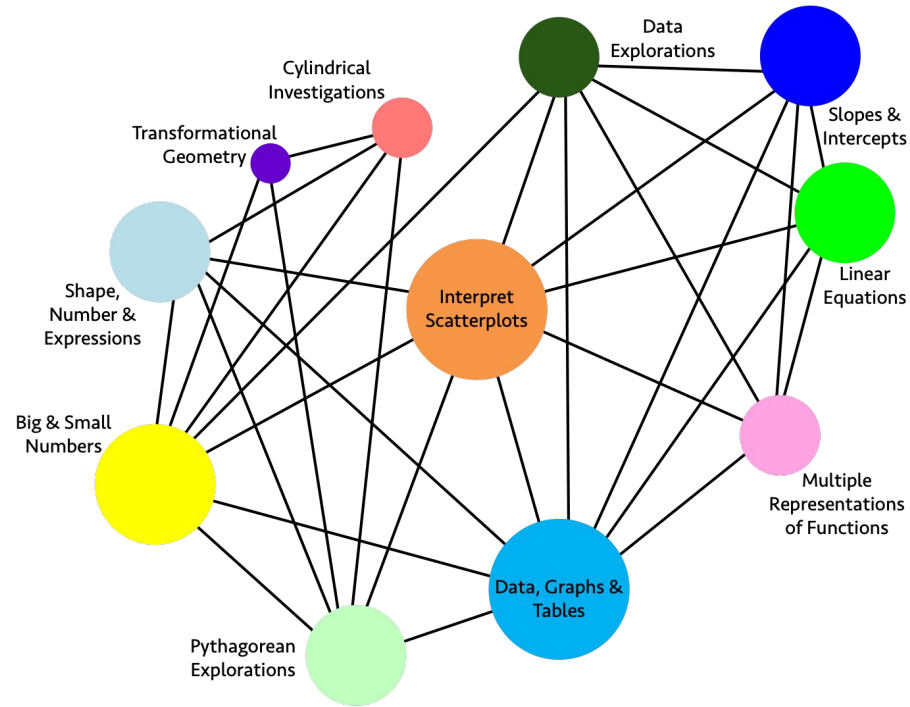


Sixth Grade

# Grade 7 and 8

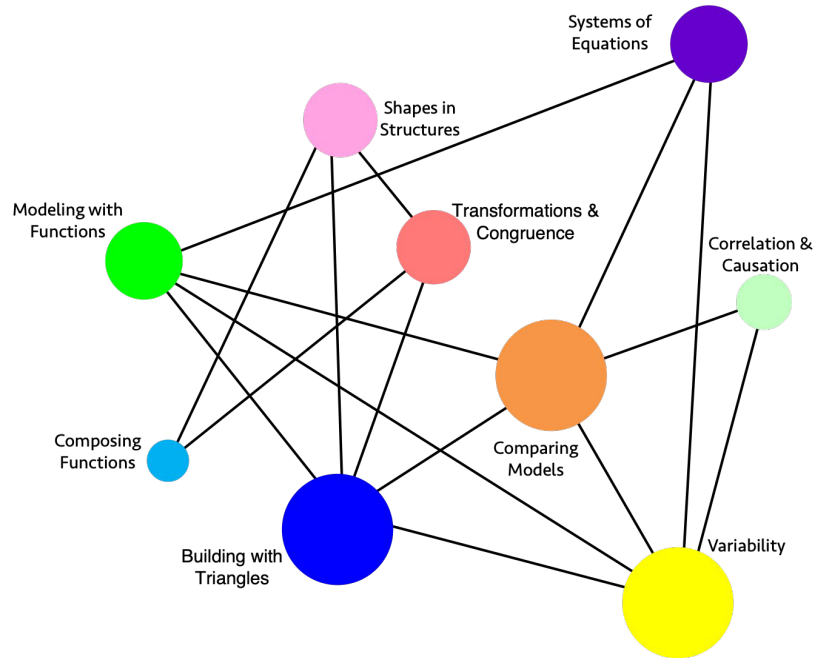


Seventh Grade

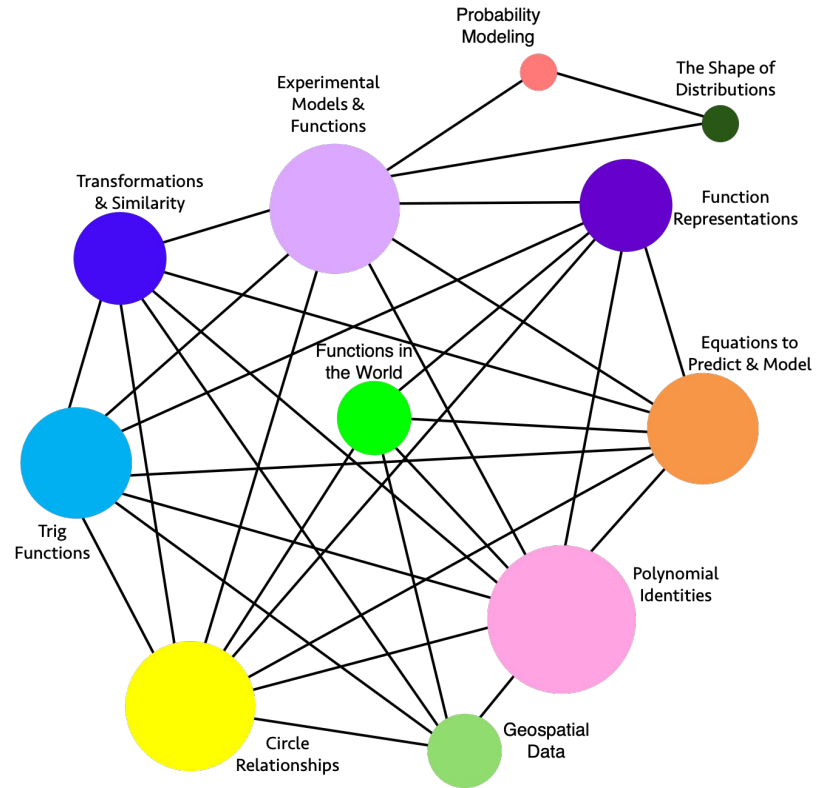


Eighth Grade

# Integrated 1 and 2

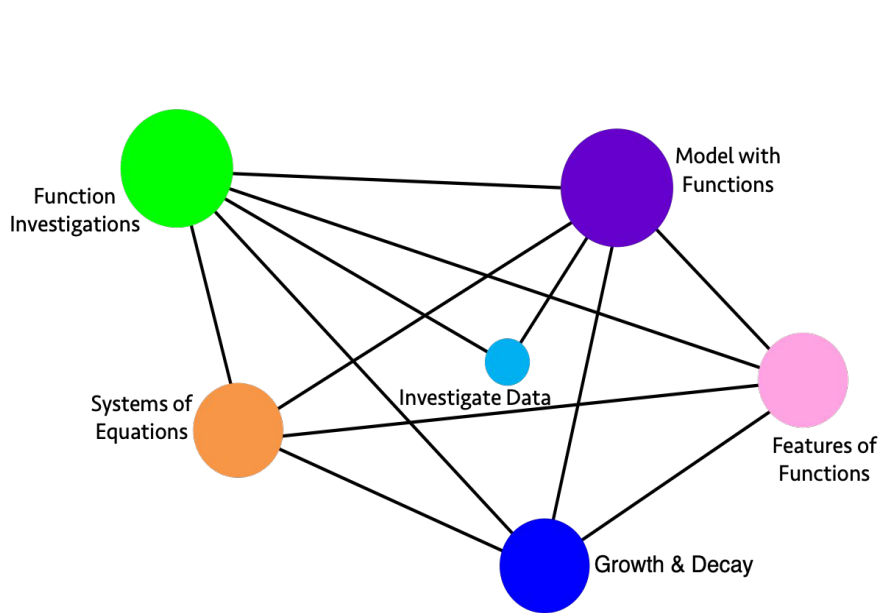


Integrated 1

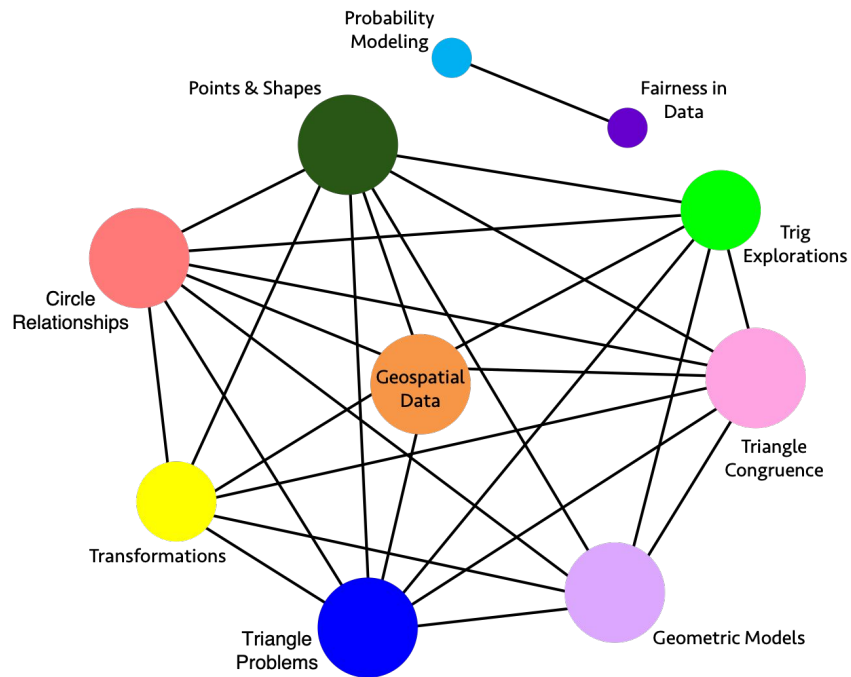


Integrated 2

# Algebra and Geometry



Algebra



Geometry