COMMON CORE STATE STANDARDS OREGON

OREGON DEPARTMENT OF EDUCATION

Common Core State Standards High School Mathematics:

Bridging K-12 and Post-Secondary Expectations

Oregon Core to College Mathematics Summit

Lane Community College

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Mark Freed

Mathematics Education Specialist

Oregon Department of Education

Creating CCSS HS units and courses that bridge K-8 and Post-Secondary

- Math Graduation Requirement for Class of 2014
  - Three credits of “Algebra 1 and above”
  - Meets Essential Skills in Mathematics
- Common Questions
  - What makes a course a “high school credit”?
    - E.g. - How much K-8 content can be taught and still be a HS credit?
    - Better question: How much high school content would be taught in the course?
  - What options for a third credit do student have?
    - E.g. - Do all students have to take an “Algebra 2” course?
    - Can students take a two year Algebra 1 course?
  - Could applied courses or dual credits count for high school credit?
    - Example applied courses: Financial Algebra, Construction Geometry, Math for Computer Science, etc.
    - Dual credit: math in career technical education (CTE) courses (e.g. automotive, agriculture, drafting, etc)

How do we align CCSS HS content into units and courses?

- Math Content Alignment
  - Focus
    - Align content to college and career readiness
    - Understand priority and supporting content standards
  - Coherence
    - Connections across grade levels
    - Connections within grade content
  - Rigor
    - Procedural Fluency, Conceptual Understanding, & Authentic Applications
    - Include opportunities for theoretical and applied content for all students
    - Connect to STEM education work in Oregon
- Math Practices Alignment
  - Practices describe student actions and dispositions
  - Implementing practices have natural content and instructional implications

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Focus

What are the important concepts in CCSS HS mathematics?

Finding Focus

- Triangulation of priority content
  - (1) Smarter Balanced Claim 1 content *(Concepts & Procedures)*
  - (2) Smarter Balanced remaining claims *[Claim 2 (problem solving); Claim 3 (communication); Claim 4 (modeling and data analysis)]*
  - (3) CCSSO/Achieve HS publishers criteria
- Classifying content
  - Category 3 – Identified in all three sources above
  - Category 2 – Identified in two of three sources above
  - Category 1 – Identified in only one source above
  - Category 0 – Not identified

Common Core HS clusters

Number and Quantity	The Real Number System N-RN-A N-RN-B	Quantities N-Q-C	The Complex Number System N-CN-D N-CN-E [+] N-CN-F [+]	Vector and Matrix Quantities N-VM-G [+] N-VM-H [+] N-VH-I [+]		
Algebra	Seeing Structure in Expressions A-SSE-A A-SSE-B	Arithmetic with Polynomials and Rational Expressions A-APR-C A-APR-D A-APR-E A-APR-F	Creating Equations A-CED-G	Reasoning with Equations and Inequalities A-REI-H A-REI-I A-REI-J A-REI-K		
Functions	Interpreting Functions F-IF-A F-IF-B F-IF-C	Building Functions F-BF-D F-BF-E	Linear, Quadratic, and Exponential Models F-LE-F F-LE-G	Trigonometric Functions F-TF-H F-TF-I F-TF-J		
Geometry	Congruence G-CO-A G-CO-B G-CO-C G-CO-D	Similarity, Right Triangles, and Trigonometry G-SRT-E G-SRT-F G-SRT-G G-SRT-H [+]	Circles G-C-I G-C-J	Expressing Geometric Properties with Equations G-GPE-K G-GPE-L	Geometric Measurement and Dimension G-GMD-M G-GMD-N	Modeling with Geometry G-MG-O
Statistics and Probability	Interpreting Categorical and Quantitative Data S-ID-A S-ID-B S-ID-C	Making Inferences and Justifying Conclusions S-IC-D S-IC-E	Conditional Probability and the Rules of Probability S-CP-F S-CP-G	Using Probability to Make Decisions S-MD-H [+] S-MD-I [+]		

Category 3
[identified in 3 sources]

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Number and Quantity	The Real Number System N-RN-A	Quantities N-Q-C	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions A-SSE-A A-SSE-B	Arithmetic with Polynomials and Rational Expressions A-APR-C	Creating Equations A-CED-G	Reasoning with Equations and Inequalities A-REI-H A-REI-I A-REI-K		
Functions	Interpreting Functions F-IF-A F-IF-B F-IF-C	Building Functions F-BF-D	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
Geometry	Congruence	Similarity, Right Triangles, and Trigonometry	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimension	Modeling with Geometry
Statistics and Probability	Interpreting Categorical and Quantitative Data S-ID-A	Making Inferences and Justifying Conclusions	Conditional Probability and the Rules of Probability	Using Probability to Make Decisions		

Category 2
[identified in 2 sources]

Number and Quantity	The Real Number System N-RN-B	Quantities	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions	Arithmetic with Polynomials and Rational Expressions	Creating Equations	Reasoning with Equations and Inequalities A-REI-J		
Functions	Interpreting Functions	Building Functions	Linear, Quadratic, and Exponential Models F-LE-F	Trigonometric Functions		
Geometry	Congruence G-CO-A G-CO-B G-CO-C	Similarity, Right Triangles, and Trigonometry G-SRT-E G-SRT-F G-SRT-G	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimension	Modeling with Geometry
Statistics and Probability	Interpreting Categorical and Quantitative Data S-ID-C	Making Inferences and Justifying Conclusions S-IC-D	Conditional Probability and the Rules of Probability	Using Probability to Make Decisions		

Category 1
[identified in 1 sources]

Number and Quantity	The Real Number System	Quantities	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions	Arithmetic with Polynomials and Rational Expressions A-APR-D A-APR-E A-APR-F	Creating Equations	Reasoning with Equations and Inequalities		
Functions	Interpreting Functions	Building Functions F-BF-E	Linear, Quadratic, and Exponential Models F-LE-G	Trigonometric Functions F-TF-H F-TF-I F-TF-J		
Geometry	Congruence	Similarity, Right Triangles, and Trigonometry	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimension G-GMD-M G-GMD-N	Modeling with Geometry
Statistics and Probability	Interpreting Categorical and Quantitative Data S-ID-B	Making Inferences and Justifying Conclusions S-IC-E	Conditional Probability and the Rules of Probability	Using Probability to Make Decisions		

Category 0 (with [+] content)

[identified in 0 sources]

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Number and Quantity	The Real Number System	Quantities	The Complex Number System N-CN-D N-CN-E [+] N-CN-F [+]	Vector and Matrix Quantities N-VM-G [+] N-VM-H [+] N-VH-I [+]		
Algebra	Seeing Structure in Expressions	Arithmetic with Polynomials and Rational Expressions	Creating Equations	Reasoning with Equations and Inequalities		
Functions	Interpreting Functions	Building Functions	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
Geometry	Congruence G-CO-D	Similarity, Right Triangles, and Trigonometry G-SRT-H [+]	Circles G-C-I G-C-J	Expressing Geometric Properties with Equations G-GPE-K G-GPE-L	Geometric Measurement and Dimension	Modeling with Geometry G-MG-O
Statistics and Probability	Interpreting Categorical and Quantitative Data	Making Inferences and Justifying Conclusions	Conditional Probability and the Rules of Probability S-CP-F S-CP-G	Using Probability to Make Decisions S-MD-H [+] S-MD-I [+]		

Category 0 (non [+])

[identified in 0 sources]

Number and Quantity	The Real Number System	Quantities	The Complex Number System N-CN-D	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions	Arithmetic with Polynomials and Rational Expressions	Creating Equations	Reasoning with Equations and Inequalities		
Functions	Interpreting Functions	Building Functions	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
Geometry	Congruence G-CO-D	Similarity, Right Triangles, and Trigonometry	Circles G-C-I G-C-J	Expressing Geometric Properties with Equations G-GPE-K G-GPE-L	Geometric Measurement and Dimension	Modeling with Geometry G-MG-O
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Coherence

How does math content connect across high school courses?

Coherence: HS courses that bridge K-8 and Post-secondary

- How does a *traditional pathway* connect CCSS content across grades?
- How does a *integrated pathway* connect CCSS content across grades?
- How do traditional & integrated course designs position students for:
  - Smarter Balanced (Grade 11)?
  - College & Career Expectations?

Example Pathway: Traditional
Year 1 & 2

TRADITIONAL

Grade 9: Algebra One

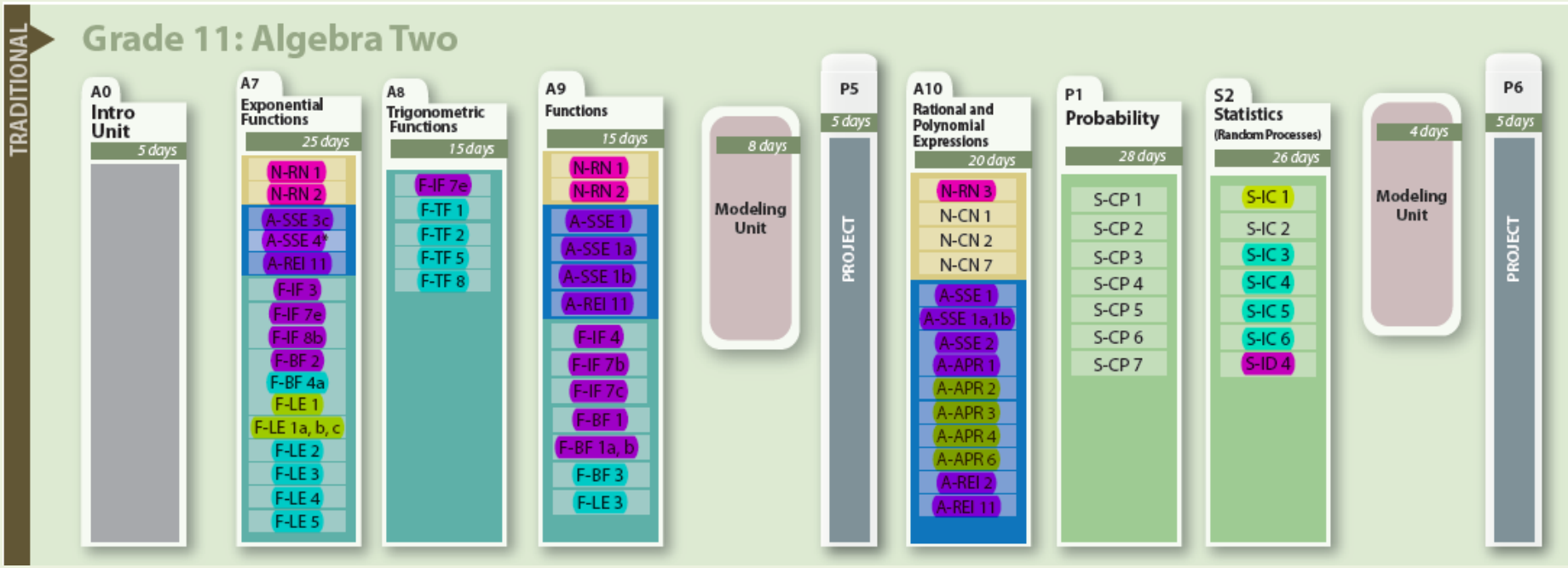
- **A0** Intro Unit — 5 days
- **A1** Modeling with Functions — 15 days: N-Q 1, N-Q 2, N-Q 3, F-IF 1, F-IF 2, F-IF 3, F-IF 4*, F-IF 5*, F-IF 9*, F-LE 1, F-LE 1a,1b, F-LE 3, F-LE 5
- **A2** Linear Functions — 15 days: F-IF 6, F-IF 7a, F-IF 9, F-BF 1, F-BF 1a, F-BF 2, F-BF 4a, F-LE 1, F-LE 1a,1b
- **A3** Linear Equations & Inequalities in One Variable — 15 days: A-REI 1, A-REI 3, A-REI 11*, A-CED 1, A-CED 3, A-CED 4
- Modeling Unit — 4 days
- **A4** Linear Equations & Inequalities in Two Variables — 15 days: A-CED 2, A-CED 3, A-CED 4, A-REI 5, A-REI 6, A-REI 10, A-REI 12
- **P1** PROJECT — 5 days
- **A5** Quadratic Functions — 20 days: F-IF 4*, F-IF 5*, F-IF 6, F-IF 7, F-IF 7a*, F-IF 8, F-IF 8a, F-IF 9, F-BF 1, F-BF 1a, b, F-BF 3
- **A6** Quadratic Equations — 26 days: N-CN 7, A-SSE 3a, A-SSE 3b, A-REI 4, A-REI 4a,b, A-REI 7
- Modeling Unit — 4 days
- **S1** Statistics — 30 days: S-ID 1, S-ID 2, S-ID 3, S-ID 5, S-ID 6, S-ID 6a, b, c, S-ID 7, S-ID 8, S-ID 9
- **P2** PROJECT — 5 days

TRADITIONAL

Grade 10: Geometry

- **G0** Intro and Construction — 12 days: G-CO 12, G-CO 13
- **G1** Basic Definitions & Rigid Motions — 20 days: G-CO 1, G-CO 3, G-CO 2, G-CO 4, G-CO 5, G-CO 6, G-CO 7, G-CO 8
- **G2** Geometric Relationships & Properties — 15 days: G-CO 9, G-CO 10, G-CO 11, G-C 3
- **G3** Similarity — 20 days: G-SRT 1, G-SRT 2, G-SRT 3, G-SRT 4, G-SRT 5
- Modeling Unit — 4 days
- **P3** PROJECT — 5 days
- **G4** Coordinate Geometry — 15 days: G-GPE 4, G-GPE 5, G-GPE 6, G-GPE 7*
- **G5** Circles and Conics — 15 days: G-C 1, G-C 2, G-C 5, G-GPE 1, G-GPE 2
- **G7** Geometric Measurement & Dimensions — 15 days: G-GMD 1, G-GMD 3, G-GMD 4
- **G6** Trigonometric Ratios — 15 days: G-SRT 6, G-SRT 7, G-SRT 8
- **M4** Capstone Geometric Modeling Project — 10 days: G-MG 1*, G-MG 2*, G-MG 3*
- **P4** PROJECT — 5 days

Example Pathway: Traditional Year 3



Example Pathway: Integrated Year 1 & 2

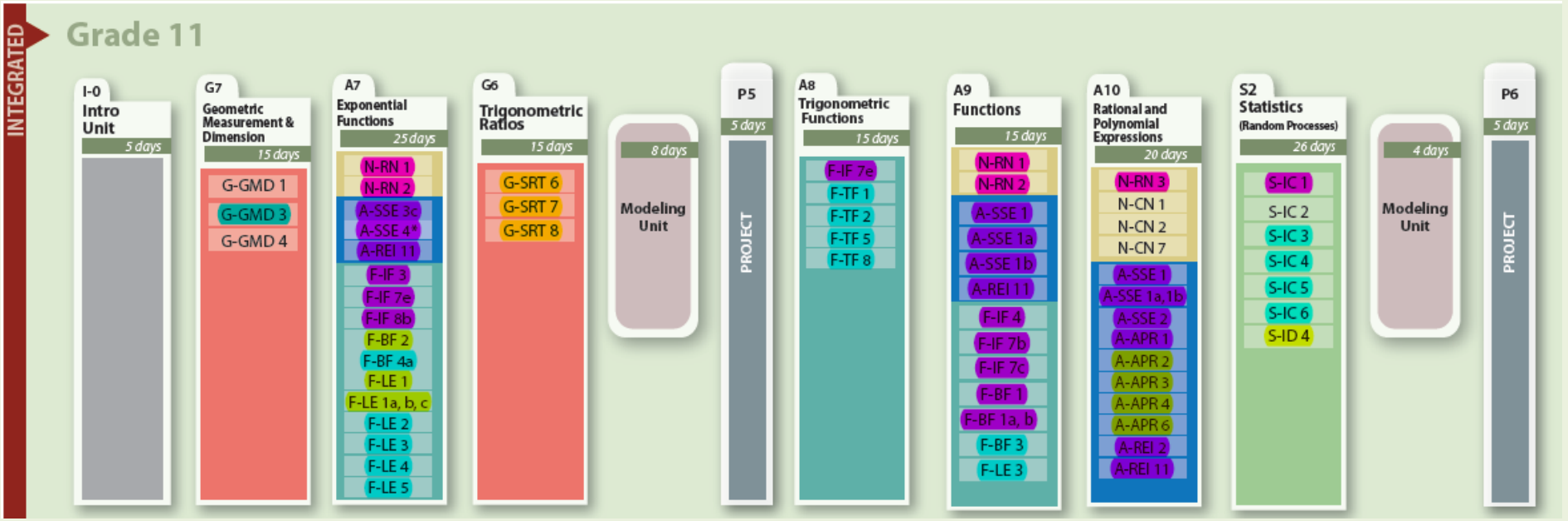
INTEGRATED — Grade 9

- **I-0 Intro Unit** — 5 days
- **A1 Modeling with Functions** — 15 days: N-Q 1, N-Q 2, N-Q 3, F-IF 1, F-IF 2, F-IF 3, F-IF 4*, F-IF 5*, F-IF 9*, F-LE 1, F-LE 1a,1b, F-LE 3, F-LE 5
- **A2 Linear Functions** — 15 days: F-IF 6, F-IF 7a, F-IF 9, F-BF 1, F-BF 1a, F-BF 2, F-BF 4a, F-LE 1, F-LE 1a,1b
- **A3 Linear Equations & Inequalities in One Variable** — 15 days: A-REI 1, A-REI 3, A-REI 11*, A-CED 1, A-CED 3, A-CED 4
- **A4 Linear Equations & Inequalities in Two Variables** — 15 days: A-CED 2, A-CED 3, A-CED 4, A-REI 5, A-REI 6, A-REI 10, A-REI 12
- **Modeling Unit** — 4 days
- **P1 PROJECT** — 5 days
- **G0 Tools and Construction** — 10 days: G-CO 12, G-CO 13
- **G1 Basic Definitions & Rigid Motions** — 20 days: G-CO 1, G-CO 3, G-CO 2, G-CO 4, G-CO 5, G-CO 6, G-CO 7, G-CO 8
- **G2 Geometric Relationships & Properties** — 15 days: G-CO 9, G-CO 10, G-CO 11, G-C 3
- **Modeling Unit** — 4 days
- **S1 Statistics** — 30 days: S-ID 1, S-ID 2, S-ID 3, S-ID 5, S-ID 6, S-ID 6a, b, c, S-ID 7, S-ID 8, S-ID 9
- **P2 PROJECT** — 5 days

INTEGRATED — Grade 10

- **I-0 Intro Unit** — 5 days
- **G4 Coordinate Geometry** — 15 days: G-GPE 4, G-GPE 5, G-GPE 6, G-GPE 7*
- **A5 Quadratic Functions** — 20 days: F-IF 4*, F-IF 5*, F-IF 6, F-IF 7, F-IF 7a*, F-IF 8, F-IF 8a, F-IF 9, F-BF 1, F-BF 1a, b, F-BF 3
- **A6 Quadratic Equations** — 26 days: N-CN 7, A-SSE 3a, A-SSE 3b, A-REI 4, A-REI 4a,b, A-REI 7
- **Modeling Unit** — 4 days
- **P3 PROJECT** — 5 days
- **G3 Similarity** — 20 days: G-SRT 1, G-SRT 2, G-SRT 3, G-SRT 4, G-SRT 5
- **G5 Circles and Conics** — 20 days: G-C 1, G-C 2, G-C 5, G-GPE 1, G-GPE 2
- **P1 Probability** — 28 days: S-CP 1, S-CP 2, S-CP 3, S-CP 4, S-CP 5, S-CP 6, S-CP 7
- **M4 Capstone Geometric Modeling Project** — 10 days: G-MG 1*, G-MG 2*, G-MG 3*
- **P4 PROJECT** — 5 days

Example Pathway: Integrated Year 3



Coherence of HS courses

- "Traditional" and "Integrated" HS course sequences may not inherently align to CCSS HS priority topics
- Both traditional and integrated pathways need to address the content needs of the CCSS and connect across grades
  - Careful attention to first two years
  - Additional options are needed for third and fourth credits of mathematics

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Rigor

How do we deepen content knowledge and increase interest in mathematics?

CCSS Rigor

- Rigor in the CCSS is consists of
  - Procedural Fluency
  - Conceptual Understanding
  - Authentic Applications
- Oregon secondary and post-secondary schools integrate the work underway with current STEM Education initiatives

  STEM (Science, Technology, Engineering, Math) Education

Lessons learned from Math-in-CTE and Applied Math Grants

- Students benefit from both authentic/applied and theoretical instruction
  - *Balanced instruction: Applied/Theoretical/Applied*
- Develop positive attitudes and interest in STEM content and careers
- Model for collaboration between “contextual” and “theoretical” experts that could be utilized

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What does it mean?

Implications for Focus, Coherence, and Rigor for CCSS HS standards

Pulling it together

What does this mean?

Number and Quantity	The Real Number System	Quantities	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions	Arithmetic with Polynomials and Rational Expressions	Creating Equations	Reasoning with Equations and Inequalities		
Functions	Interpreting Functions	Building Functions	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
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Level 3
Level 2
Level 1
Level 0

Priority content:

Multiple opportunities needed throughout HS

Number and Quantity	The Real Number System N-RN-A	Quantities N-Q-C	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions A-SSE-A A-SSE-B	Arithmetic with Polynomials and Rational Expressions A-APR-C	Creating Equations A-CED-G	Reasoning with Equations and Inequalities A-REI-H A-REI-I A-REI-K		
Functions	Interpreting Functions F-IF-A F-IF-B F-IF-C	Building Functions F-BF-D	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
Geometry	Congruence	Similarity, Right Triangles, and Trigonometry	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimension	Modeling with Geometry
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Level 3
Level 2
Level 1
Level 0

Priority & Supporting Content:

Emphasis needed in first two years

Number and Quantity	The Real Number System N-RN-A N-RN-B	Quantities N-Q-C	The Complex Number System	Vector and Matrix Quantities		
Algebra	Seeing Structure in Expressions A-SSE-A A-SSE-B	Arithmetic with Polynomials and Rational Expressions A-APR-C A-APR-D A-APR-E A-APR-F	Creating Equations A-CED-G	Reasoning with Equations and Inequalities A-REI-H A-REI-I A-REI-J A-REI-K		
Functions	Interpreting Functions F-IF-A F-IF-B F-IF-C	Building Functions F-BF-D F-BF-E	Linear, Quadratic, and Exponential Models F-LE-F F-LE-G	Trigonometric Functions F-TF-H F-TF-I F-TF-J		
Geometry	Congruence G-CO-A G-CO-B G-CO-C	Similarity, Right Triangles, and Trigonometry G-SRT-E G-SRT-F G-SRT-G	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimension G-GMD-M G-GMD-N	Modeling with Geometry
Statistics and Probability	Interpreting Categorical and Quantitative Data S-ID-A S-ID-B S-ID-C	Making Inferences and Justifying Conclusions S-IC-D S-IC-E	Conditional Probability and the Rules of Probability	Using Probability to Make Decisions		

Level 3
Level 2
Level 1
Level 0

Priority & Additional Content:

Possible Year 3 or 4 courses

Number and Quantity	The Real Number System N-RN-A	Quantities N-Q-C	The Complex Number System N-CN-D N-CN-E [+] N-CN-F [+]	Vector and Matrix Quantities N-VM-G [+] N-VM-H [+] N-VH-I [+]		
Algebra	Seeing Structure in Expressions A-SSE-A A-SSE-B	Arithmetic with Polynomials and Rational Expressions A-APR-C	Creating Equations A-CED-G	Reasoning with Equations and Inequalities A-REI-H A-REI-I A-REI-K		
Functions	Interpreting Functions F-IF-A F-IF-B F-IF-C	Building Functions F-BF-D	Linear, Quadratic, and Exponential Models	Trigonometric Functions		
Geometry	Congruence G-CO-D	Similarity, Right Triangles, and Trigonometry G-SRT-H [+]	Circles G-C-I G-C-J	Expressing Geometric Properties with Equations G-GPE-K G-GPE-L	Geometric Measurement and Dimension	Modeling with Geometry G-MG-O
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Level 3
Level 2
Level 1
Level 0

Can the pieces fit together?

CCSS HS Math 1 (e.g. Alg.1)

Applied & Theoretical

CCSS HS Math 2 (e.g. Alg. 2)

Applied & Theoretical

CCSS HS Applied Math (e.g. Financial Algebra, Const. Geometry, Math for Computer Science)

CCSS HS Math 3 (e.g. Adv. Alg.)

Theoretical

CCSS HS Applied Math

Dual Credit

AP Calculus

CCSS HS Linear Alg.

CCSS HS Statistics

CCSS HS Adv. Geometry