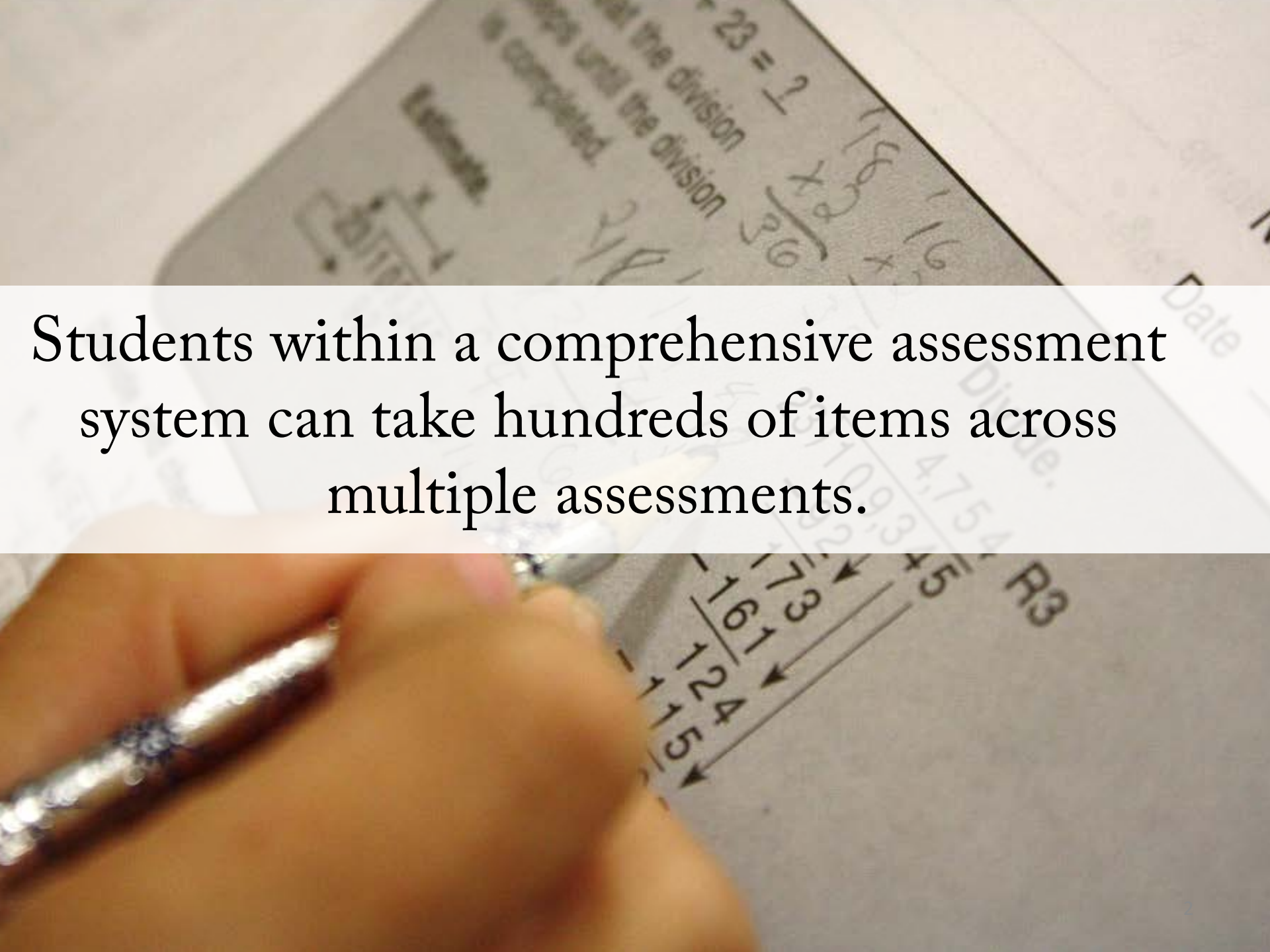
Synthesizing Evidence in a Comprehensive Assessment System

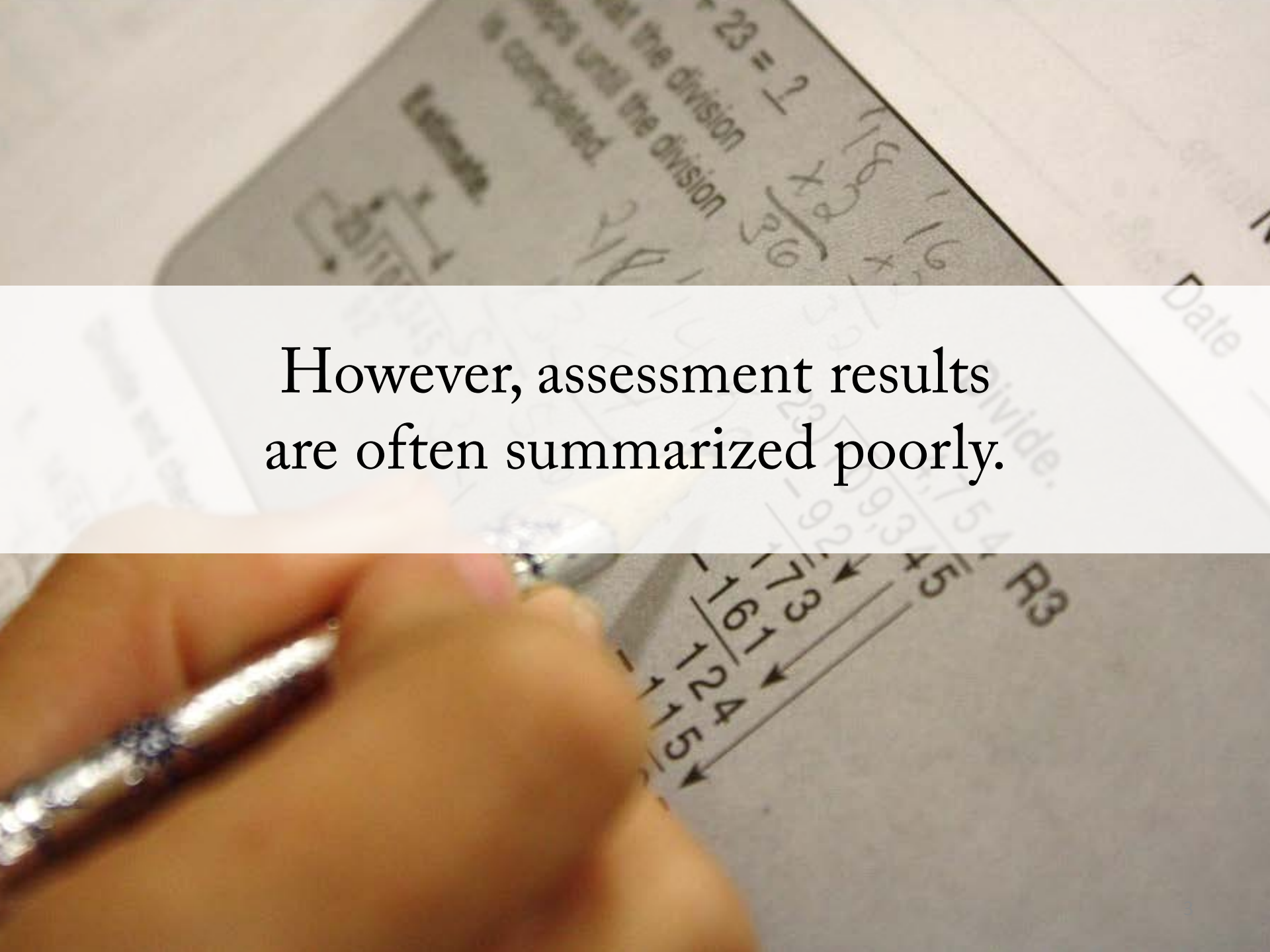
Nathan Dadey & Brian Gong
Center for Assessment

Reidy Interactive Lecture Series
September 17th, 2015

Center for Assessment



Students within a comprehensive assessment system can take hundreds of items across multiple assessments.



However, assessment results are often summarized poorly.

The Goal: find a way to combine information across multiple assessments

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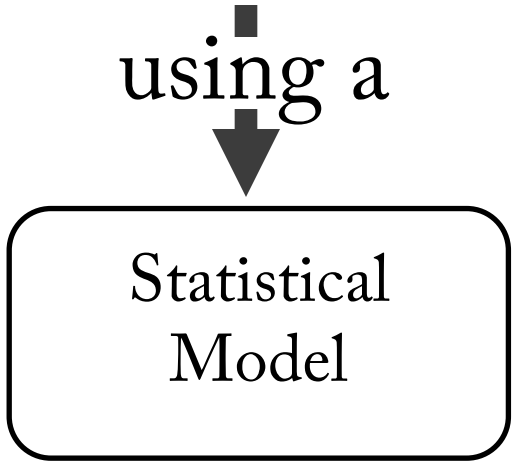
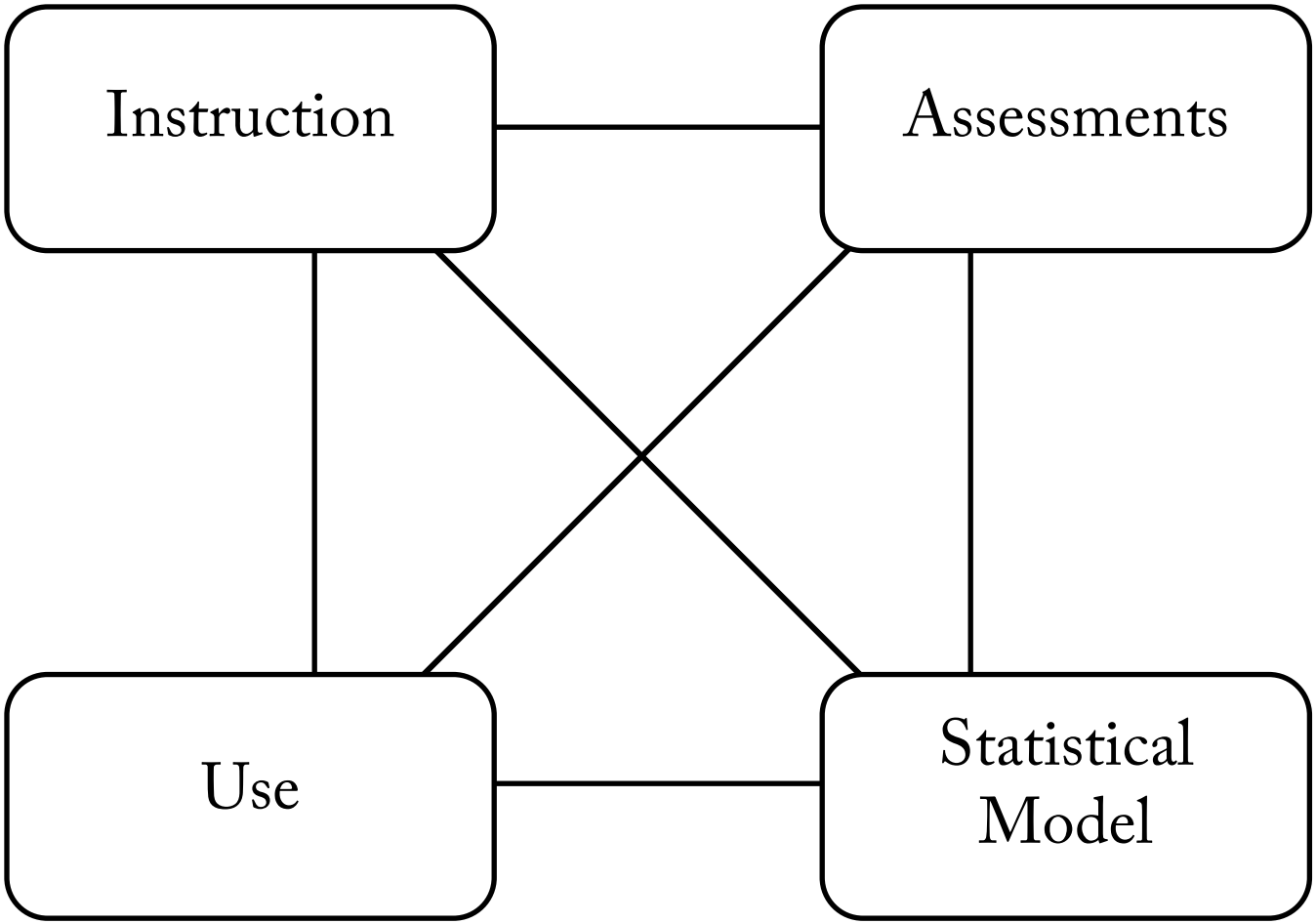


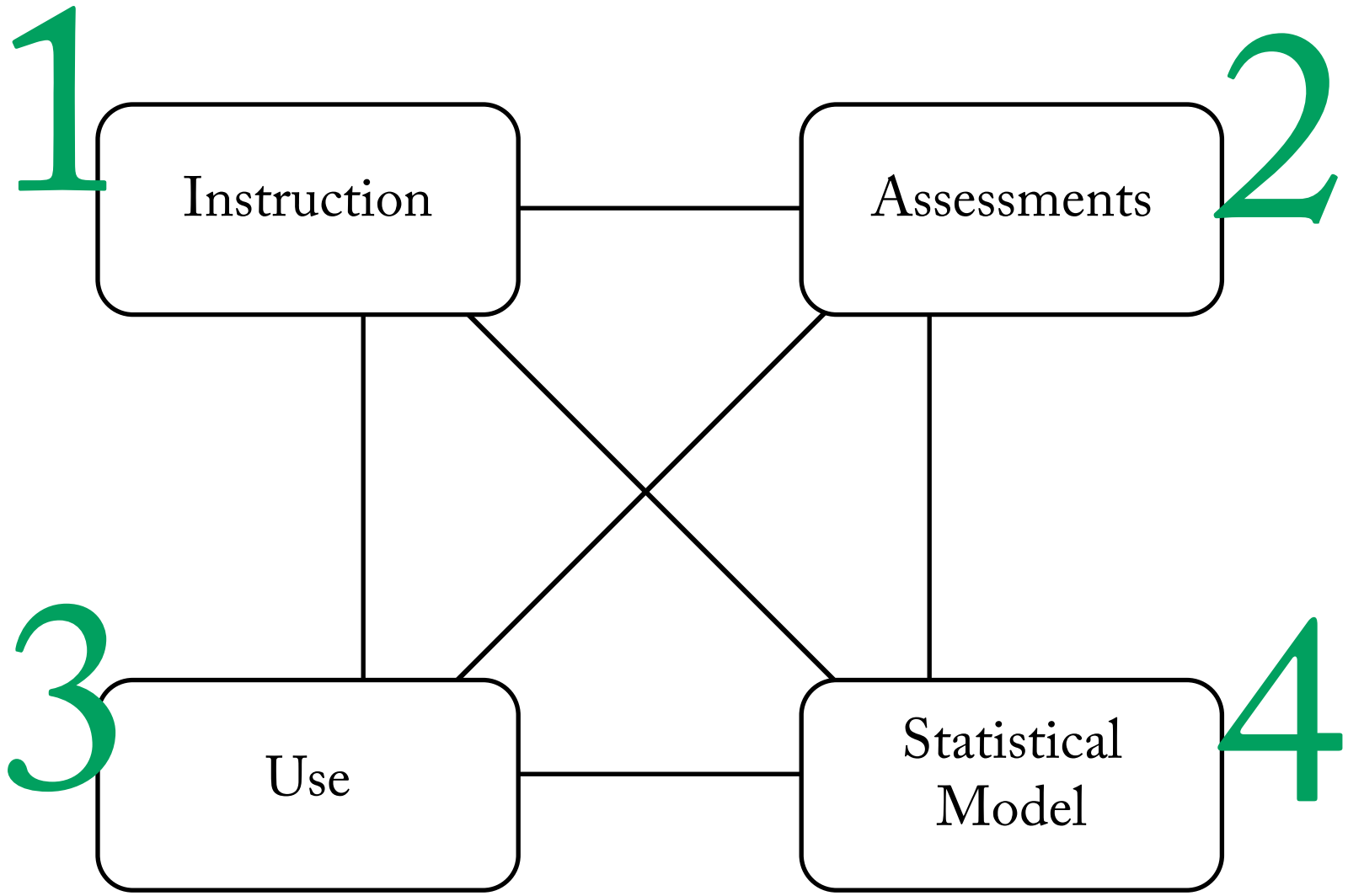
However, the results of such a model can't be understood in isolation.

Statistical Model

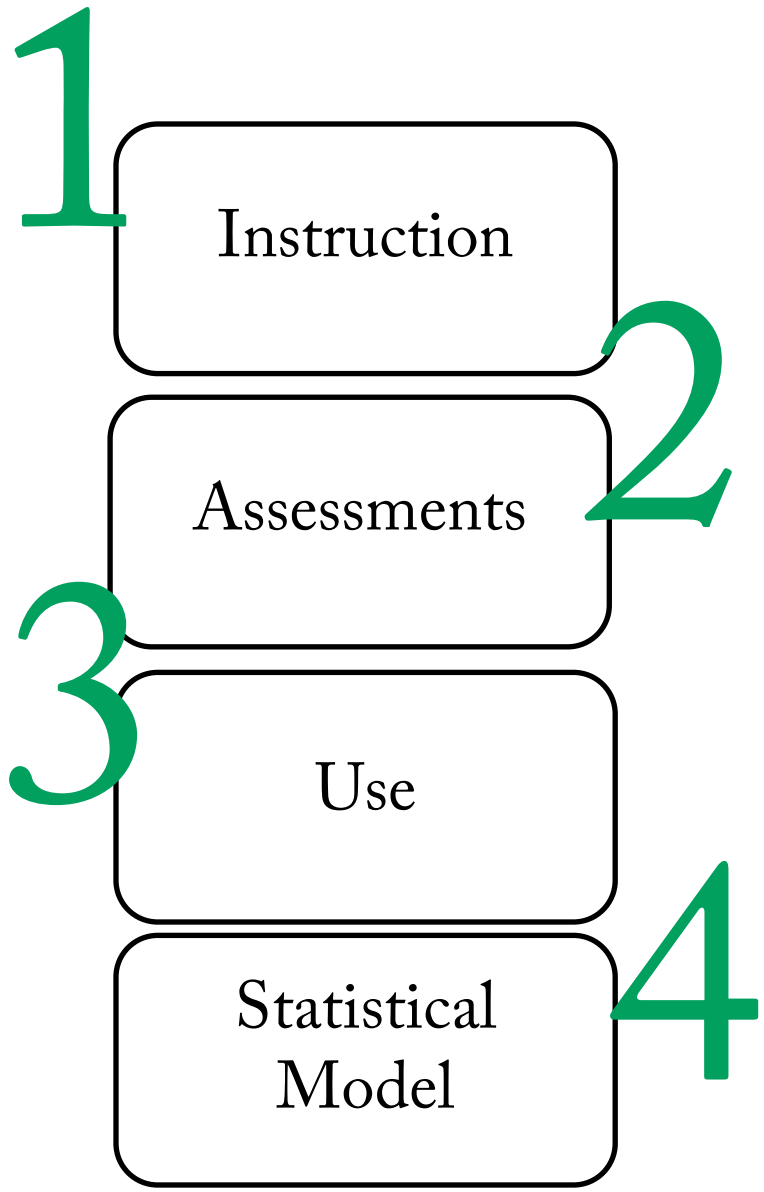
Interpretive Framework



Presentation Structure



Presentation Structure

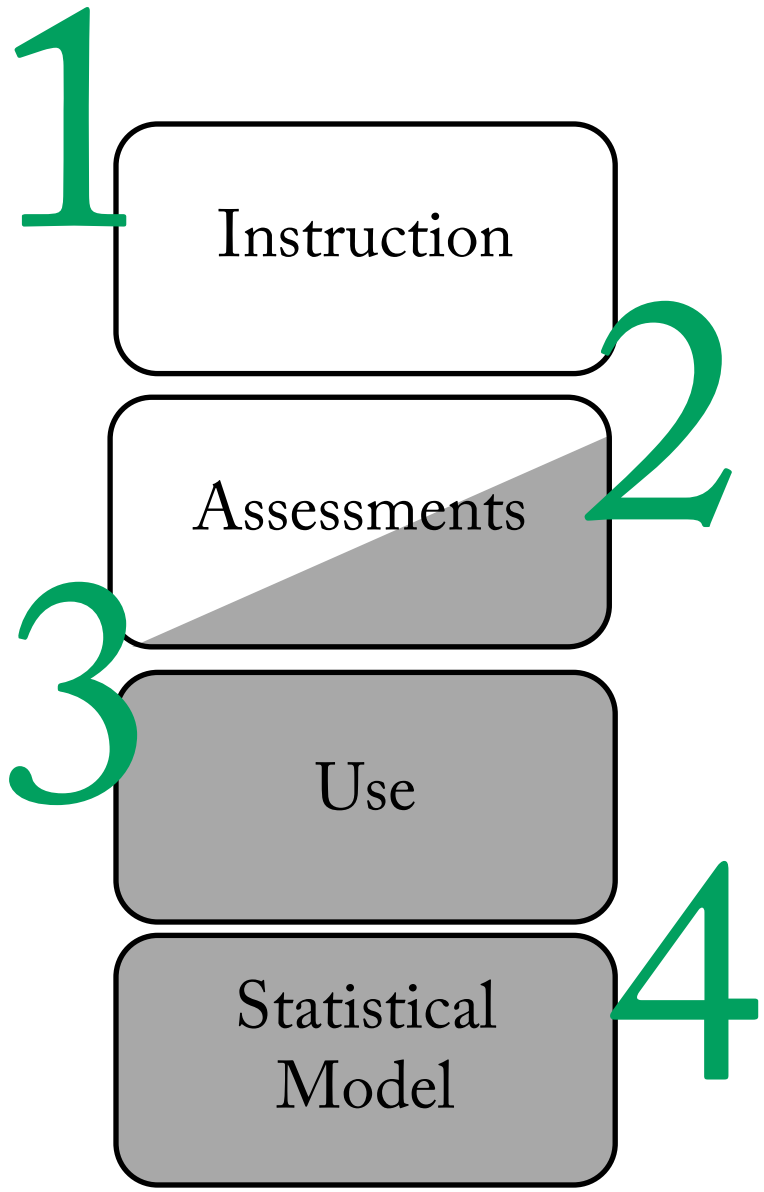


We examine these elements generally,

&

in terms of a specific hypothetical example.

Presentation Structure



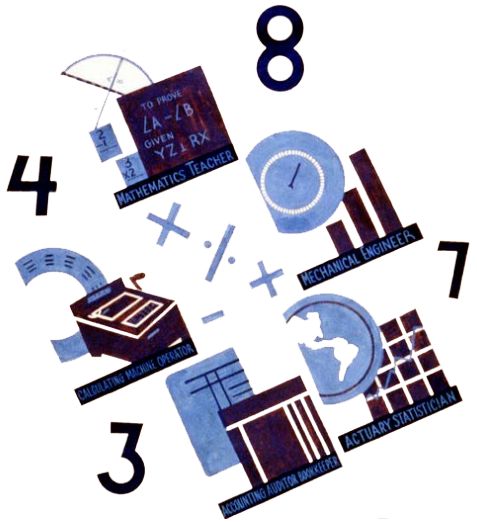
We examine these elements generally,

&

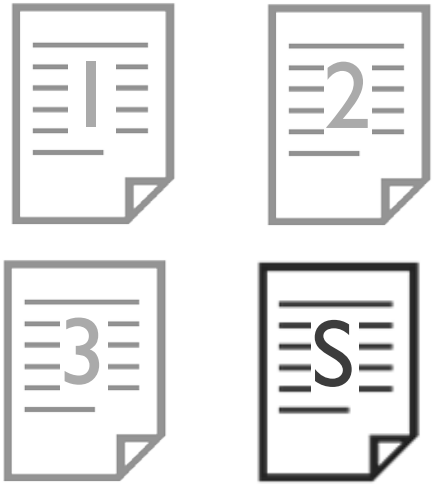
in terms of a specific hypothetical example.

Context

Large District In a Southern State



4th Grade Mathematics



Quarterly Interim Assessments & End of Year Summative Assessment

1 Instruction

Instruction

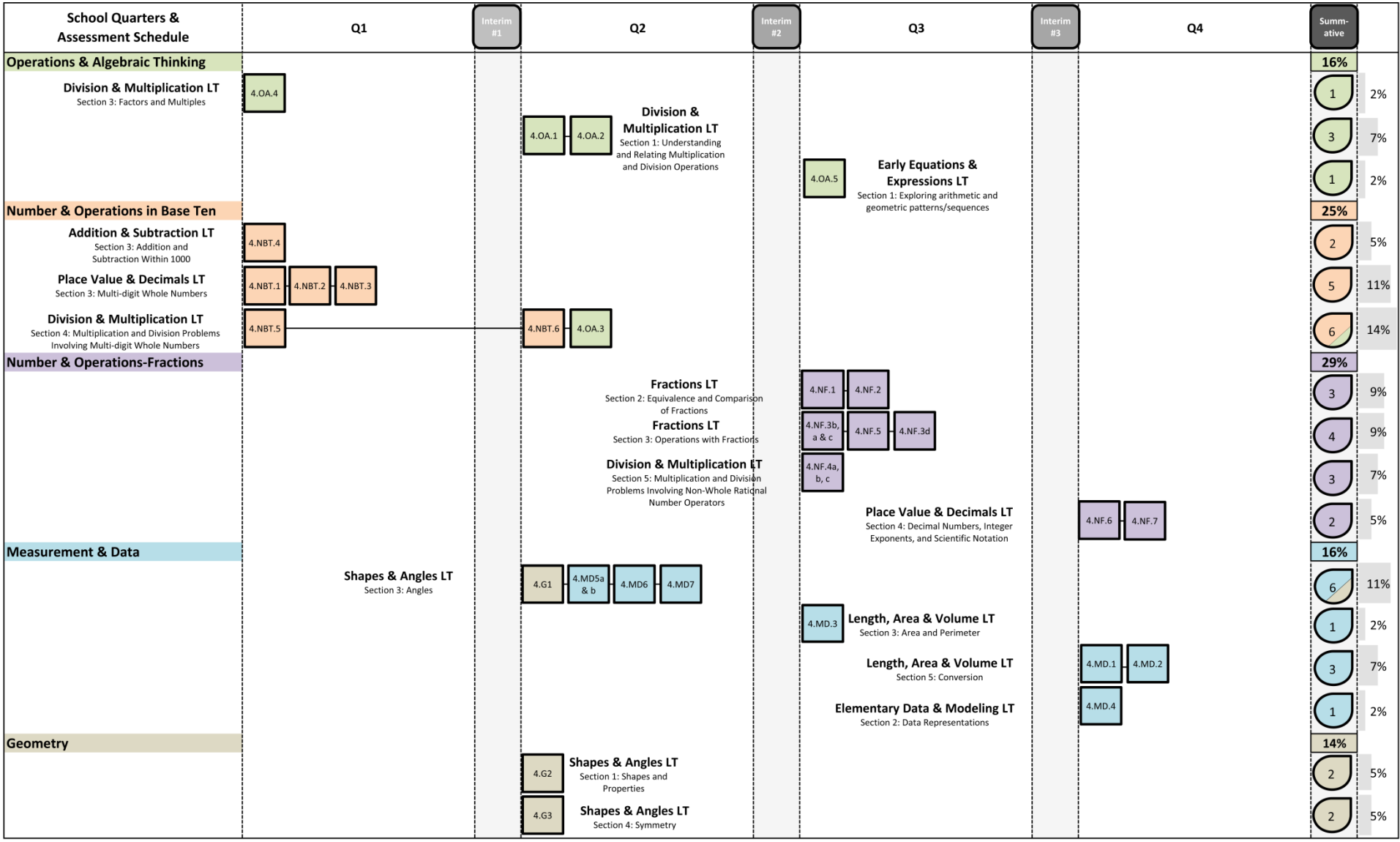
Scope & sequence of instruction, as captured by the ordering the Common Core State Standards.

Instruction

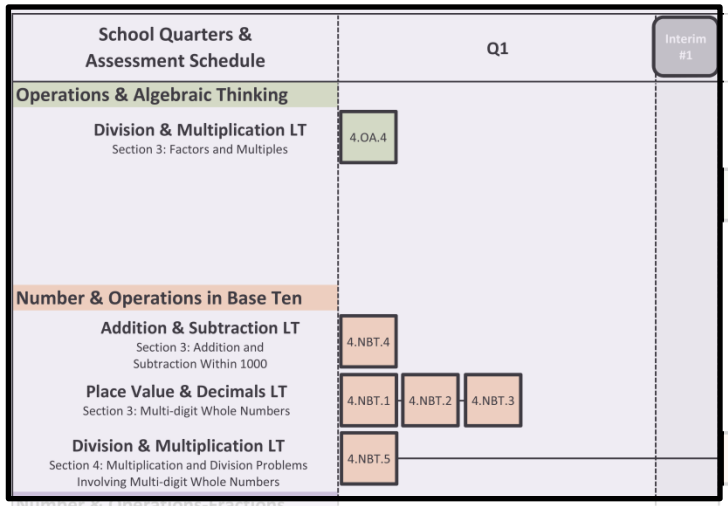
Scope & sequence of instruction, as captured by the ordering the Common Core State Standards.

We show this as a Curriculum Map.

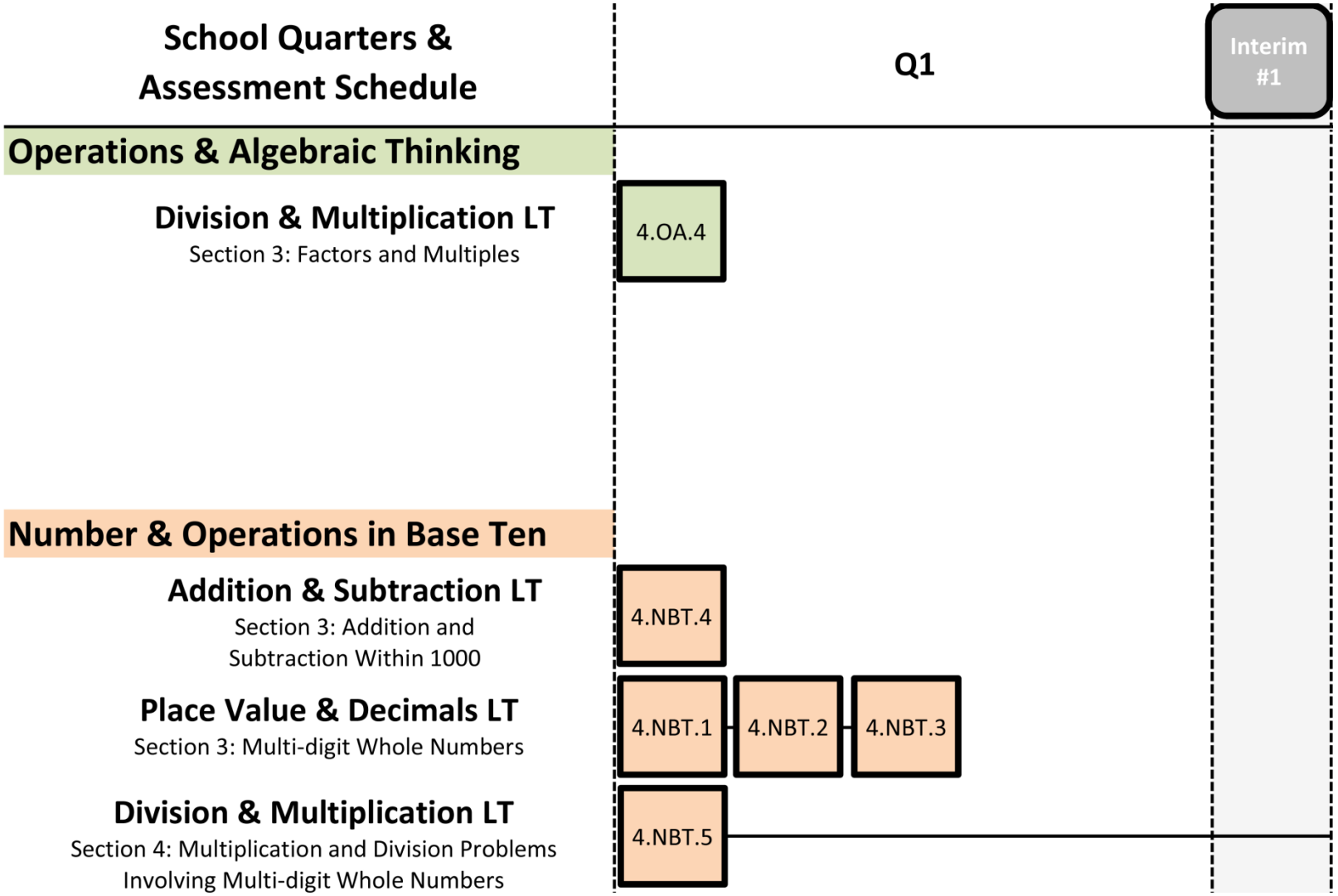
Curriculum Map



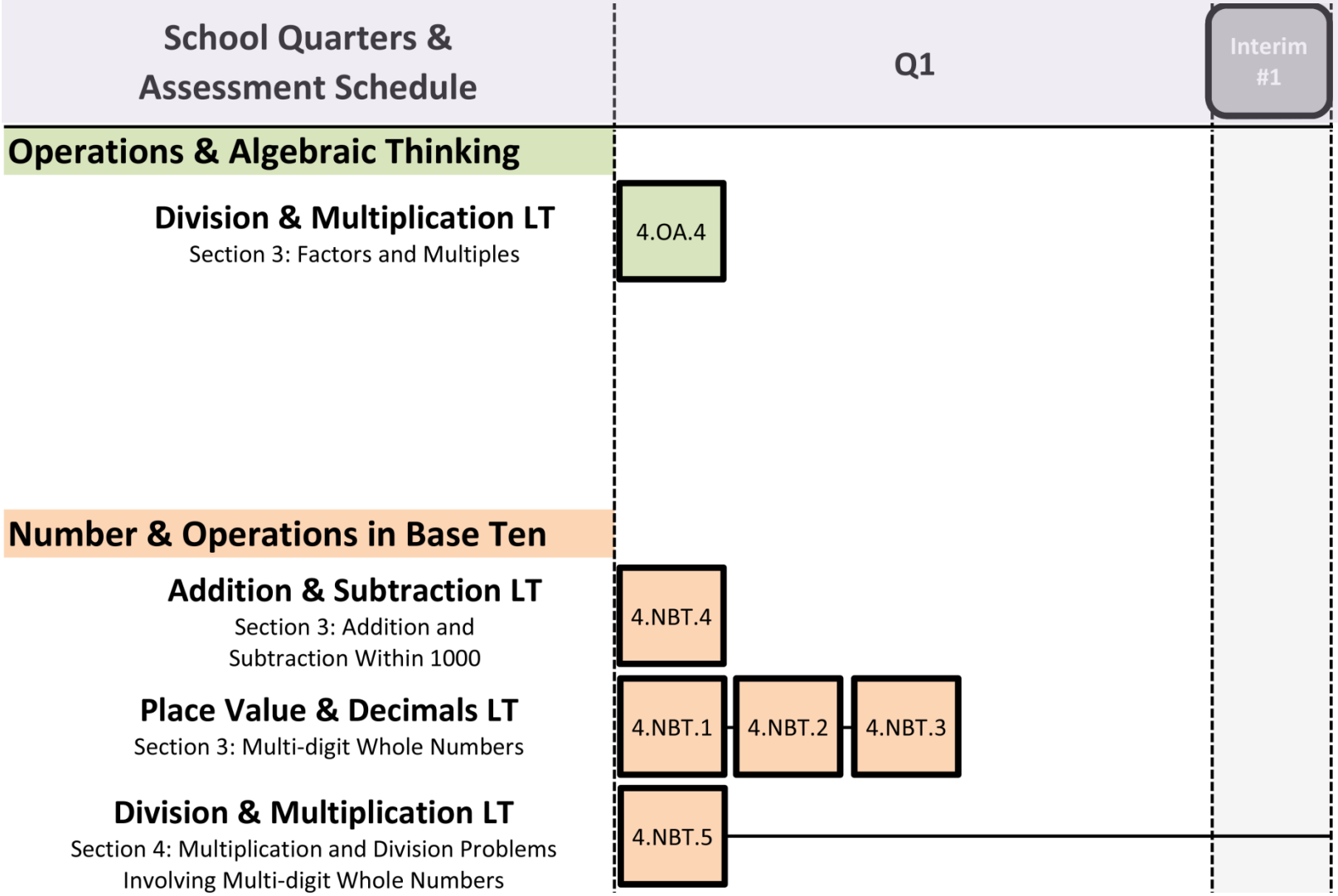
Curriculum Map

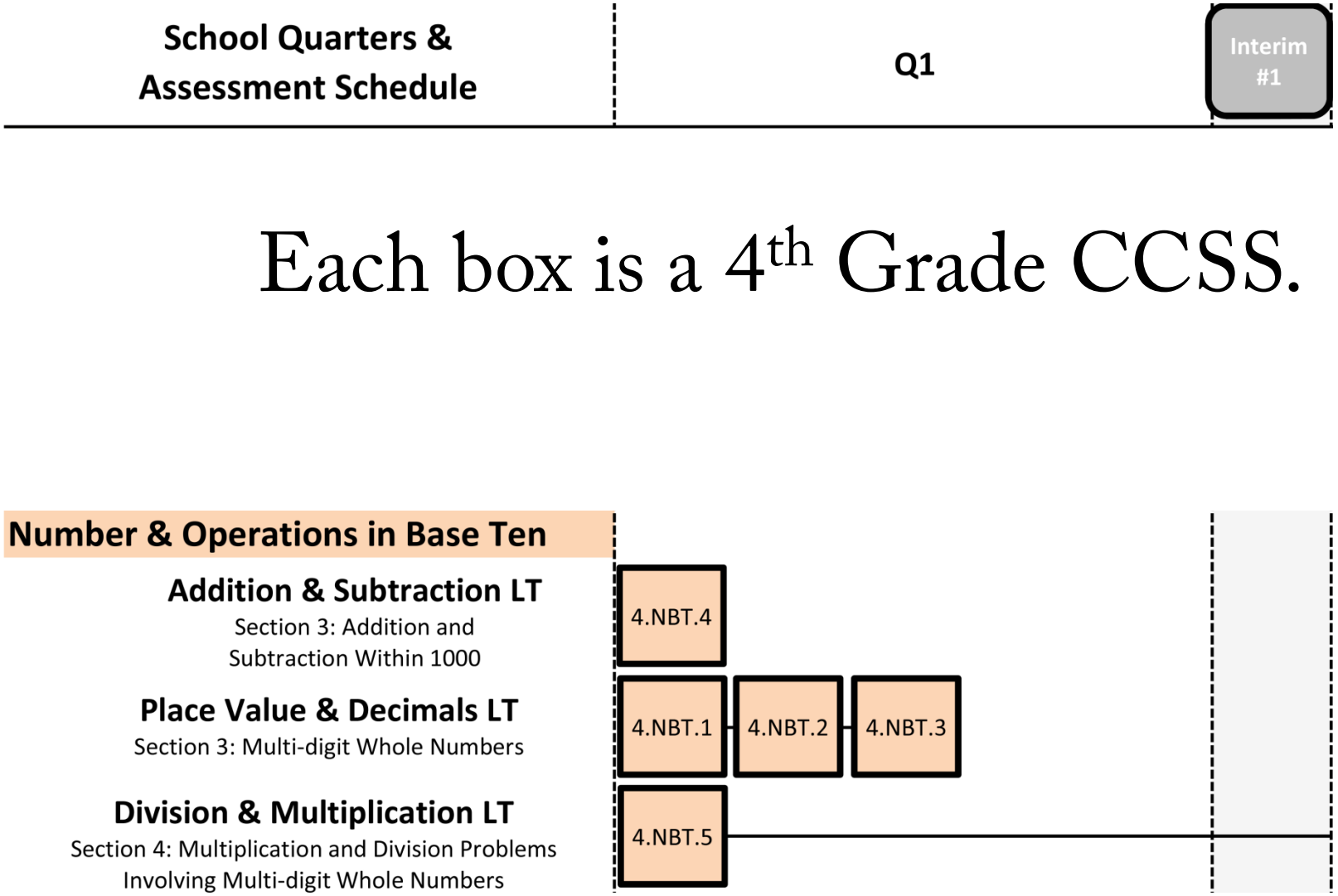


Let's examine the key parts of this map by looking at Quarter 1.


School Quarters &
Assessment Schedule
Q1
Interim #1
Operations & Algebraic Thinking
Division & Multiplication LT
Section 3: Factors and Multiples
4.OA.4
Number & Operations in Base Ten
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5

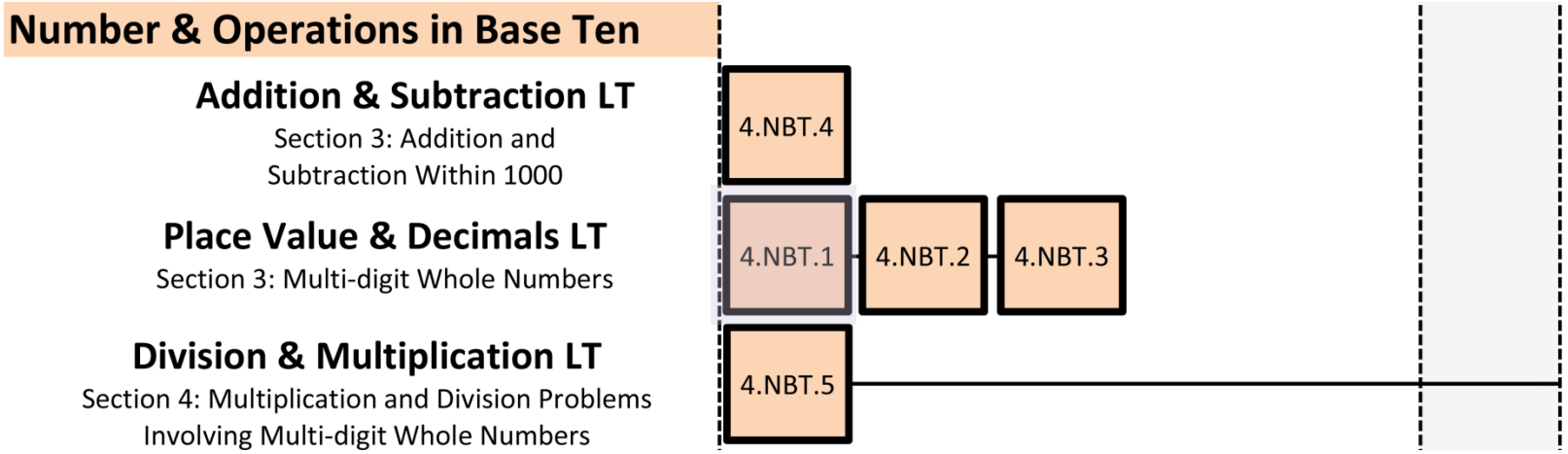
Quarter & Assessment Administration

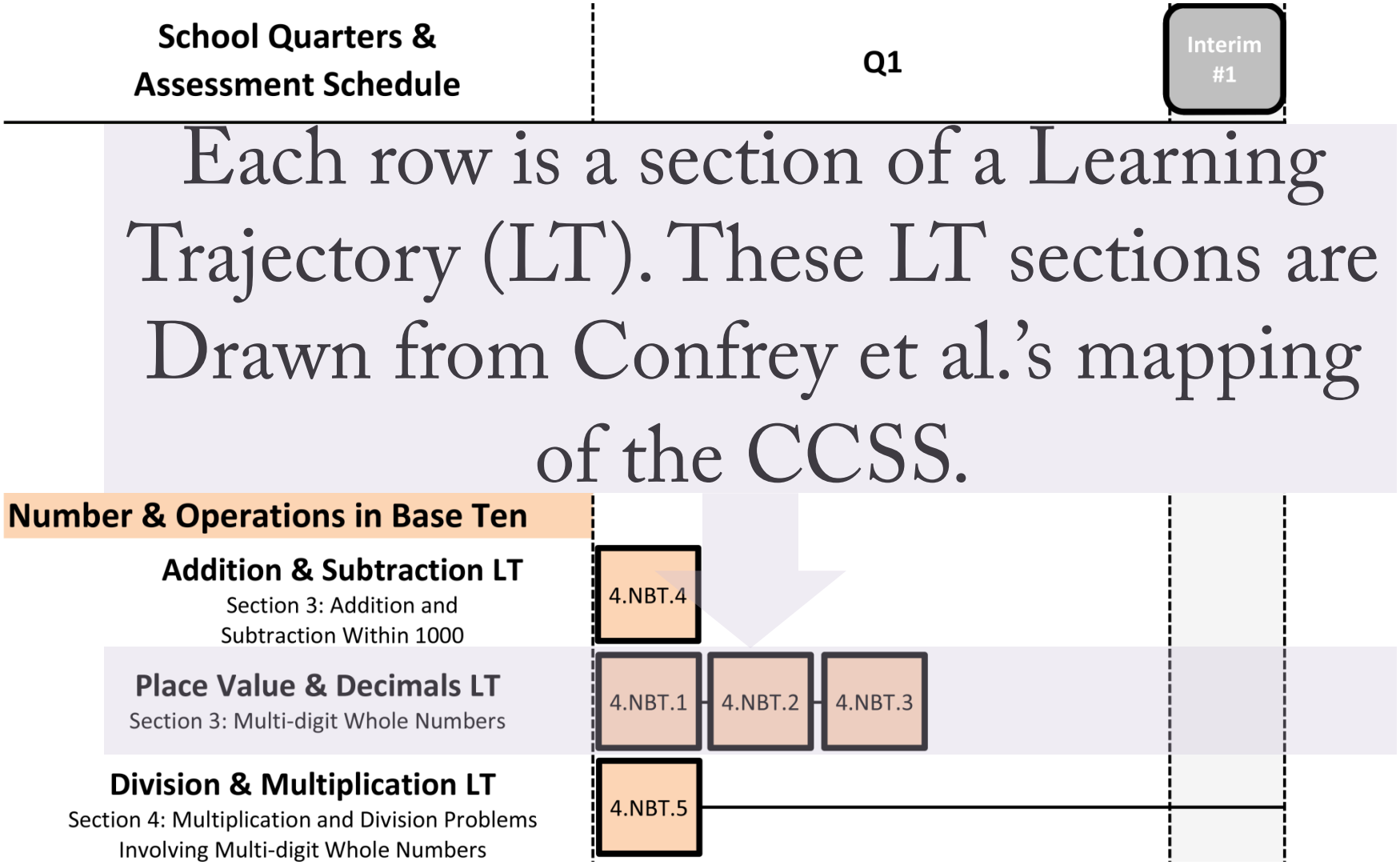




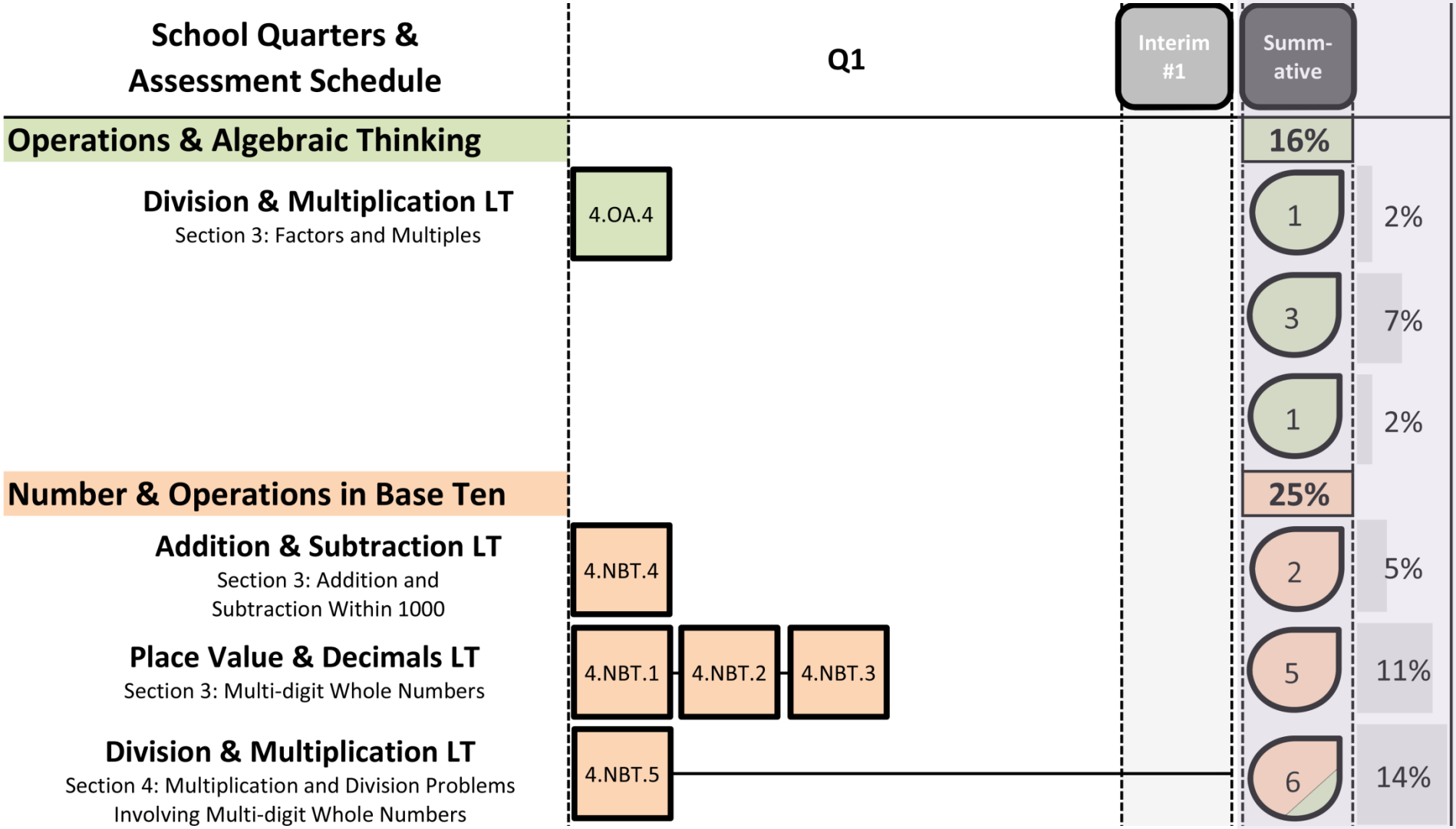
Each box is a 4th Grade CCSS.

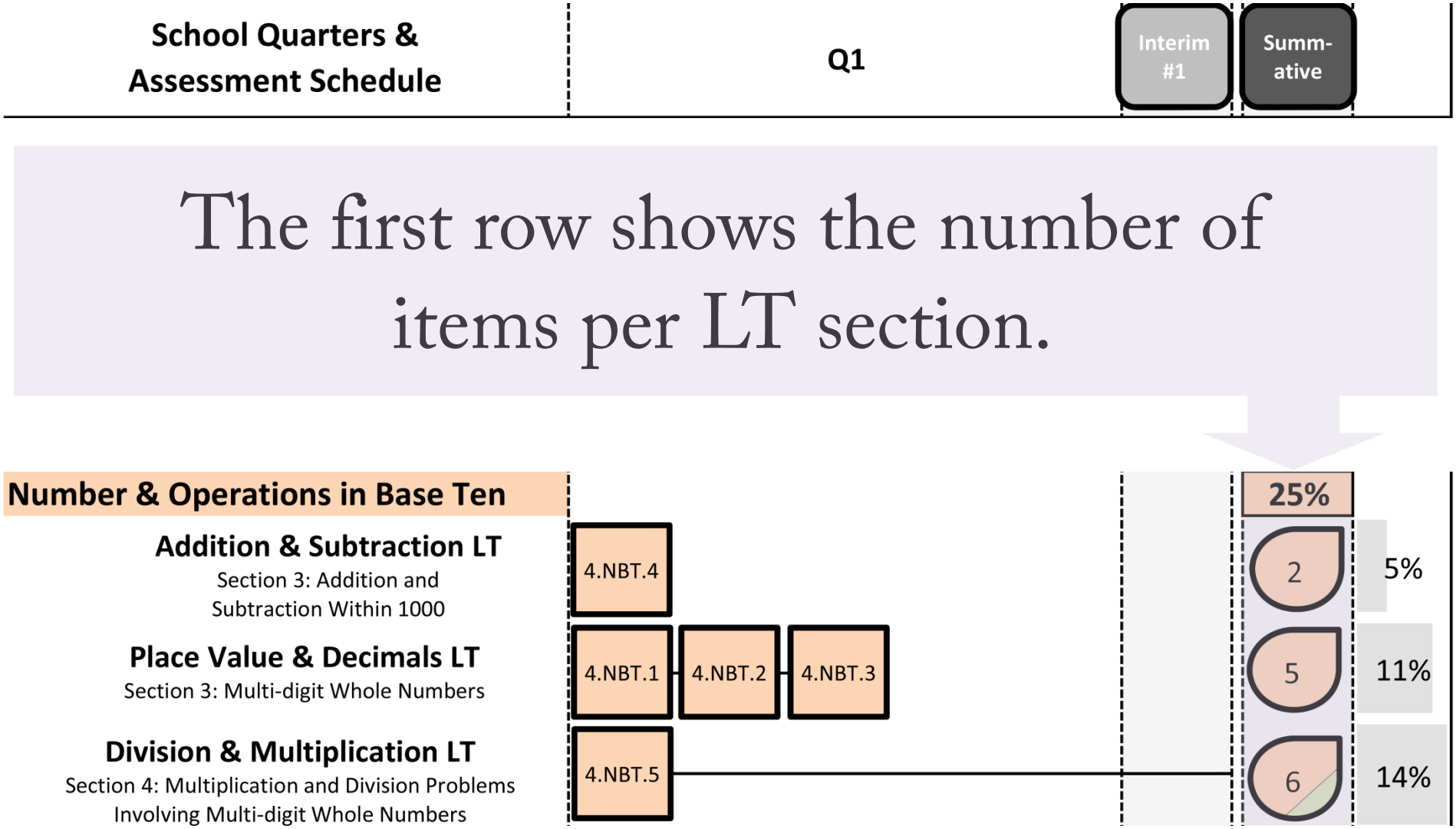
E.g., 4.NBT.1 is Numbers & Operations in Base Ten, Standard 1.




School Quarters &
Assessment Schedule
Q1
Interim #1
Each row is a section of a Learning Trajectory (LT). These LT sections are Drawn from Confrey et al.'s mapping of the CCSS.
Number & Operations in Base Ten
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5

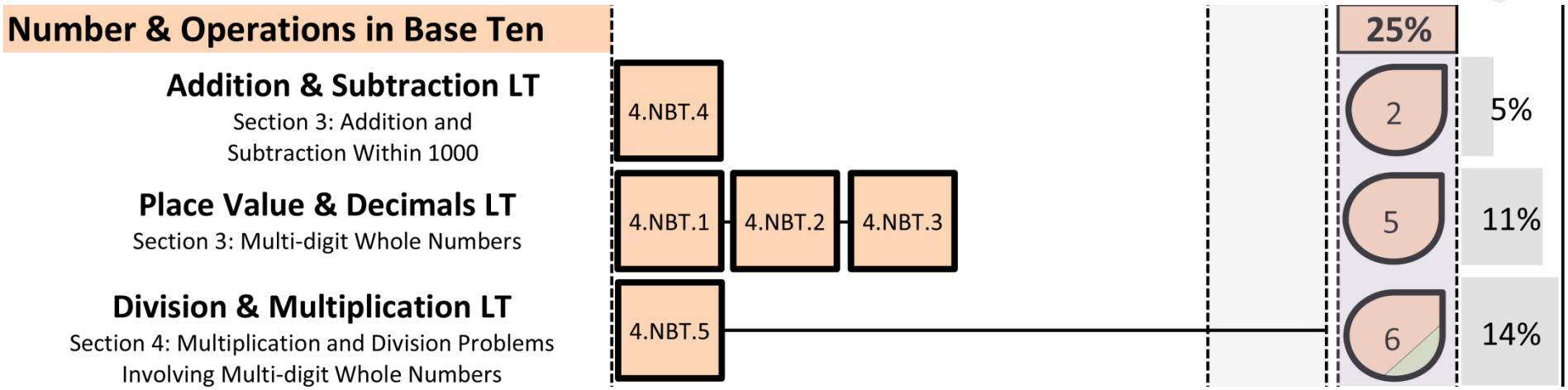
Summative Assessment



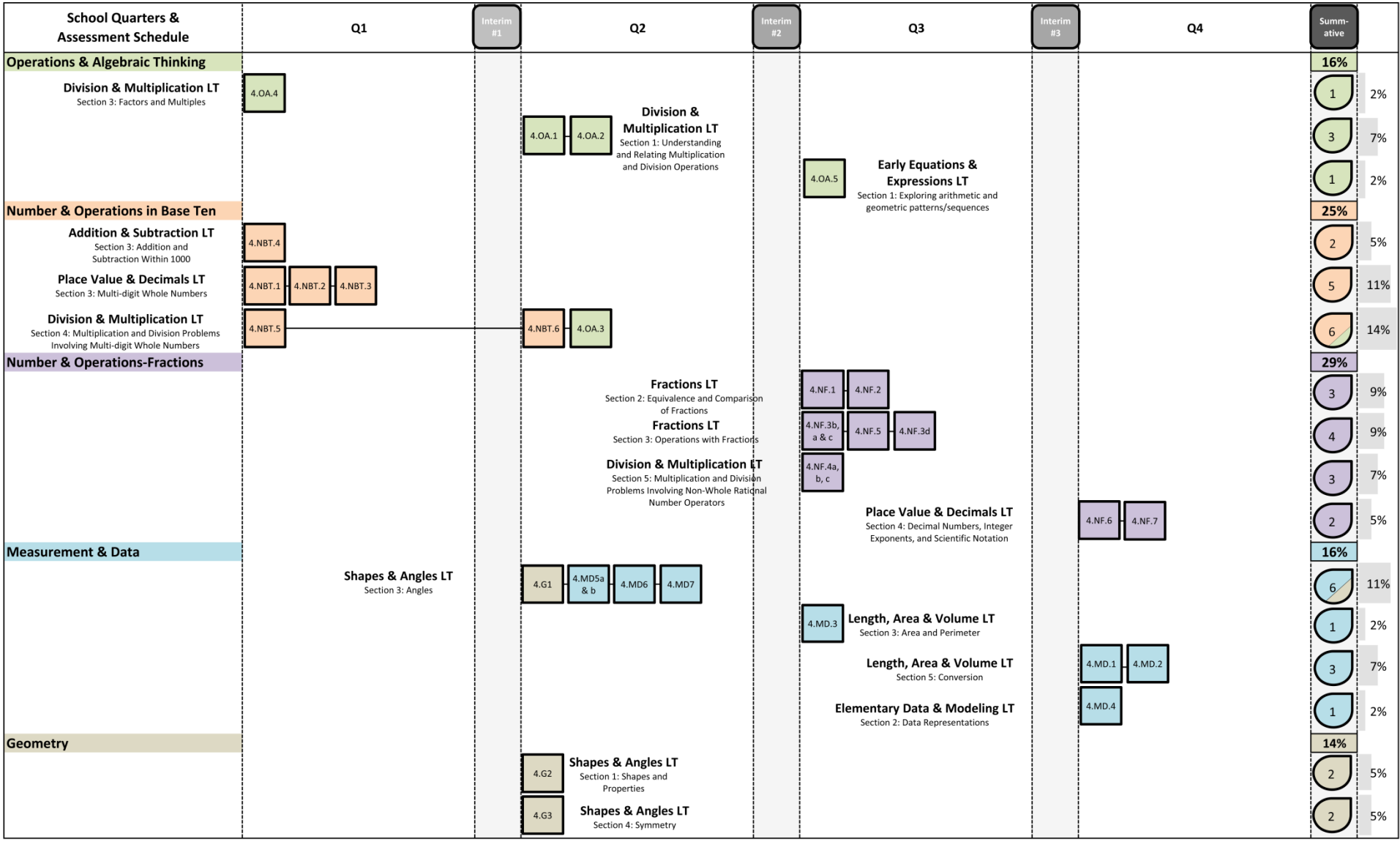

School Quarters & Assessment Schedule
Q1
Interim #1
Summ-ative
The first row shows the number of items per LT section.
Number & Operations in Base Ten
25%
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
2
5%
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
5
11%
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5
6
14%

School Quarters & Assessment Schedule	Q1	Interim #1	Summ-ative

The second row shows the percent of items per LT section.



Curriculum Map



2 Assessment

Assessment

The LT Sections on each assessment, the number of items per LT, the scores reported, & when the assessments are given.

Assessment

The LT Sections on each assessment, the number of items per LT, the scores reported, & when the assessments are given.

Assessment

The LT Sections on each assessment, the number of items per LT

Issues of design that cut across "types" of assessments.

The LT Sections on each assessment can be selected based on

The summative assessment.

Instruction.

A Post/Pre Design.

The LT Sections on each assessment can be selected based on

The summative assessment.

Instruction, for this example.

A Post/Pre Design.

The number of items per LT section can

Equal.

Unequal.

The number of items per LT section can

Equal.

Unequal,
with emphasis
based on

Summative
Assessment.

District
Judgment.

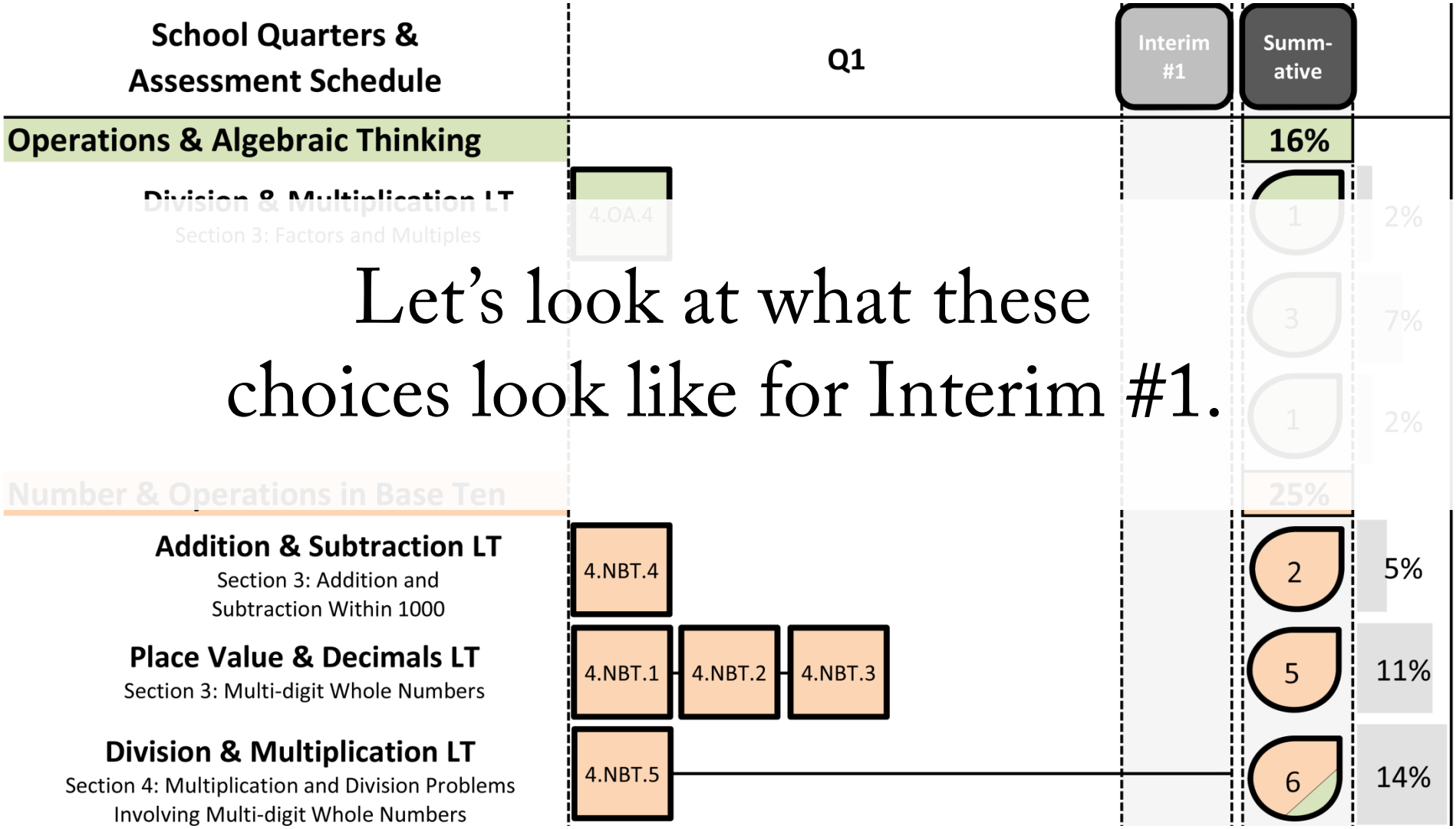
The number of items per LT section can

Equal.

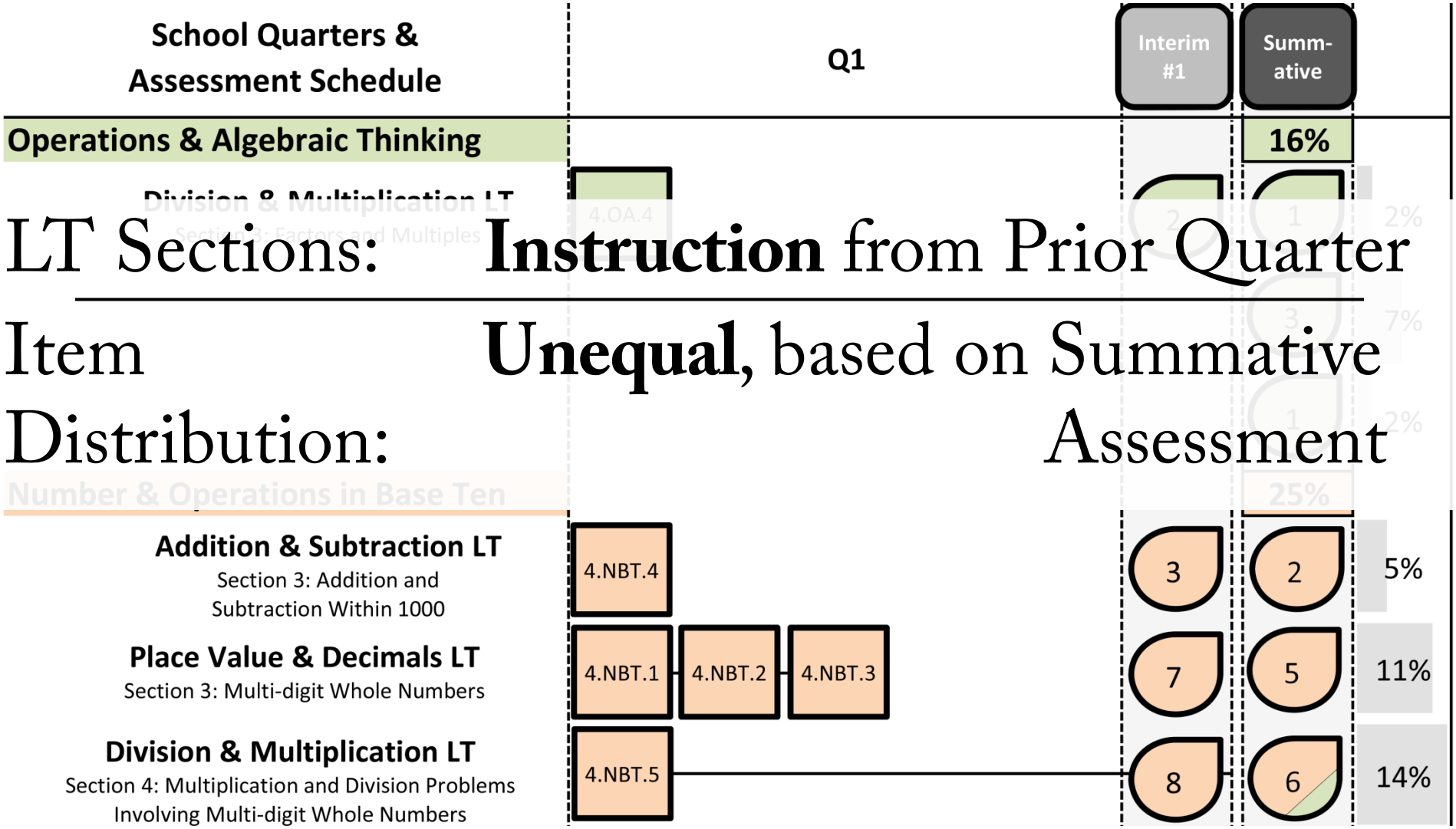
Unequal, with emphasis based on

Summative Assessment.

District Judgment.

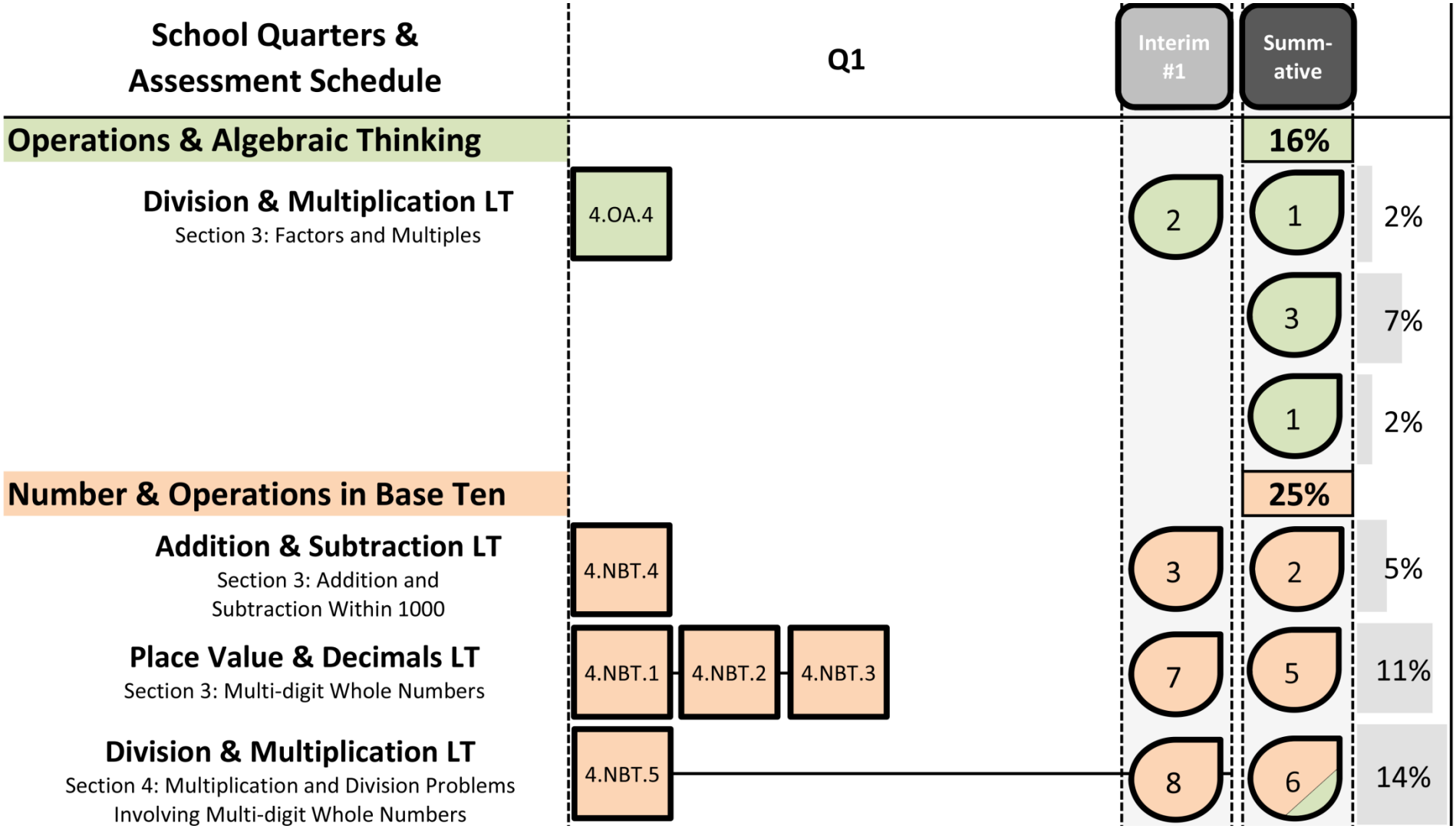


Let's look at what these choices look like for Interim #1.



LT Sections: **Instruction** from Prior Quarter

Item Distribution: **Unequal**, based on Summative Assessment


School Quarters & Assessment Schedule
Q1
Interim #1
Summ-ative
Operations & Algebraic Thinking
16%
Division & Multiplication LT
Section 3: Factors and Multiples
4.OA.4
2
1
2%
3
7%
1
2%
Number & Operations in Base Ten
25%
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
3
2
5%
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
7
5
11%
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5
8
6
14%

3

Use

Use

The purpose of the assessment system and the theory of action that supports it.

Purpose

Diagnostic

Predictive

Evaluative

Purpose

Diagnostic

Predictive

Evaluative

Purpose

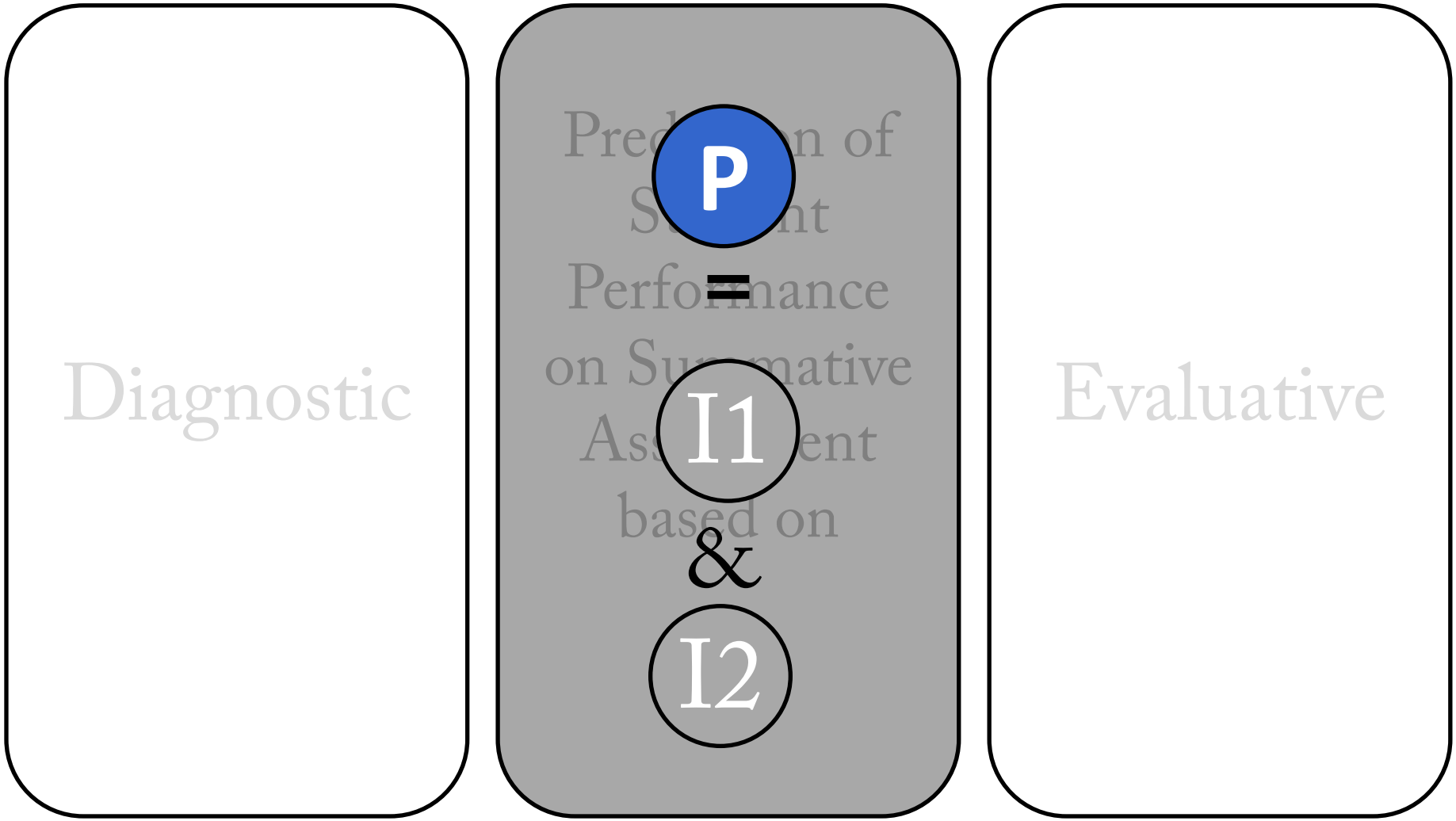
Diagnostic

Prediction of Student Performance on Summative Assessment based on

Interim #1 & Interim #2

Evaluative

Purpose


Diagnostic
Prediction of Student Performance on Summative Assessment based on
P
=
I1
&
I2
Evaluative

What is 

?

is a prediction of performance on the summative assessment.

is a prediction of performance on the summative assessment,

based on a statistical model, e.g.,
- linear regression,
- Bayesian network, or
- tree model.

Teachers use  to
inform their instructional decisions.

Teachers use  to inform their instructional decisions.

Extra support within the classroom
Extra support outside the classroom
Extended support outside of the classroom
Intensive support outside of the classroom

see the work of Phil Daro.

Teachers use  to
inform their instructional decisions.

Extra support within the classroom

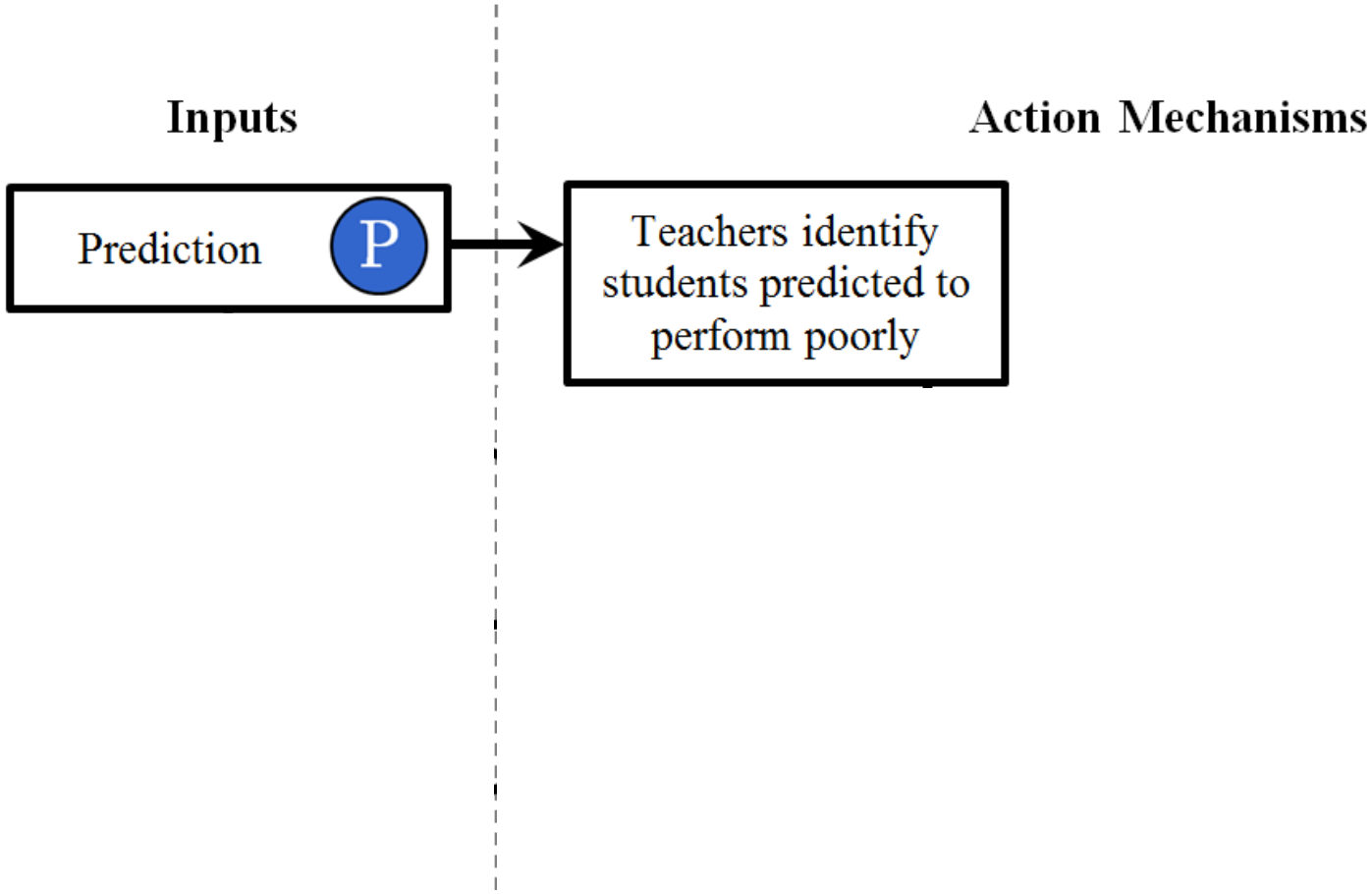
Extra support outside the classroom

Extended support outside of the classroom

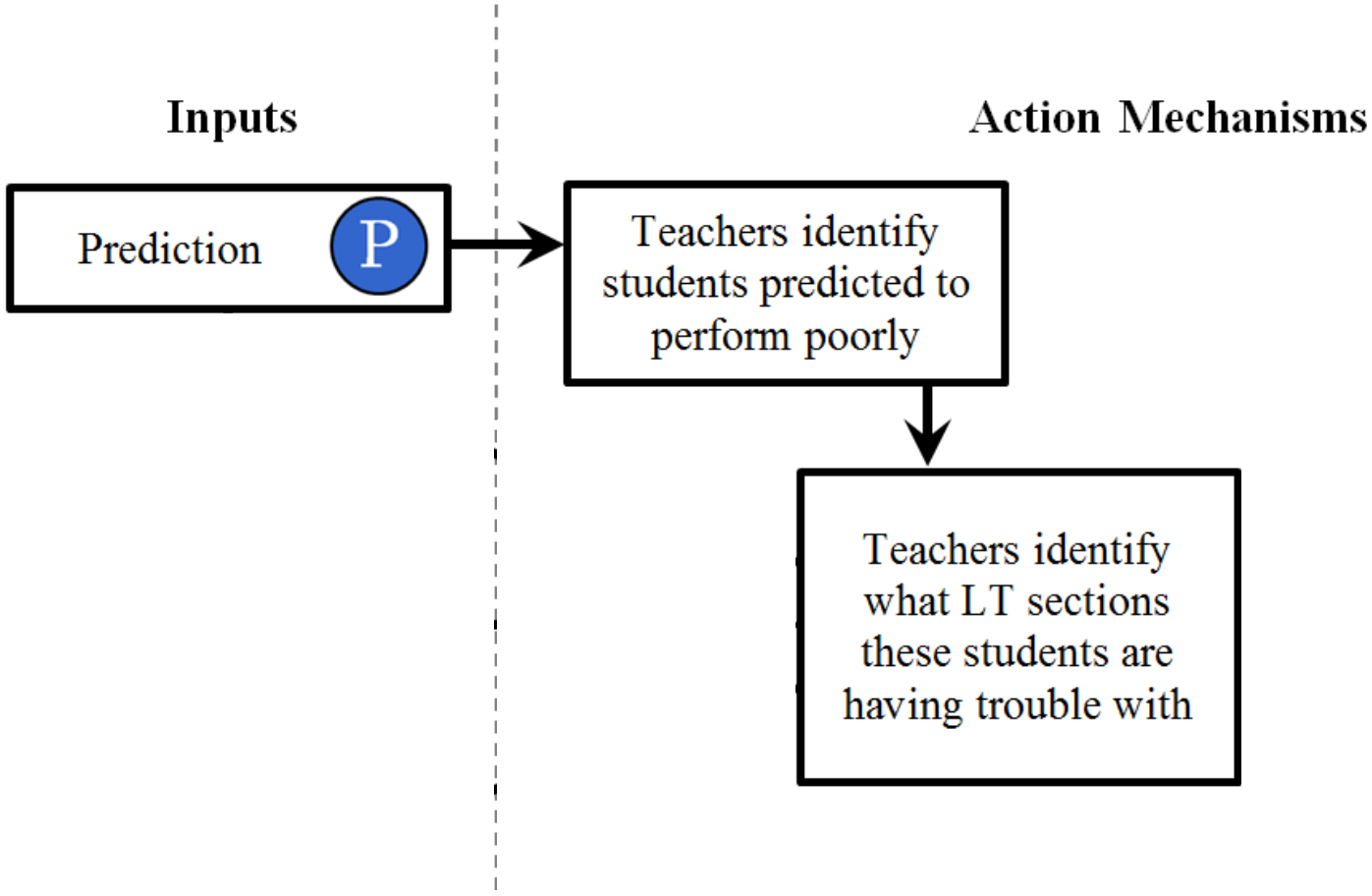
Intensive support outside of the classroom

see the work of Phil Daro.

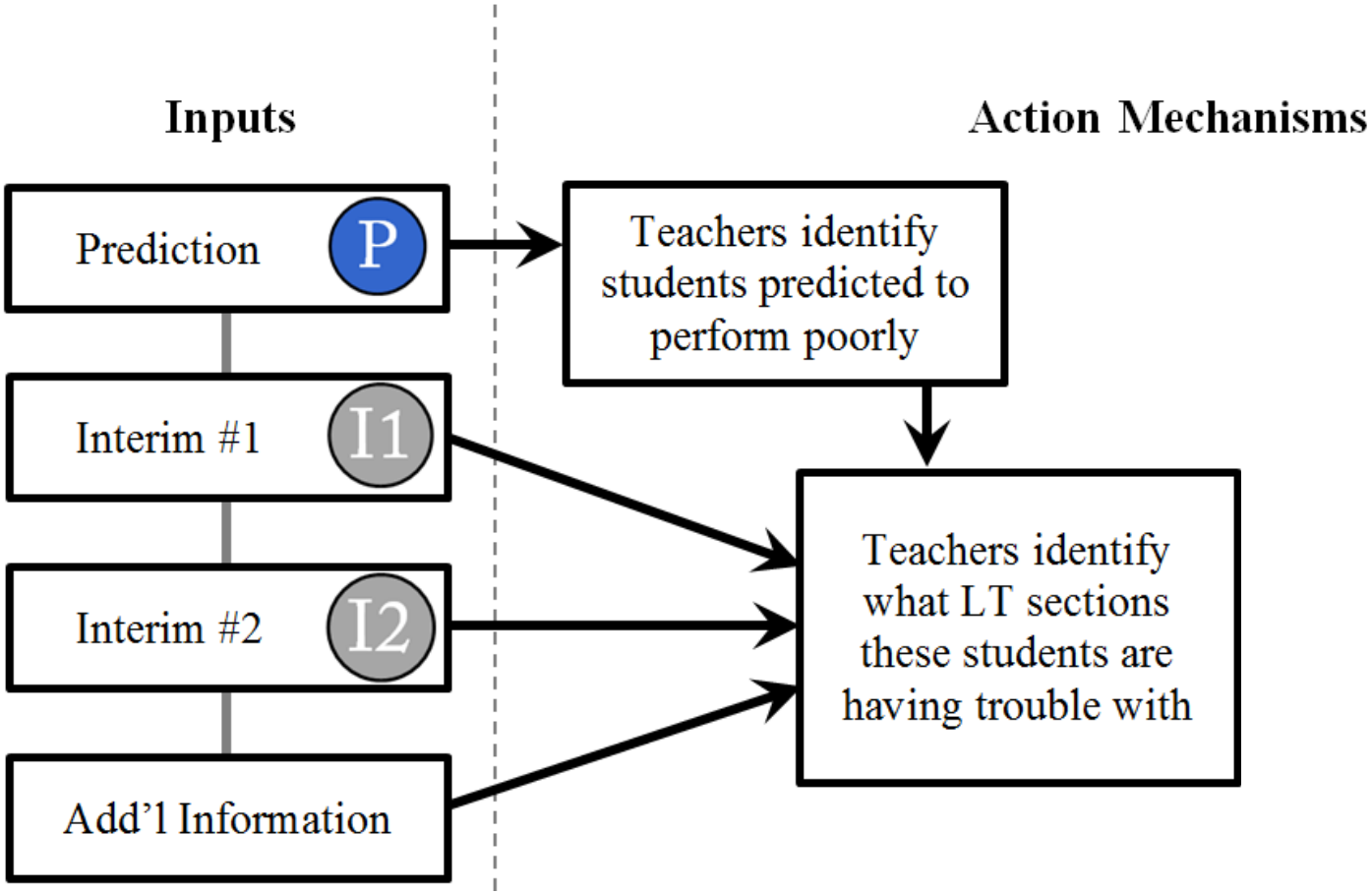
Theory of Action

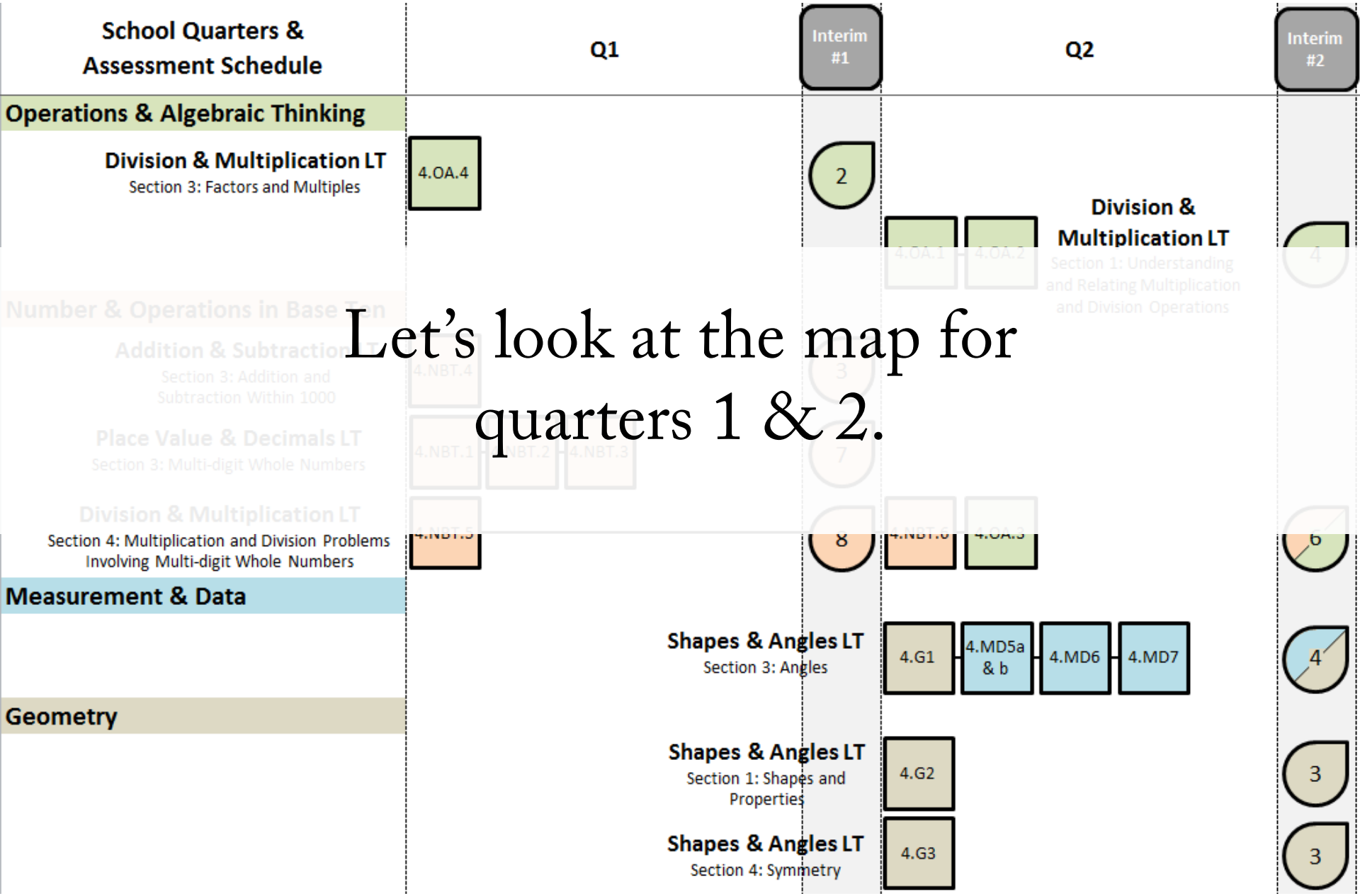


Theory of Action

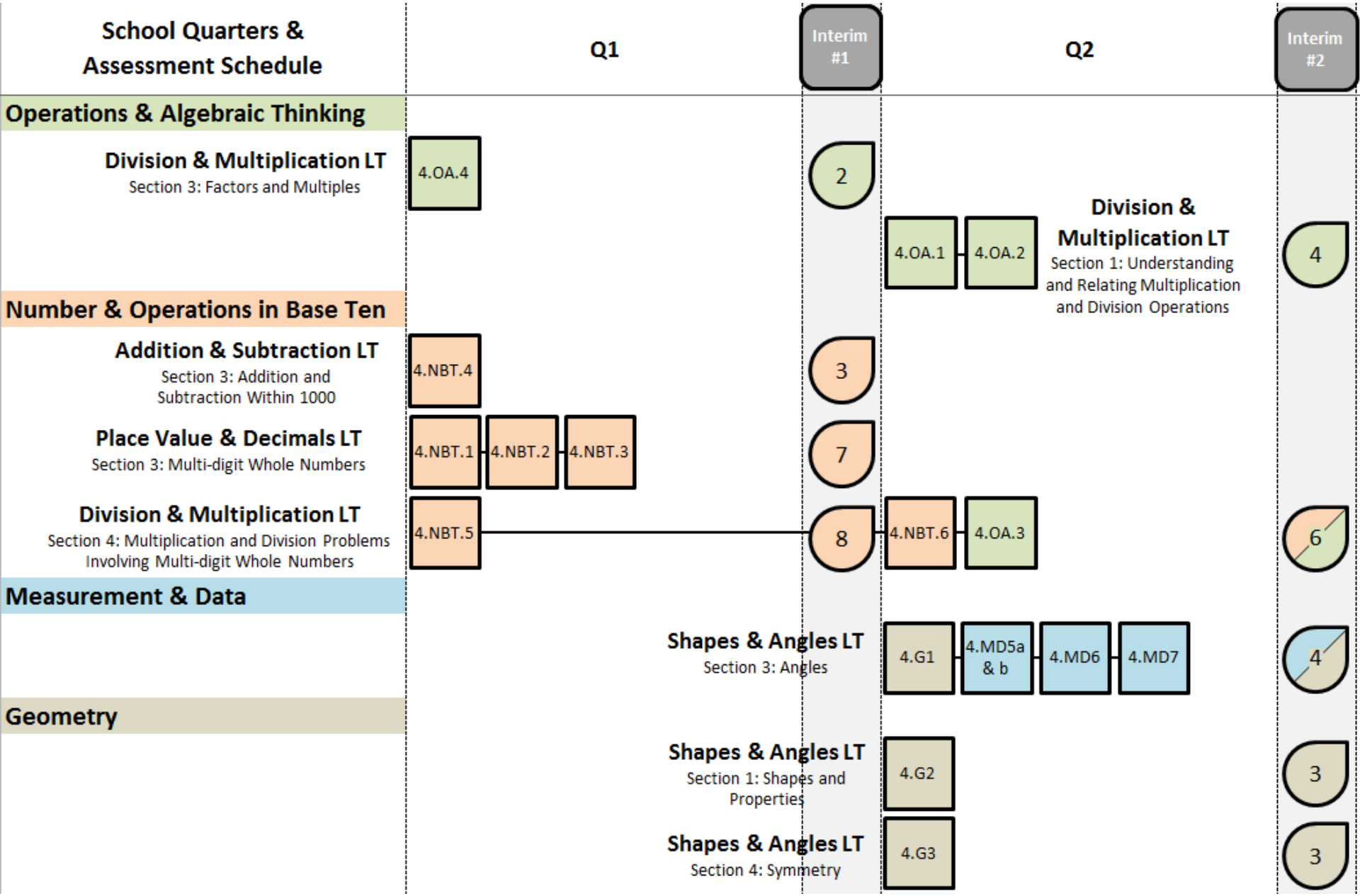


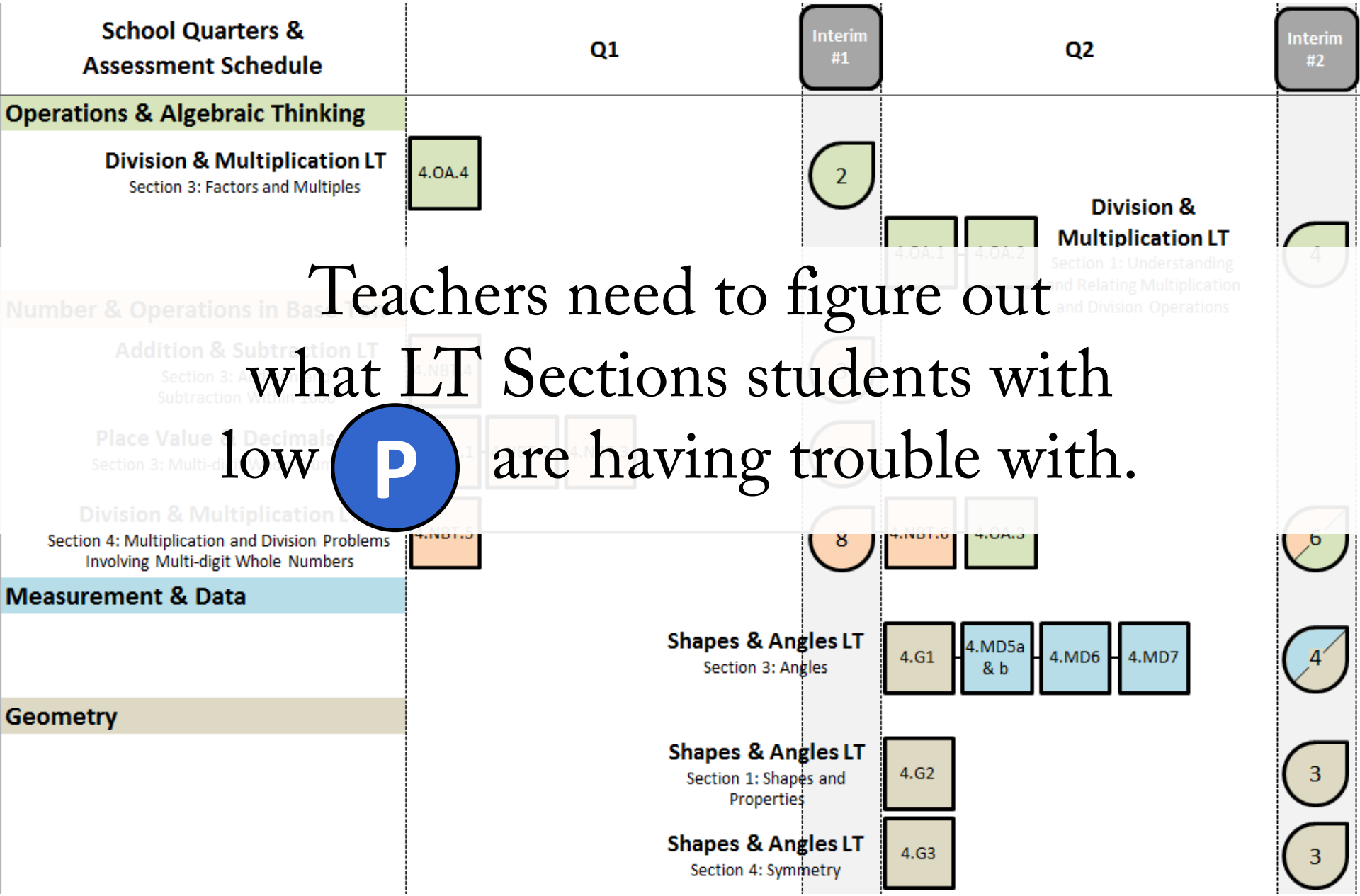
Theory of Action



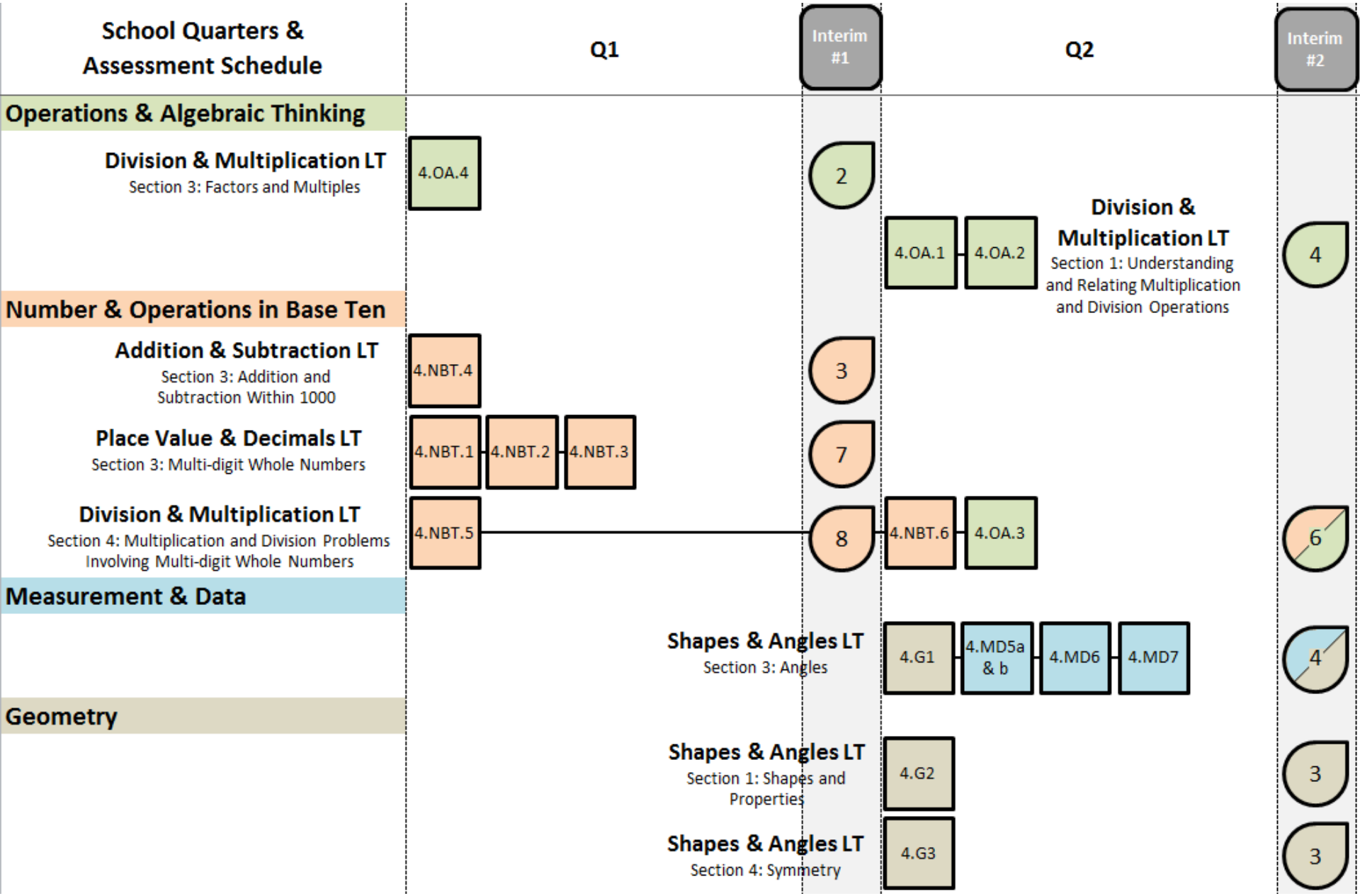


Let's look at the map for quarters 1 & 2.


School Quarters & Assessment Schedule
Q1
Interim #1
Q2
Interim #2
Operations & Algebraic Thinking
Division & Multiplication LT
Section 3: Factors and Multiples
4.OA.4
2
4.OA.1
4.OA.2
Division & Multiplication LT
Section 1: Understanding and Relating Multiplication and Division Operations
4
Number & Operations in Base Ten
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
3
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
7
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5
8
4.NBT.6
4.OA.3
6
Measurement & Data
Shapes & Angles LT
Section 3: Angles
4.G1
4.MD5a & b
4.MD6
4.MD7
4
Geometry
Shapes & Angles LT
Section 1: Shapes and Properties
4.G2
3
Shapes & Angles LT
Section 4: Symmetry
4.G3
3



Teachers need to figure out what LT Sections students with low P are having trouble with.


School Quarters & Assessment Schedule
Q1
Interim #1
Q2
Interim #2
Operations & Algebraic Thinking
Division & Multiplication LT
Section 3: Factors and Multiples
4.OA.4
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4.OA.1
4.OA.2
Division & Multiplication LT
Section 1: Understanding and Relating Multiplication and Division Operations
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Number & Operations in Base Ten
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Section 3: Addition and Subtraction Within 1000
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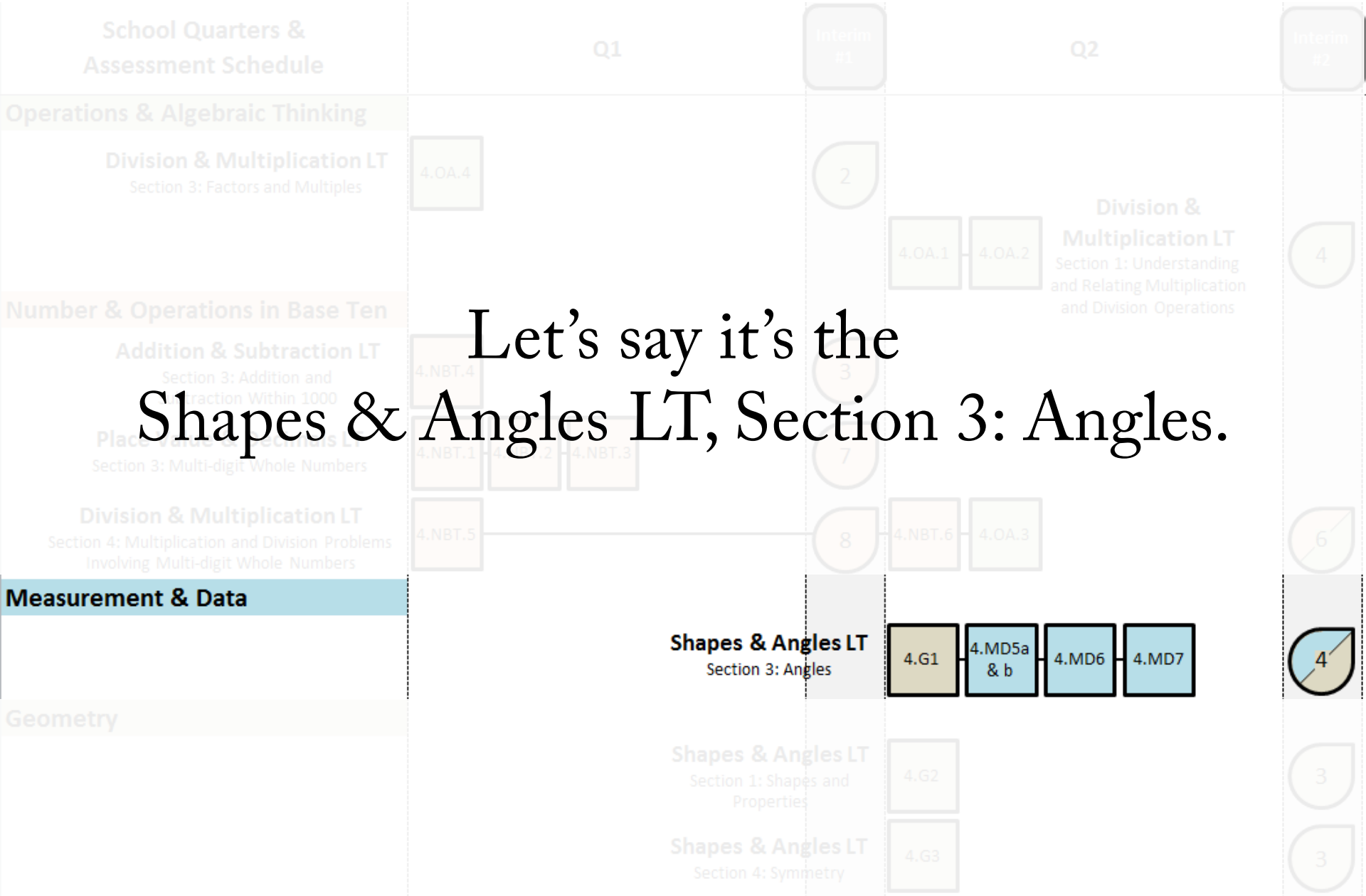
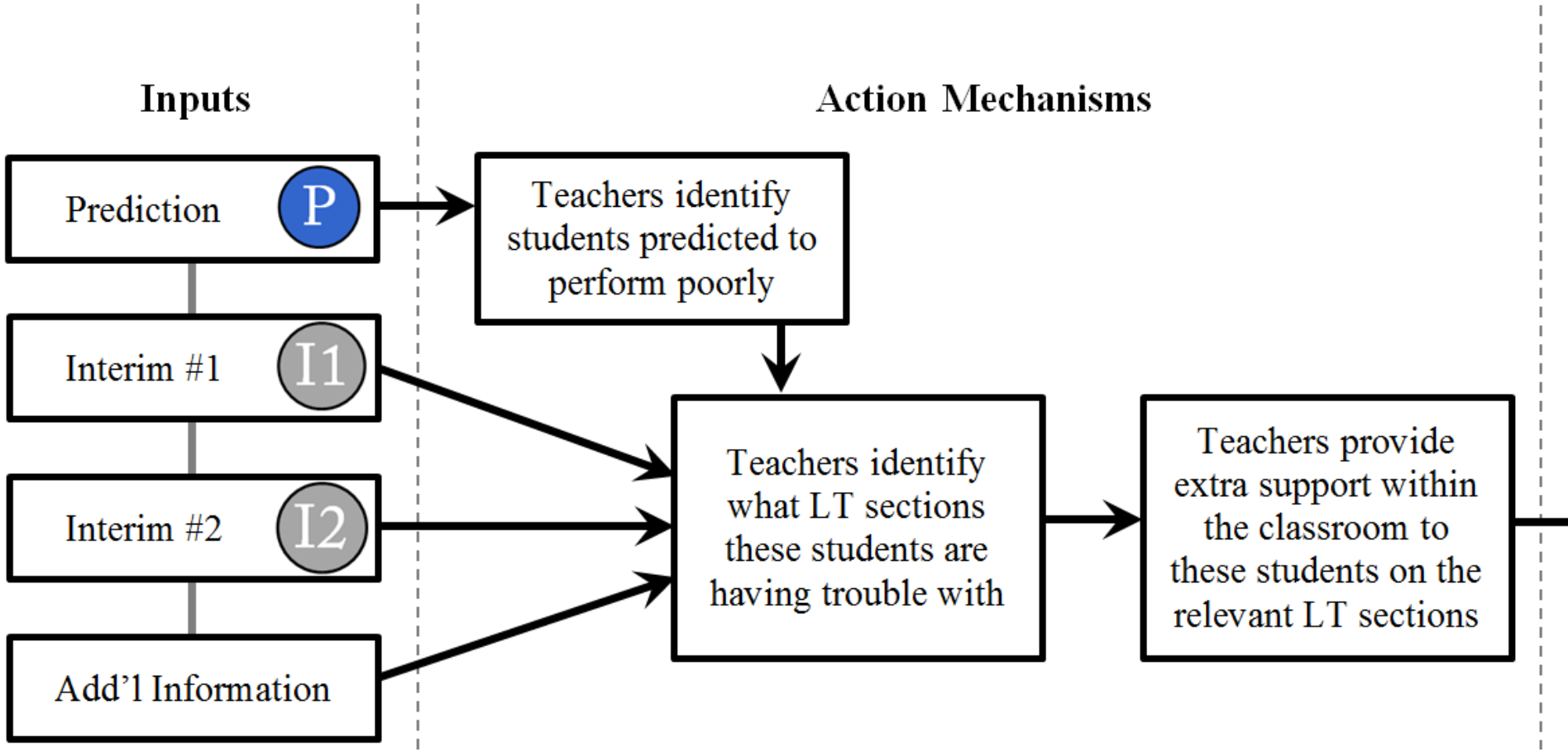
3
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
7
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5
8
4.NBT.6
4.OA.3
6
Measurement & Data
Shapes & Angles LT
Section 3: Angles
4.G1
4.MD5a & b
4.MD6
4.MD7
4
Geometry
Shapes & Angles LT
Section 1: Shapes and Properties
4.G2
3
Shapes & Angles LT
Section 4: Symmetry
4.G3
3

Let's say it's the
Shapes & Angles LT, Section 3: Angles.

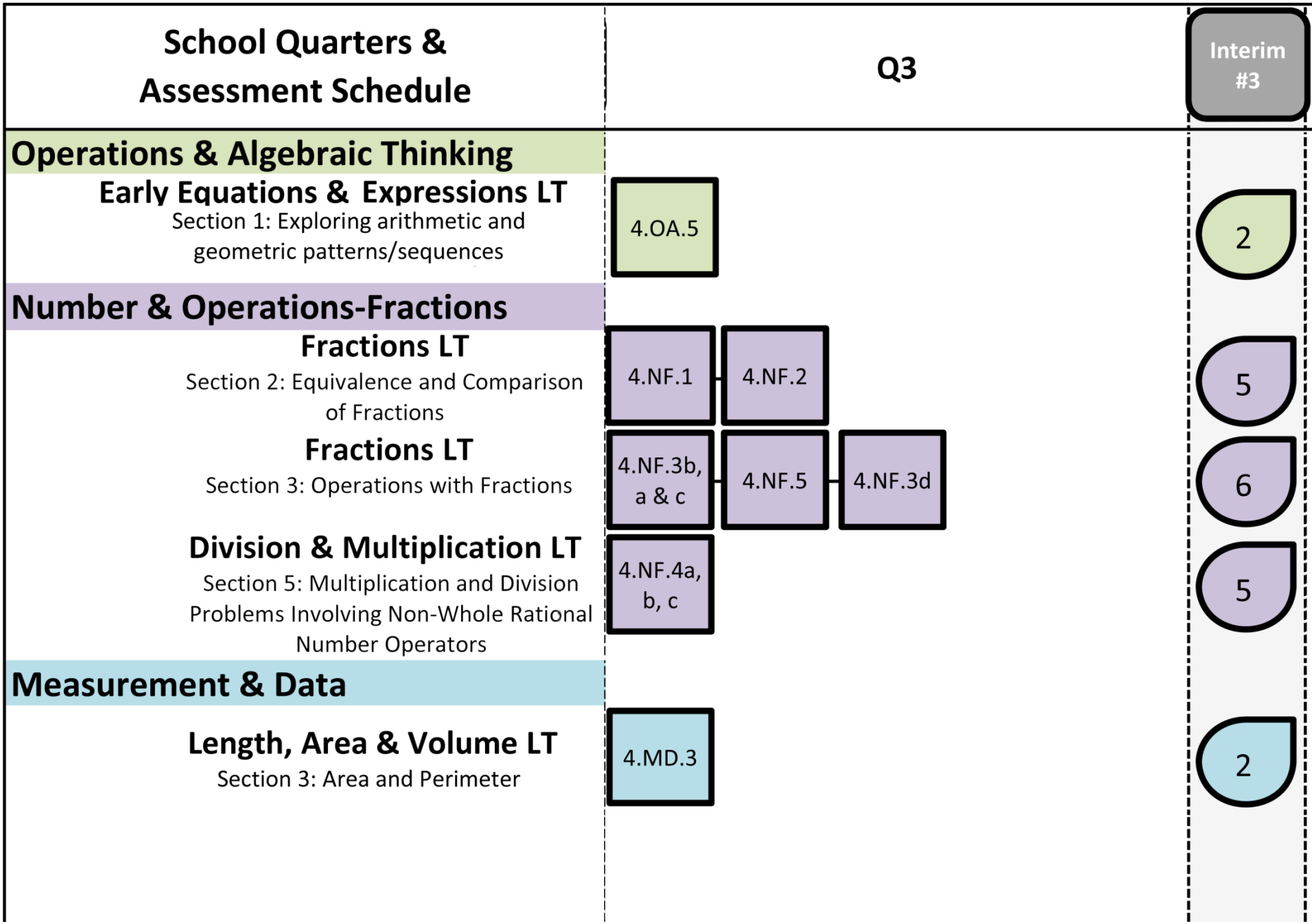


Theory of Action



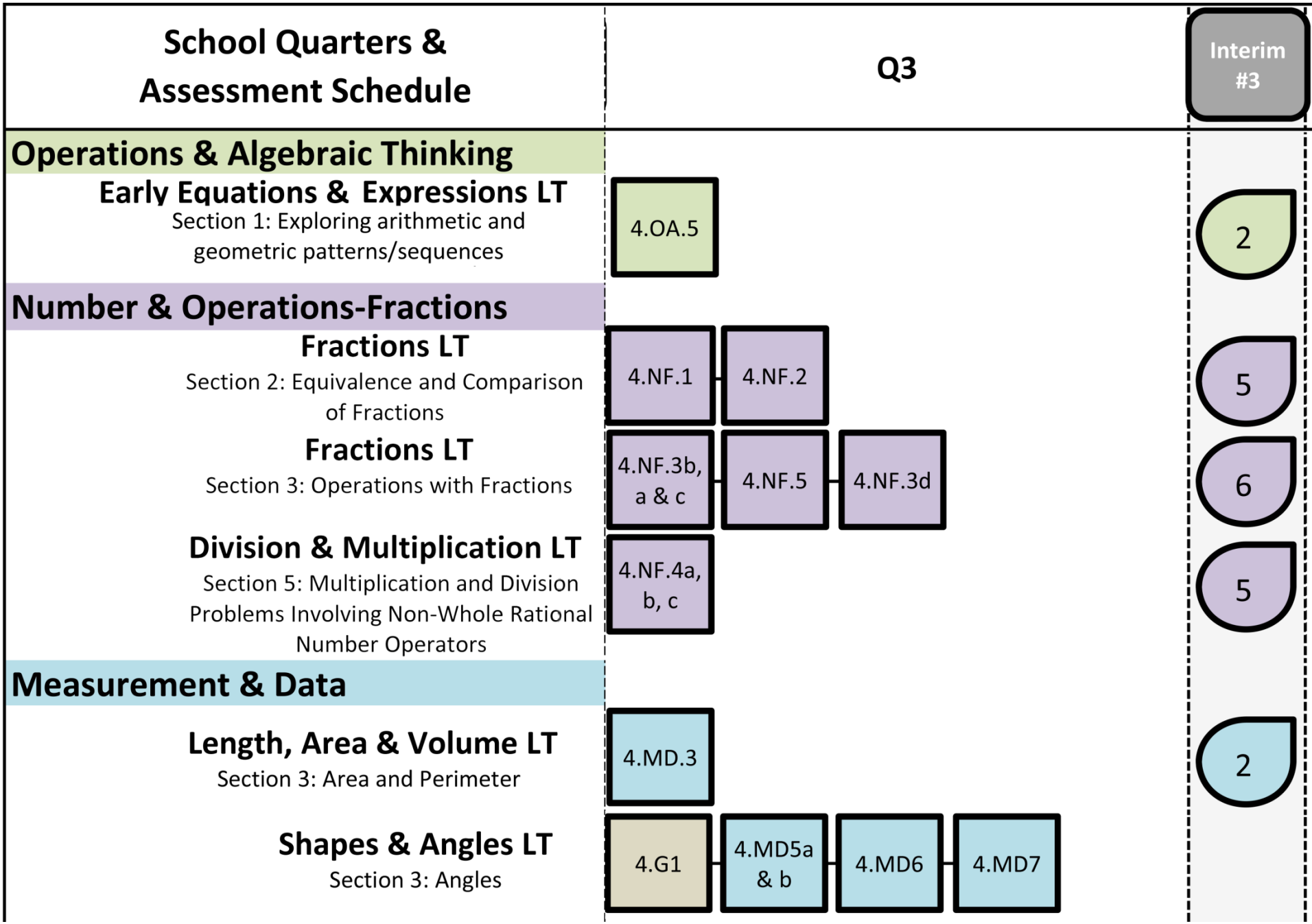
School Quarters & Assessment Schedule	Q3	Interim #3
Operations & Algebraic Thinking		
Early Equations & Expressions LT Section 1: Exploring arithmetic and geometric patterns/sequences	4.OA.5	2
Number & Operations-Fractions		
Fractions LT Section 2: Equivalence and Comparison of Fractions	4.NF.1 4.NF.2	5
Fractions LT Section 3: Operations with Fractions	4.NF.3b, a & c 4.NF.5 4.NF.3d	6
Division & Multiplication LT Section 5: Multiplication and Division Problems Involving Non-Whole Rational Number Operators	4.NF.4a, b, c	5
Measurement & Data		
Length, Area & Volume LT Section 3: Area and Perimeter	4.MD.3	2

Regular Instruction for Quarter 3.


School Quarters &
Assessment Schedule
Q3
Interim #3
Operations & Algebraic Thinking
Early Equations & Expressions LT
Section 1: Exploring arithmetic and geometric patterns/sequences
4.OA.5
2
Number & Operations-Fractions
Fractions LT
Section 2: Equivalence and Comparison of Fractions
4.NF.1
4.NF.2
5
Fractions LT
Section 3: Operations with Fractions
4.NF.3b, a & c
4.NF.5
4.NF.3d
6
Division & Multiplication LT
Section 5: Multiplication and Division Problems Involving Non-Whole Rational Number Operators
4.NF.4a, b, c
5
Measurement & Data
Length, Area & Volume LT
Section 3: Area and Perimeter
4.MD.3
2

School Quarters & Assessment Schedule	Q3	Interim #3
Operations & Algebraic Thinking		
Early Equations & Expressions LT Section 1: Exploring arithmetic and geometric patterns/sequences	4.OA.5	2
Number & Operations-Fractions		
Fractions LT Section 2: Equivalence and Comparison of Fractions	4.NF.1 — 4.NF.2	5
Fractions LT Section 3: Operations with Fractions	4.NF.3b, a & c — 4.NF.5 — 4.NF.3d	6
Division & Multiplication LT Section 5: Multiplication and Division Problems Involving Non-Whole Rational Number Operators	4.NF.4a, b, c	5
Measurement & Data		
Length, Area & Volume LT Section 3: Area and Perimeter	4.MD.3	2
Shapes & Angles LT Section 3: Angles	4.G1 — 4.MD5a & b — 4.MD6 — 4.MD7	

Instruction for students with low P.


School Quarters &
Assessment Schedule
Q3
Interim #3
Operations & Algebraic Thinking
Early Equations & Expressions LT
Section 1: Exploring arithmetic and geometric patterns/sequences
4.OA.5
2
Number & Operations-Fractions
Fractions LT
Section 2: Equivalence and Comparison of Fractions
4.NF.1
4.NF.2
5
Fractions LT
Section 3: Operations with Fractions
4.NF.3b, a & c
4.NF.5
4.NF.3d
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Division & Multiplication LT
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4.NF.4a, b, c
5
Measurement & Data
Length, Area & Volume LT
Section 3: Area and Perimeter
4.MD.3
2
Shapes & Angles LT
Section 3: Angles
4.G1
4.MD5a & b
4.MD6
4.MD7

School Quarters & Assessment Schedule

Q3

Interim #3

Operations & Algebraic Thinking

Early Equations & Expressions LT

Section 1: Exploring arithmetic and geometric patterns/sequences

4.OA.5

2

Number & Operations-Fractions

Fractions LT

Section 3: Equivalence and Comparison of Fractions

4.NF.1

4.NF.2

5

Fractions LT

Section 3: Operations with Fractions

4.NF.3 a & c

4.NF.4

6

Division & Multiplication

Section 5: Multiplication and Division Problems Involving Non-Whole Rational Number Operators

4.NF.4a, b, c

5

Measurement & Data

Length, Area & Volume LT

Section 3: Area and Perimeter

4.MD.3

2

Shapes & Angles LT

Section 3: Angles

4.G1

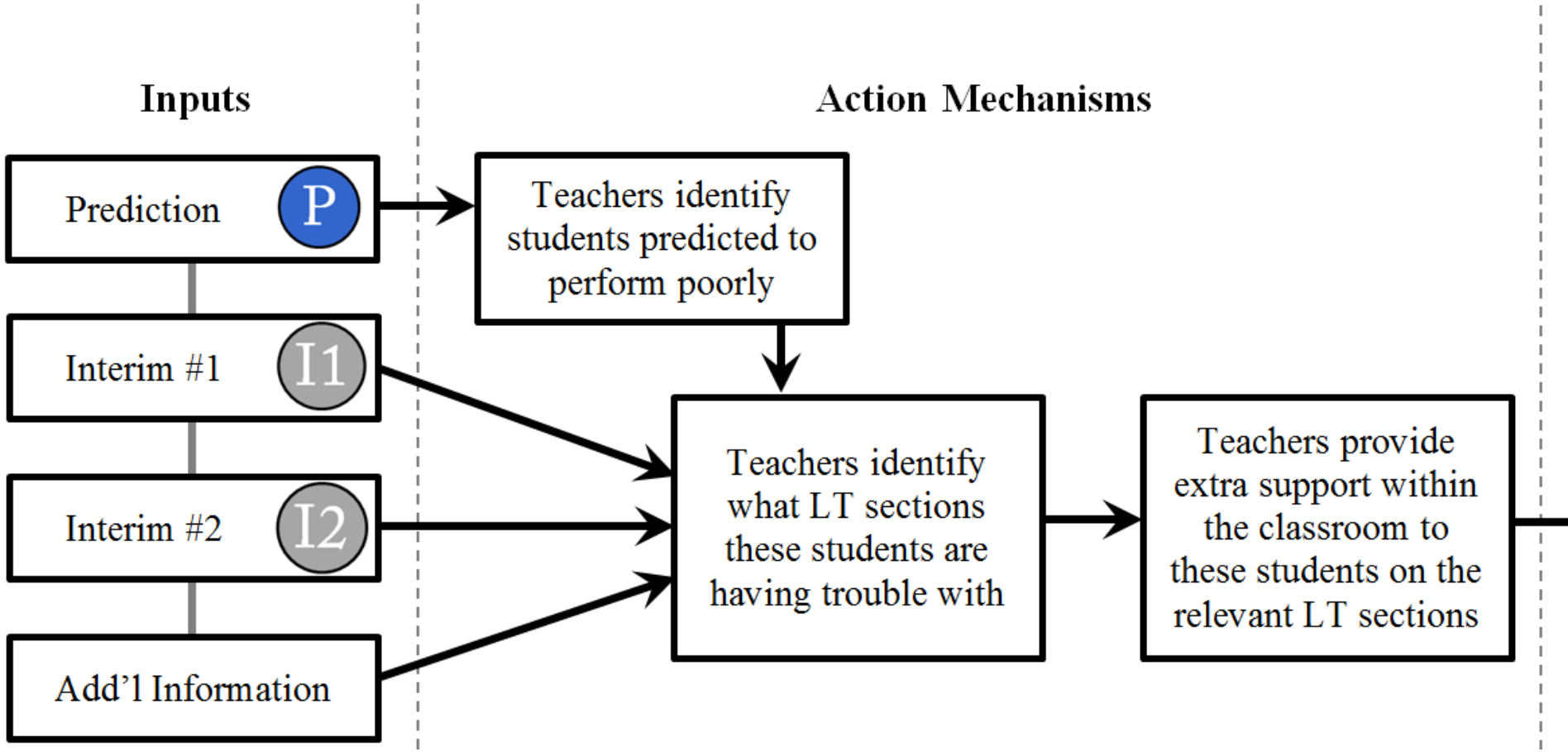
4.MD5a & b

4.MD6

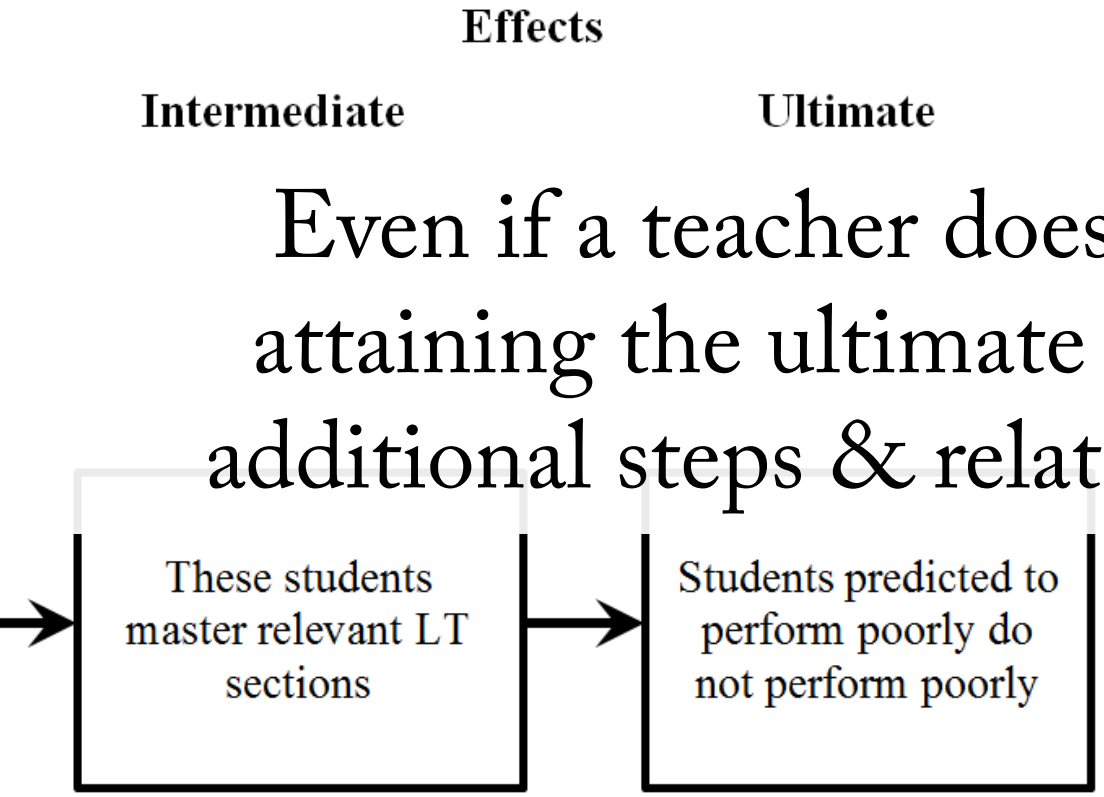
4.MD7

These students must be taught all of the third quarter LT sections plus an extra LT section.

Theory of Action



Theory of Action

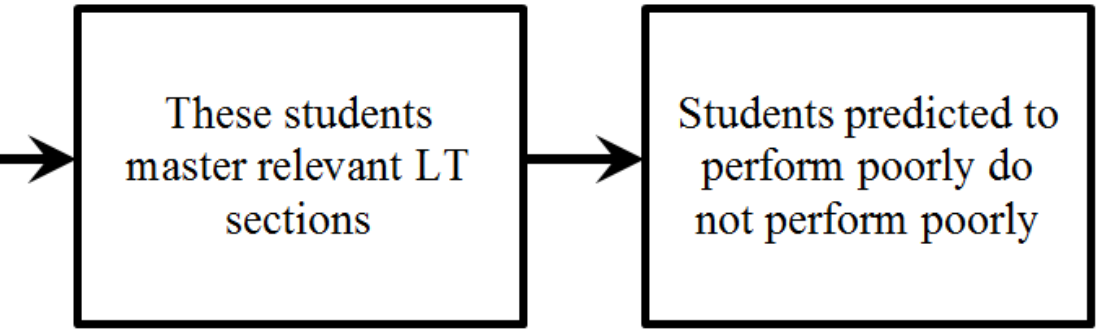


Even if a teacher does these actions, attaining the ultimate effect relies on additional steps & related assumptions.

Theory of Action

Effects

Intermediate **Ultimate**

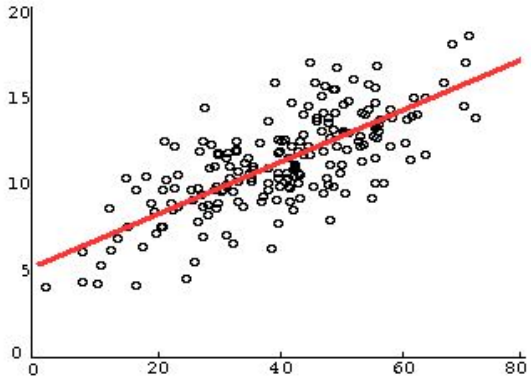


4 Statistical Model

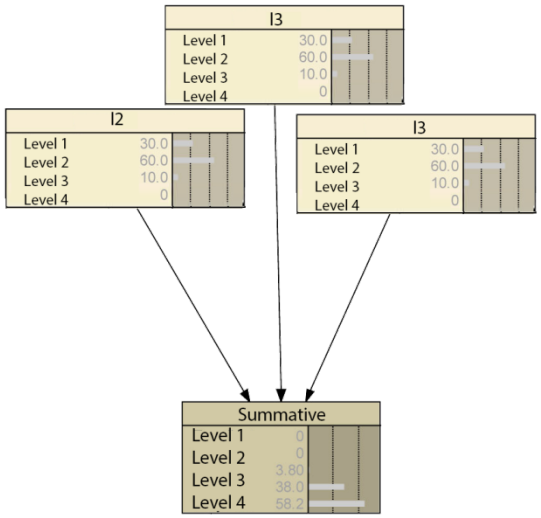
Statistical Model

The model used and their benefits.

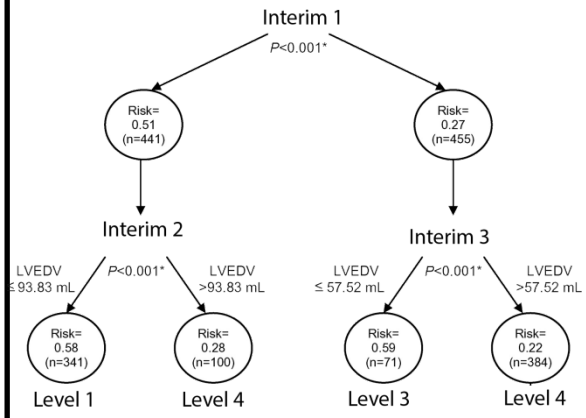
Some Possible Models



Regression



Bayesian Networks



Tree Models

Despite their differences, these models have many of the same benefits.

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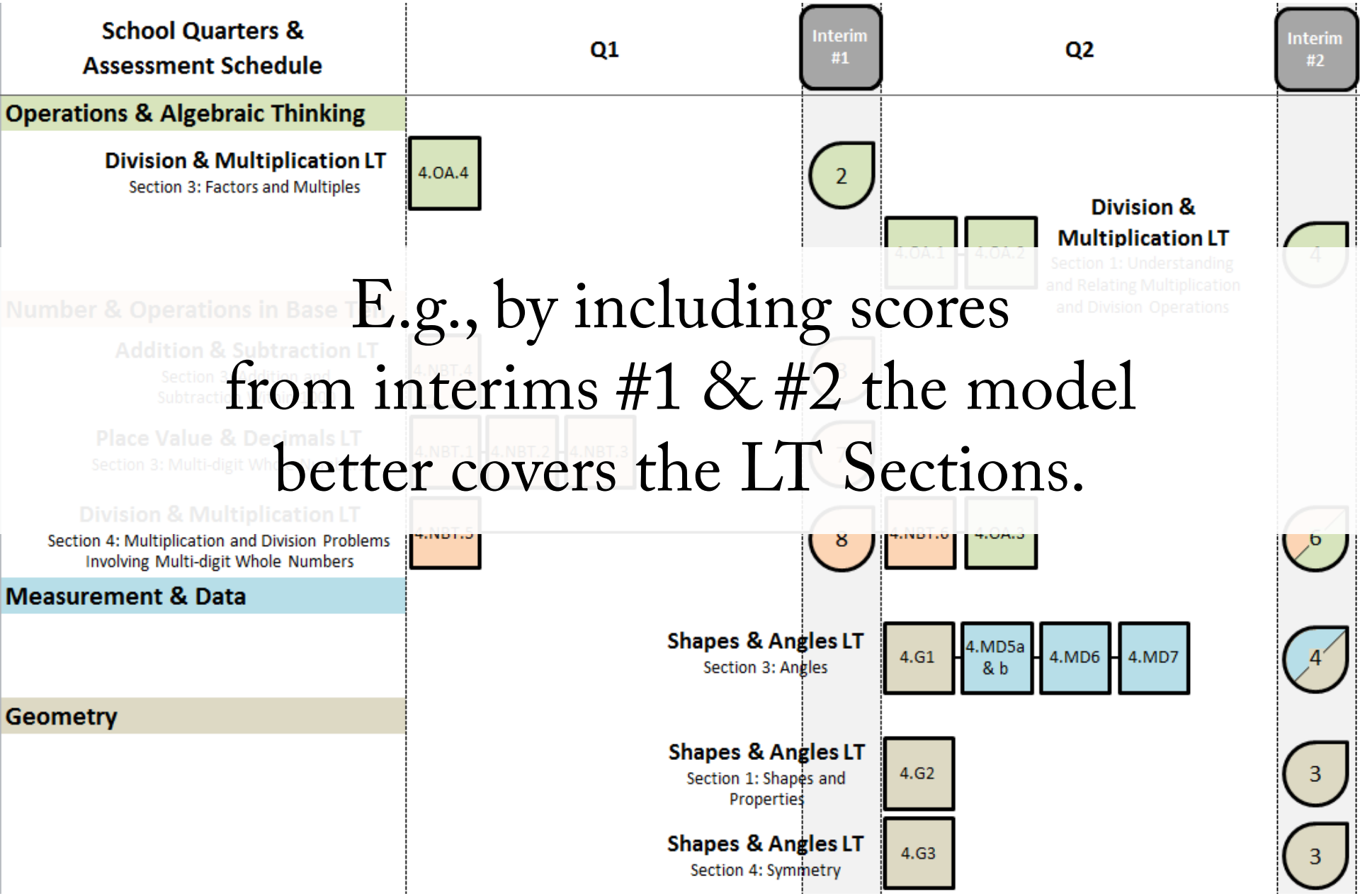
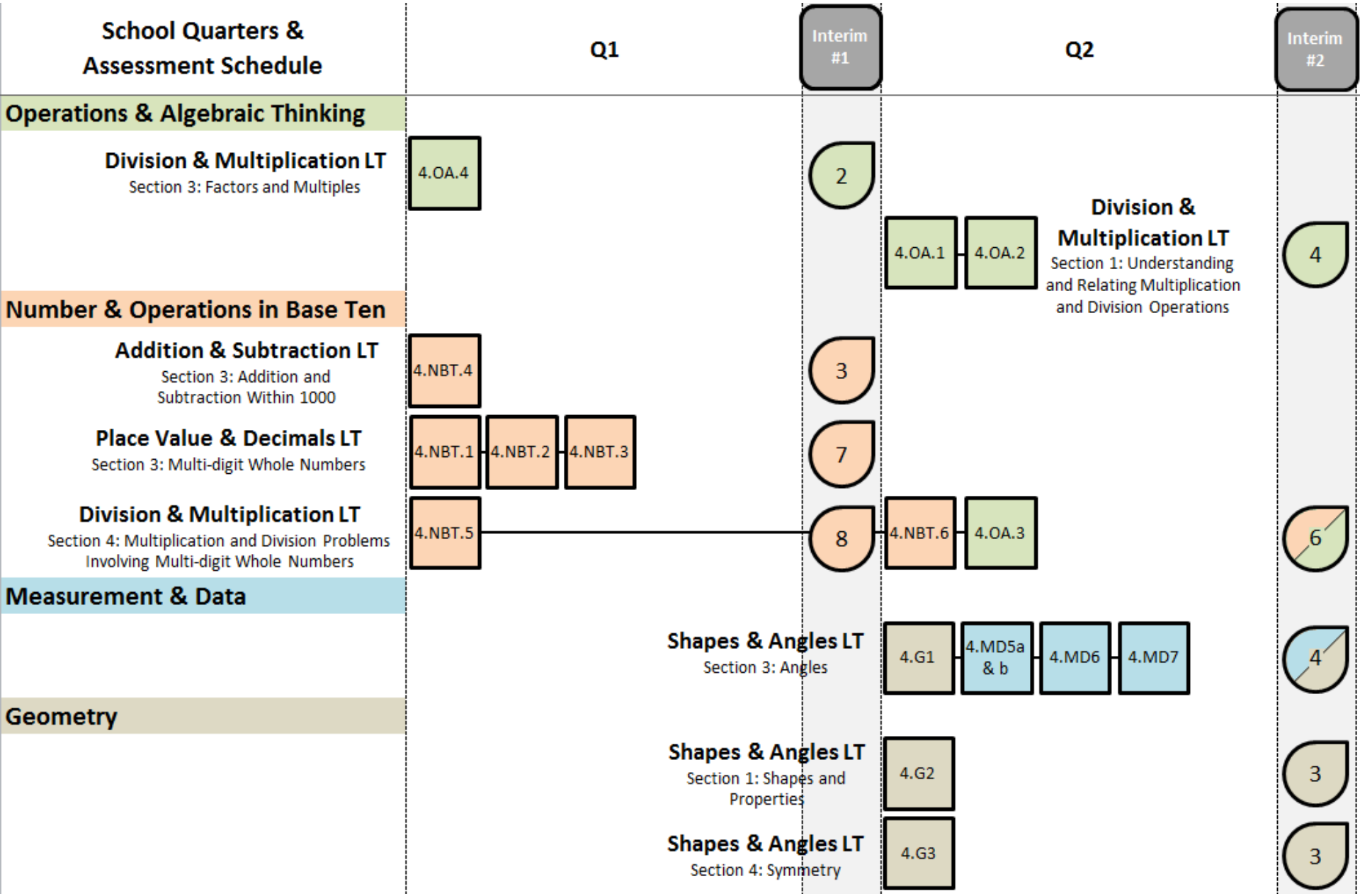
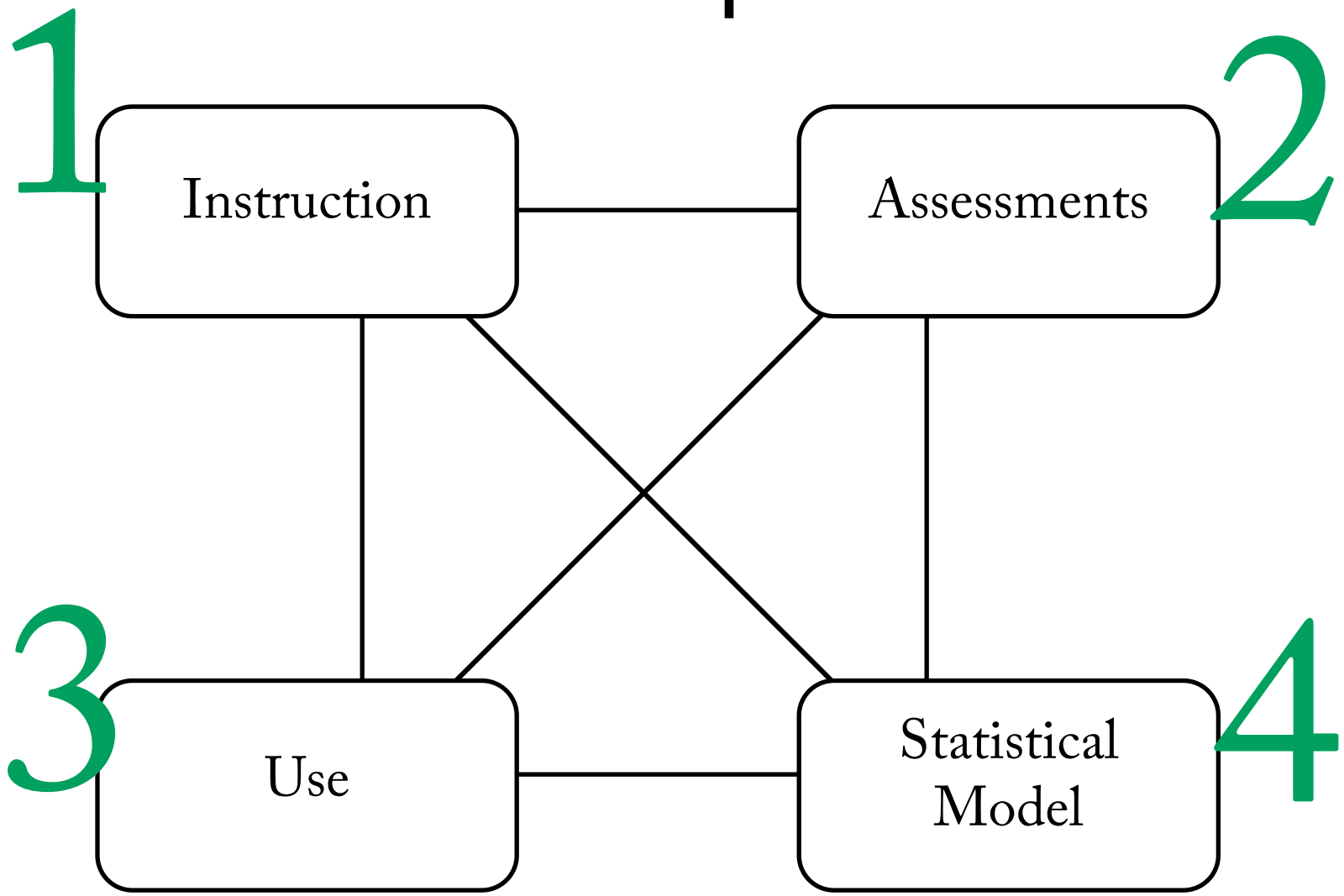
Better coverage of LT Sections
Parameterization Relationships between Assessments
Incorporate Additional Information
Increased Accuracy



E.g., by including scores from interims #1 & #2 the model better covers the LT Sections.


School Quarters & Assessment Schedule
Q1
Interim #1
Q2
Interim #2
Operations & Algebraic Thinking
Division & Multiplication LT
Section 3: Factors and Multiples
4.OA.4
2
4.OA.1
4.OA.2
Division & Multiplication LT
Section 1: Understanding and Relating Multiplication and Division Operations
4
Number & Operations in Base Ten
Addition & Subtraction LT
Section 3: Addition and Subtraction Within 1000
4.NBT.4
3
Place Value & Decimals LT
Section 3: Multi-digit Whole Numbers
4.NBT.1
4.NBT.2
4.NBT.3
7
Division & Multiplication LT
Section 4: Multiplication and Division Problems Involving Multi-digit Whole Numbers
4.NBT.5
8
4.NBT.6
4.OA.3
6
Measurement & Data
Shapes & Angles LT
Section 3: Angles
4.G1
4.MD5a & b
4.MD6
4.MD7
4
Geometry
Shapes & Angles LT
Section 1: Shapes and Properties
4.G2
3
Shapes & Angles LT
Section 4: Symmetry
4.G3
3

Recap



Modeling results from multiple assessments can add value, but interpretation depends on the other elements.

Modeling results from multiple assessments can add value, but interpretation depends on the other elements.

However,

the articulation of each element is valuable in its own right.

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