Grade 8 Sample - Roadmap to Implementing High Quality Mathematics Instruction

The Roadmap to Implementing High Quality Mathematics Instruction seeks to **ground instruction in the *Kentucky Academic Standards (KAS) for Mathematics*, thus reaffirming a commitment to equitable learning opportunities for all Kentucky students.**

How did we get here:
As much of the information in this first section of the Roadmap relates to clarity around the standard and ensuring the learning experience is aligned to grade-level *KAS for Mathematics*, educators might begin by exploring the connection between these two resources:

- Grade 8 Breaking Down a Standard sample for KY.8.SP.3:
  Designed to mirror the architecture of the *KAS for Mathematics*, the Breaking Down a Mathematics Standard resource supports clarity by guiding educators to look deeply at the components of the architecture of the standards, contributing to a holistic understanding of the *KAS for Mathematics*, and the instructional implications resulting from that exploration, including the impact on student learning.
- Grade 8 Assignment Review Protocol for US Airports, Assessment Variation:
  A protocol intended to help answer the question, "Does this task give students the opportunity to meaningfully engage in worthwhile grade-appropriate content?"

KAS for Mathematics	Cluster:	Learning Experience:
KY.8.SP.3	Investigate patterns of association in bivariate data.	US Airports, Assessment Variation, Illustrative Mathematics

Identify the Target of the Standard(s):

- ✓ **Conceptual Understanding** refers to understanding mathematical concepts, operations and relations. Conceptual understanding is more than knowing isolated facts and methods; students should be able to make sense of why a mathematical idea is important and the kinds of contexts in which it is useful. Conceptual understanding allows students to connect prior knowledge to new ideas and concepts.
- ☐ **Procedural Skill/Fluency** is the ability to apply procedures accurately, efficiently, flexibly and appropriately. It requires speed and accuracy in calculation while giving students opportunities to practice basic skills. Students' ability to solve more complex application and modeling tasks is dependent on procedural skill and fluency
- ✓ **Application** provides a valuable context for learning and the opportunity to solve problems in a relevant and meaningful way. It is through real-world application that students learn to select an efficient method to find a solution, determine whether the solution(s) makes sense by reasoning and develop critical thinking skills.

Identify the Practice Standard(s):
May reference *Engaging the SMPs: Look fors & Question stems*

- ☐ MP.1. Make sense of problems and persevere in solving them.
- ✓ MP.2. Reason abstractly and quantitatively.
  - What does the number ___ represent in the problem?
- ☐ MP.3. Construct viable arguments and critique the reasoning of others.
- ☐ MP.5. Use appropriate tools strategically.
- ☐ MP.6. Attend to precision.
- ✓ MP.7. Look for and make use of structure.

- What patterns do you find in ____? How do you know ____ is a pattern?

✓ MP.4. Model with mathematics.
- Why do the results make sense?
- What connections do you see?

✓ MP.8. Look for and express regularity in repeated reasoning.
- What predictions or generalizations can you make?

How did we get here:

As educators begin considering what this learning experience might look like and feel like with students, the *Engaging the SMPs: Look fors and Question Stems* can be a really great place to start. For this learning experience, questions from MP.2, MP.4, MP.7 and MP.8 felt like a natural fit to keep in mind when considering how to move student thinking forward while not taking away the thinking away from the student.

Note: As this task is written as an assessment variation, "in the moment" teacher moves which are dependent upon teacher-student interaction might not feel authentic or appropriate. Thus, sections 2 and 3 of the Roadmap will talk about how to wrap the assessment task with intentional moves prior to and following the assessment to support student learning.

The Roadmap to Implementing High Quality Mathematics Instruction seeks to **support intentional integration of evidence-based instructional practices.**

Identify Evidence-based Instructional Practice(s) May reference *Effective Mathematics Teaching Practices (NCTM)*	
☐ EMTP 1: Establish mathematics goals to focus learning.	☐ EMTP 5: Pose purposeful questions.
☐ EMTP 2: Implement tasks that promote reasoning and problem solving.	☐ EMTP 6: Build procedural fluency from conceptual understanding.
✓ EMTP 3: Use and connect mathematical representations.	☐ EMTP 7: Support productive struggle in learning mathematics.
☐ EMTP 4: Facilitate meaningful mathematical discourse.	☐ EMTP 8: Elicit and use evidence of student thinking.

Teacher Actions:	**Student Actions:**
☐ Selecting tasks that allow students to decide which representations to use in making sense of the problems.	✓ Using multiple forms of representations to make sense of and understand mathematics. Students consider the context through multiple representations (graph, equation) as they make sense of mathematics. • Potential Revision of Question B: "*How many airports does LaToya's model predict for a state with a population of 30 million people?"* To include *"Explain your thinking. Why does your result make sense?"*
✓ Allocating substantial instructional time for students to use, discuss and make connections among representations. This task positions students to consider context through multiple representations as they make sense of mathematics. Prior to this assessment task (the day before or in a more ongoing way throughout instruction), the class will develop a chart to represent struggles that might arise when "using the equation of a linear model to solve problems	☐ Describing and justifying their mathematical understanding and

in the context of bivariate numerical data" and what they might do if they encounter those challenges.

Struggles	Strategies

☐ Introducing forms of representations that can be useful to students.

☐ Asking students to make math drawings or use other visual supports to explain and justify their reasoning.

✓ Focusing students' attention on the structure or essential features of mathematical ideas that appear, regardless of the representation.

Ask questions to encourage students to make connections between multiple representations, such as:

- What does the number ___ represent in the problem?
- What do you already know about solving this problem? What connections do you see?
- Which tool or strategy might be best for this problem?
- What can using a ____ show us that ____ may not?
- What labels could you use?
- How is ___ related to ___? Why is this important to the problem?
- What predictions or generalizations can you make?

☐ Designing ways to elicit and assess students' abilities to use representations meaningfully to solve problems.

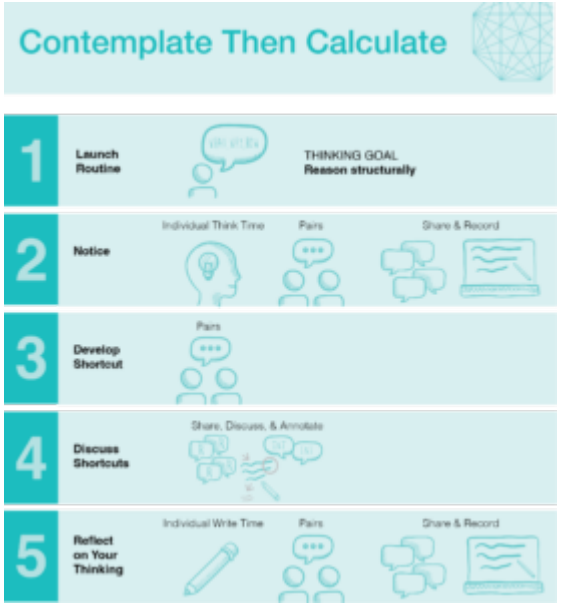
reasoning with drawings, diagrams and other representations.

☐ Making choices about which forms of representations to use as tools for solving problems.

☐ Sketching diagrams to make sense of problem situations.

✓ Contextualizing mathematical ideas by connecting them to real-world situations.

Using the Contemplate and Calculate Routine for Reasoning will support students in engaging in MP.7, shifting attention away from mindless calculations and toward necessary structural interpretations of mathematics. This routine also elevates MP.2 as students attend to the meaning of quantities, not just how to compute them.



☐ Considering the advantages or suitability of using various representations when solving problems.

How did we get here:

EMTP 3 feels like a natural fit here as within this cluster students are investigating patterns of association in bivariate data, connecting representations of linear relationships. In grade 8 students are using linear equations, linear functions and their understanding of the slope of a line to represent, analyze and solve a variety of problems. Students are also describing how aspects of functions are reflected in the different representations. Allocating substantial instructional time for students to use, discuss and make connections among representations and focusing students' attention on the structure or essential features of the mathematical ideas that appear will be critical to supporting student success on this assessment.

Within the student actions is a possible modification to increase the Cognitive Complexity of the task. As written, the task has students relate multiple grade 8 concepts and connect concepts with procedures or strategies. The student must do some reasoning but may not need to demonstrate a line of reasoning. The indicated modification provides one way to increase the Cognitive Complexity and allow students to demonstrate an understanding of mathematics in context.

The Roadmap to Implementing High Quality Mathematics Instruction seeks to **expand educator familiarity with strategies to interweave the development of social emotional competencies with development of mathematics content.**

Identify the Competency Intended to Support the Evidence-Based Instructional Practice: May reference *Integrating SEAD within the KAS for Mathematics* resource library				
☐ SELF-AWARENESS	✓ SELF-MANAGEMENT	☐ SOCIAL AWARENESS	☐ RELATIONSHIP SKILLS	☐ RESPONSIBLE DECISION-MAKING

Specific Design Considerations from *Integrating SEAD within the KAS for Mathematics* Grade Level Resource

Provide opportunities for students to think metacognitively and organize their own thoughts with given information. Embedded time and space for student reflection can have a significant impact on how well students are able to manage their emotions and express personal agency around the mathematics being learned. Consider how to support and equip students to take the initiative and move learning forward.

Routinely ask questions that encourage students to reflect on barriers they may encounter and help them think about ways they can overcome challenges. Consistently provide students, individually and collectively, with opportunities and support to engage in productive struggle as they grapple with mathematical ideas and relationships (NCTM, 2014). Promote student engagement and identity by embedding systems and routines, such as Routines for Reasoning, to allow students to engage in productive struggle and take ownership of their progress and growth toward intended learning outcomes.

Teacher Reflection Questions from *Integrating SEAD within the KAS for Mathematics* Grade Level Resource

How do I utilize formative assessment practices in a way that highlights student knowledge rather than deficit knowledge? How do I embed instructional routines to support students in self-assessing their progress toward the learning goal? Is there anything I might want to shift about my current approach?

I want to continue to learn more about how might I provide more effective feedback. Feedback culture is also impacted by the view towards making errors, being stuck or having misconceptions. If part of the classroom culture is to always “get things right”, then anything that needs improvement is considered “wrong”.

How might I support students in working through problems without taking the thinking away from them?

The Struggles and Strategies chart the class is generating together will support students in predicting what difficulties they might encounter and generating possible approaches to overcoming those challenges. This will empower students to take ownership of their progress.

How did we get here:

Focusing on self-management is a natural fit to support EMTP 3, especially as student actions, “Making choices about which forms of representations to use as tools for solving problems” and “Considering the advantages or suitability of using various representations when solving problems” place an emphasis on students weighing options and making choices based on their knowledge of multiple representations. Investments in supporting student metacognition will pay off during learning experiences in which students are working independently.