CMP STEM Problems

What is a CMP STEM Problem?
In CMP, the class discussions attend to three important features of the goal for a mathematics problem: (1) student strategies and problems solutions, (2) the embedded or encoded mathematics of the problem, and (3) connections to prior learning and future knowledge. To continue to support these discussions, the CMP problems have been newly designed to support STEM education. Rather than using conventional numbering and lettering (e.g., A1, A2, B1, B2, B3, etc.), the CMP problems now use three important components.

What are the components of a CMP STEM Problem?

Problem	*Component Description*
Initial Challenge	The Initial Challenge ***contextualizes the problem and presents the challenge***. The IC also provides an opportunity for open access to the mathematical challenge of the problem.
What If…?	The What If…? ***unpacks the embedded or encoded mathematics of the problem***. The WI…? provide students with further opportunities to probe at the mathematics. Situations focus on what happens when you consider changed quantities or parameters, new aspects to the context, or returning to mathematical ideas mentioned earlier. Situations also focus on different solution strategies and work that students can do to solve the problem.
Now What Do You Know?	The Now What Do You Know ***connects learning to prior knowledge and consider future payoffs.*** As with the Focus Questions in the CMP3 Teacher's Guide, the NWDYK provides focus on the learning goal of the mathematics problem. Whether students write answers is up to the teacher, but written and verbal discussions occur in the Problem Summary and in the Mathematical Reflections that span across problems.

Why do CMP STEM Problems matter?
Often STEM professionals work to solve problems and meaningfully connect these solutions to inform the needs of society. The complexities of the world today necessitate that each and every student be prepared with the knowledge and skills to solve difficult problems, gather and evaluate evidence, and make sense of information. To promote learning that resembles the work of STEM professionals, the problems in CMP are redesigned using the new format to help produce a population of students that is more reflective of the wider STEM community.

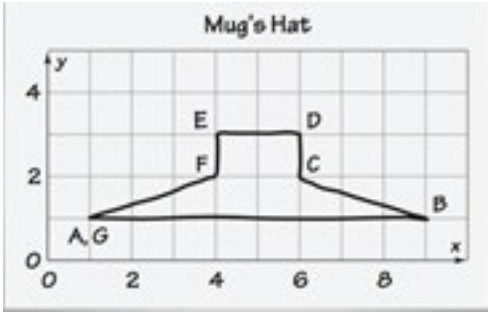
What is an example of a CMP STEM Problem?
The following is an example from *Stretching and Shrinking: Developing Proportional Reasoning in the Context of Similarity (Scale Drawings)*.

Problem 2.2

Hats Off to the Wumps: Changing a Figure's Size and Location

Initial Challenge

Zack experiments with multiplying Mug's coordinates by different whole numbers to make other characters. Marta asks her uncle how multiplying the coordinates by a decimal or adding numbers to or subtracting numbers from each coordinate will affect Mug's shape. He gives her a sketch for a new shape (a hat for Mug) and some rules to investigate.



	Mug's Hat	Hat 1	Hat 2	Hat 3	Hat 4	Hat 5
Point	(x, y)	$(x + 2, y + 3)$	$(x - 1, y + 4)$	$(x + 2, 3y)$	$(0.5x, 0.5y)$	$(2x, 3y)$

- Look closely at each rule and predict what will happen to the hat with each rule.
- Test each rule. How does your result compare with your prediction?

What If…?

Situation A. Writing New Hat Rules

What if you wanted to create a hat that is similar to Mug's hat? What rule would you write if

1. The side lengths are one third as long as Mug's hat?
2. The side lengths are 1.5 times as long as Mug's hat?
3. The hat is the same size as Mug's hat but has moved right 1 unit and up 5 units:
4. The image is in another quadrant:

Situation B. Negative Numbers and Rules

What if you multiply each coordinate by a negative number? What happens to the image?

Situation C. Isaiah's Challenge: Putting the Hat on Mug

Isaiah challenges his group to write a rule that will put Mug's hat on Mug. Is this possible? Why?

Now What Do You Know?

If you know the coordinate rules to create an image, how can you tell if the two figures are similar? How can you use the rule to predict the side lengths of the image? How is the effect of a coordinate rule like the effect of a rubber band stretcher or a copy machine setting?

How does the Launch-Explore-Summary instructional model connect to the CMP STEM Problems?

While CMP STEM Problems contain Initial Challenge, What If…? and Now What Do You Know components, the instructional model of Launch/Explore/Summary continues to be critical for CMP STEM Problems. In some ways, the Initial Challenge can be thought of as the box questions in CMP3. In the Launch, all three components are launched. There may be an occasion where teachers will want to have a brief summary before students go to the What If…? component. These are indicated in the teacher materials. The Now What Do You Know is intended for students to reflect on and be prepared to talk about what they have learned in the Summary. A teacher may choose to have students record some of their understandings in a "learning log" at the end of the Summary. These may be useful when students complete the Mathematical Reflections.

How do the Mathematical Reflections connect to the CMP STEM Problems?
The Mathematical Reflections build on the Now What Do You Know of each problem in the unit. Rather than having a Mathematical Reflection with different questions for each Investigation, the Mathematical Reflections are now streamlined around one essential question. For example, the Mathematical Reflection for each Investigation in *Stretching and Shrinking: Developing Proportional Reasoning in the Context of Similarity (Scale Drawings)* is:

Mathematical Reflection

In this unit, we used proportional relationships to investigate similar figures or scale drawings, including how to determine if two figures are similar. In this Investigation,

What do you know about similarity? How were proportional relationships used to study similarity?