The activity requires innovation - the creation of a product, method, or idea new to the student

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Students are working on a substantial real-world problem

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The activity's primary purpose is problem solving

STUDENTS
use problem solving when they define and develop solutions to problems that are new to them, or complete a task they have not been instructed how to do, or design a complex product that meets a set of requirements

Real-World Problem Solving and Innovation

Washoe County School District

21ˢᵗ Century Competencies

A Guide to Planning Instruction for 21ˢᵗ Century Learners

Real-World Problem Solving and Innovation
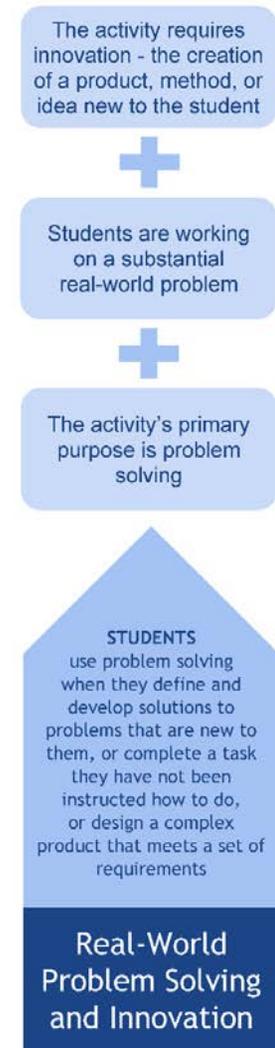
WCSD
21ST CENTURY LEARNING

Real-World Problem Solving and Innovation

(Learning the content) is very much the 20th century idea around education. But in the 21st century, it's learning the tools and the skills of remaking that content and becoming the creator and the producer.
- Diana Roten

> *Students use problem solving when they define and develop solutions to problems that are new to them, or complete a task they have not been instructed how to do, or design a complex product that meets a set of requirements.*

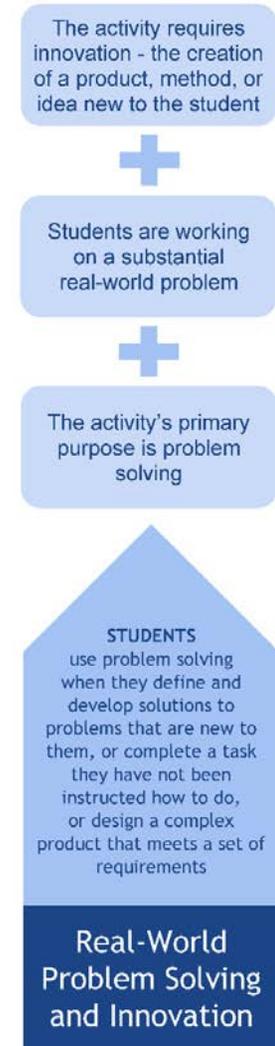## Why students should use real-world problem solving and innovation

Problem solving tasks abound in today's workplace. Complex problem solving tasks might include finding new ways to reach global markets, or redesigning products to take advantage of newly-invented materials. But, simpler, everyday problem solving tasks also require a set of skills that have been undervalued in traditional learning activities. The ability to generate and test creative ideas to solve problems within real—not artificial—requirements and constraints is the crux of knowledge work in the 21st Century.

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Real-World Problem Solving and Innovation

What is real-world problem solving and innovation?

In traditional academic settings, "problems" are often thought of as opportunities for students to practice specific learned procedures. For instance, traditional math "problems" focus on students ability to replicate techniques that have been explicitly taught. These can be important skills, but they do not help students develop the ability to define and create solutions to the less-well-defined problems they will encounter in the workplace.

Problems that provide students with opportunities to innovate solutions to real-world problems should not, therefore, focus on specific procedures students have already learned. Developing problem solving and innovation skills requires that we ask students to complete tasks for which they don't already have a response or solution. In sum, *problem solving* and *innovation* are thinking skills, not procedural skills.

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Real-World Problem Solving and Innovation

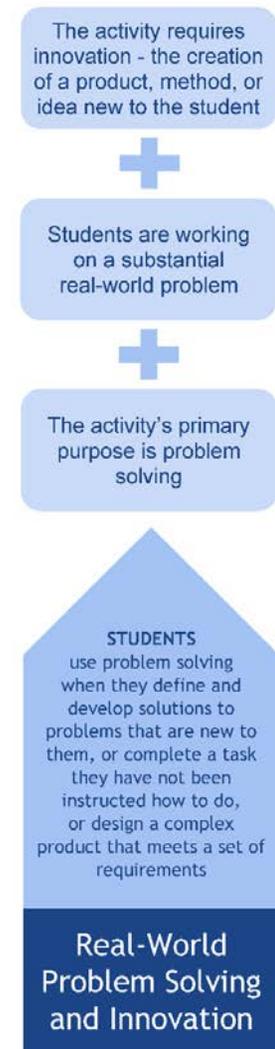# How to plan instruction that includes opportunities for students to innovate and solve real-world problems

Instruction that provides problem solving opportunities for students requires tasks with a *defined challenge* for students. These challenges may be defined by the teacher or the student, and come in three flavors. Tasks with a defined challenge ask students to:

- develop solutions to problems that are new to them; or
- complete a task they have not been instructed how to do; or
- design a complex product that meets a set of requirements.

To meet these challenges through problem solving and innovation requires students to consider some or all of the following elements:

- investigate the parameters of the problem;
- develop ideas and alternatives;
- devise an approach to solving the problem, or explore possible procedures that might be appropriate to the situation;
- design a coherent solution;
- test the solution, and seek feedback; and
- improve the solution to better satisfy the requirements of the problem through repeated iterations.

For the teacher, the key consideration when developing learning activities is to *not provide students with everything they need!* Teachers should purposely not provide students with sufficient information to complete a task, and they should not specify an entire procedure students should follow to arrive at a solution. Problem solving and innovation are about finding, or deriving, the necessary information, and developing or selecting appropriate procedures. Thus, the teacher should *provide carefully scaffolded supports to students that are focused on the process* of problem solving, and avoid providing answers, directions, or specific procedures.

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Real-World Problem Solving and Innovation

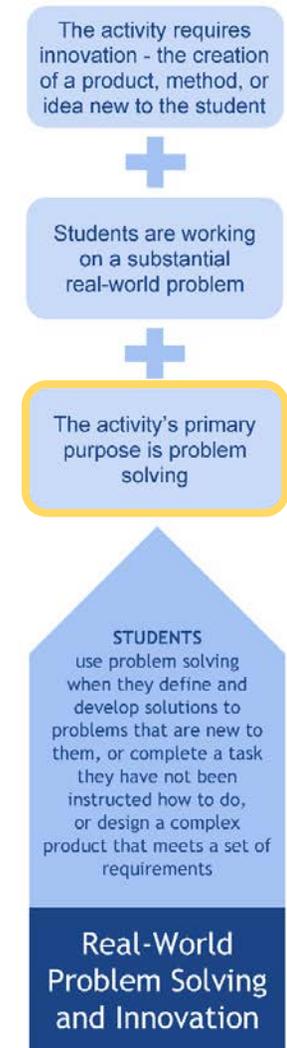## The activity's primary purpose is problem solving

A learning activity's primary purpose is problem solving when it meets all of the following three criteria:

- Students are given a defined challenge, or define their own challenge.
- The teacher does not provide students with everything they need to undertake the learning activity.
- Students commit substantial effort to create a viable solution to a problem.
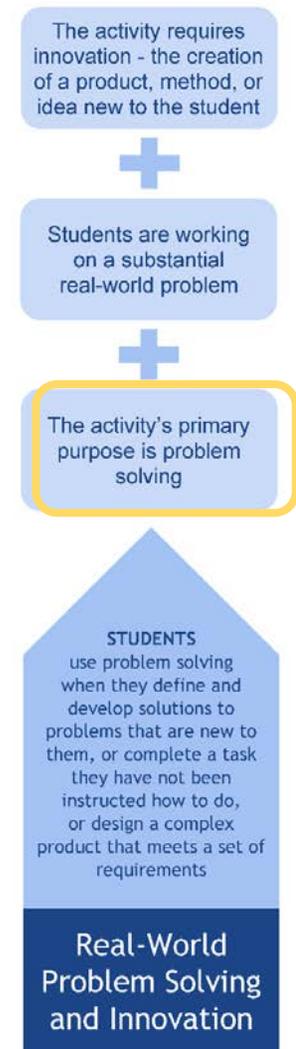
Key considerations:

- The teacher's approach to providing appropriate support to students during students' efforts to solve problems will determine the extent to which students effectively solve the problem they are considering. Being too quick to "teach" can be a detriment to students' learning in this case. Teachers who avoid "telling" by carefully scaffolding supports to students' thinking processes, permitting students to pursue solutions that the teacher knows will not work, and providing students with access to multiple sources of feedback through the process, will be better at helping students develop problem solving abilities.

Consider the learning activities in the table on the next page. What is different in the "Yes" examples?

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Real-World Problem Solving and Innovation

Is the activity's primary purpose problem solving?	
No	**Yes**
Students read a story, then take a quiz about what they read. *This learning activity does not include a defined challenge.*	**Students rewrite a story from the perspective of a character other than the narrator.** *Students are given a defined challenge, are not given everything they need to undertake the activity, and commit substantial effort to creating a story from a different perspective.*
Students enter data from an experiment into a computer spreadsheet, then calculate the mean, median, and mode of several datasets. *Students are simply practicing computations using a spreadsheet.*	**Students enter data from an experiment into a spreadsheet, then identify appropriate situations in which to use mean, median, and mode to answer different questions about the data.** *Students are given a defined challenge (identifying appropriate situations), and commit effort to creating solutions. (Note: to qualify as problem solving, the teacher should not provide answers to students' questions, but guide students toward resources students may use to develop the solution.)*
Small groups of students build tissue paper balloons according to detailed set of instructions, then launch their balloons as a class. *Students all create similar balloons, and do not undertake a process of solving a problem because they are simply following a pre-defined set of directions.*	**Small groups of students build tissue paper balloons according to a rubric containing general success criteria for the finished balloon.** *The rubric defines a challenge for students, but does not provide them with a procedure or specific design. Students must commit substantial effort—likely through information gathering and trial-and-error—to create a successful balloon.*

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Real-World Problem Solving and Innovation

Students are working on a substantial real-world problem

Real-world problems deal with issues that exist outside a classroom environment. Real-world problems must have all of the following characteristics:
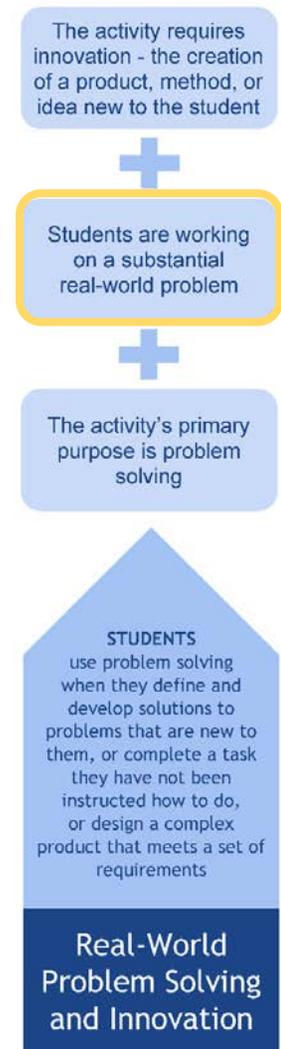
- They are experienced by real people (the problem must actually exist in the real world and affect real people).
- They have potential solutions that affect a specific audience (other than the teacher).
- They have specific, explicit contexts, rather than general contexts (specific contexts allow for solutions that could be applied in a specific context).

Key considerations:

- In creating solutions to real-world problems, students should use real-world information and data. This could include the students' creation or collection of their own data through an appropriate process, and/or their selection and analysis of others' research.
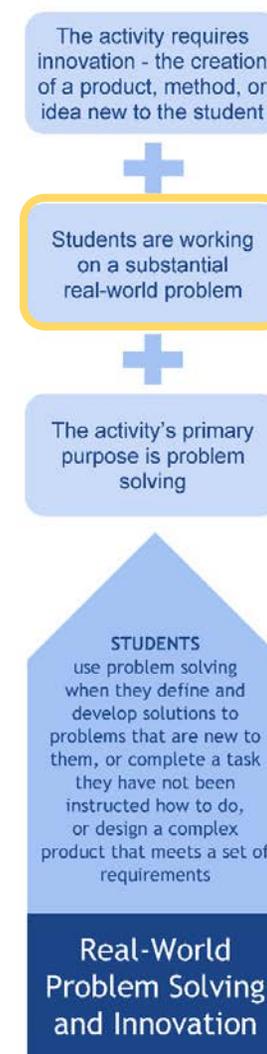
> **NOTE:**
> **It is not expected that learning activities that address this dimension will have a global impact. Sometimes the "real world" is small, depending on the context.**

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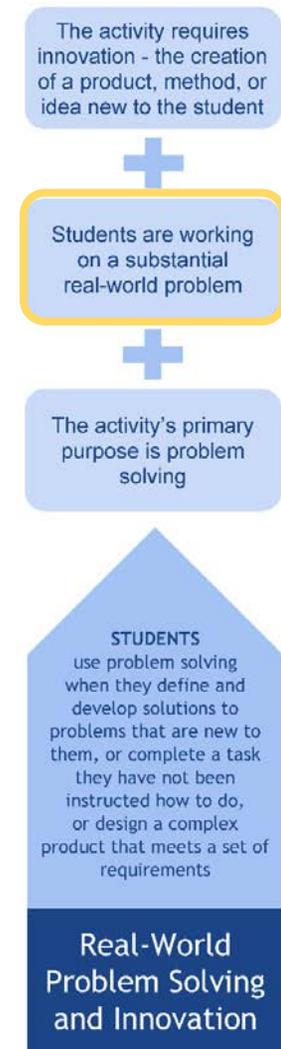**Real-World Problem Solving and Innovation**

Consider the learning activities in this table. What is different in the "Yes" examples?

(Note: To qualify as *students working on a substantial real-world problem*, the activity must also meet the requirements of *the activity's primary purpose being problem solving*.)

Are students working on a substantial real-world problem?	
No	**Yes**
Students learn about pedestrian safety by looking at a street map, and participating in a class discussion. *Students have no defined challenge, are provided with all the necessary information by the teacher, and are not creating a solution to a problem.*	**Students learn about pedestrian safety by creating a map of a fictional town and placing pedestrian crossings and other safety features in appropriate locations.** *Students have a defined challenge and create a viable solution to a problem that is experienced by real people and affects a specific audience in a specific context.*
Students use a fictional bus map in a textbook to propose where pedestrian crossings should be added. *The problem does not affect real people, and any solution students develop would only apply in a general context—not a specific context of an actual location.*	**Students use a bus map of their own town to propose where pedestrian crossings should be added.** *The problem exists for a specific group of real people in a specific context. Also, students would have access to actual data from their own town's planning and public safety departments.*
Students investigate the interaction between green plants and carbon dioxide in the air. *There is no specific context for students' investigation. The context is hypothetical.*	**Students investigate whether growing plants in their classroom can improve the air quality.** *Even though the setting for this investigation is the classroom, the problem exists in the real world, and affects real people in a real setting.*

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Real-World Problem Solving and Innovation

Are students working on a substantial real-world problem? (Continued)

No	Yes
Students learn about mean, median, and mode, then use these concepts to analyze datasets about a basketball team provided by the teacher. *Students are using datasets provided by the educator, and are not solving a problem within a specific context.*	Students collect or locate data about the local basketball team using and online survey tool and use a spreadsheet to graph performance patterns for the team and individual players. *Students are using actual data and performing an analysis that would typically be conducted by the team's coaching staff, thus representing a real-world problem.*

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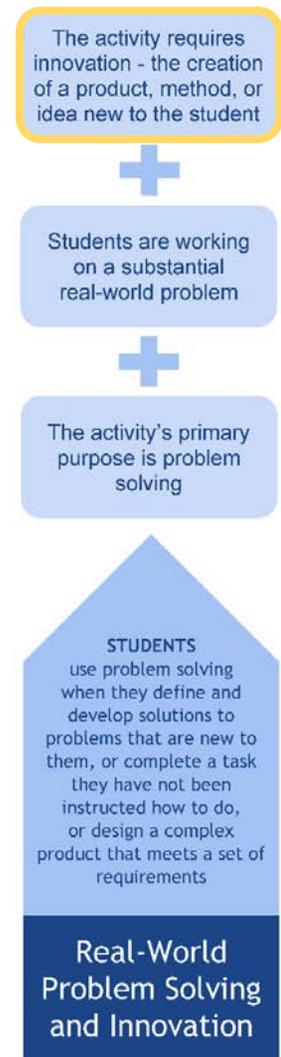Real-World Problem Solving and Innovation

The activity requires innovation – the creation of a product, method, or idea new to the student

Innovation has two main components, both of which must be present in a learning activity.

- First, innovation requires that students put their ideas or solutions into practice in the real world, or communicate these ideas and solutions to others with the ability to implement them. For instance, students who design *and build* a community garden for a local senior center are innovating, whereas students who just design the garden are not. Students who design the garden and present the plans to the senior center leadership ARE innovating.
- Second, innovation must benefit others. To benefit others, the learning activity must create a real-world solution that has potential value beyond the requirements learning activity. For example, designing a community garden has no value to others unless the garden is actually considered by others for building.
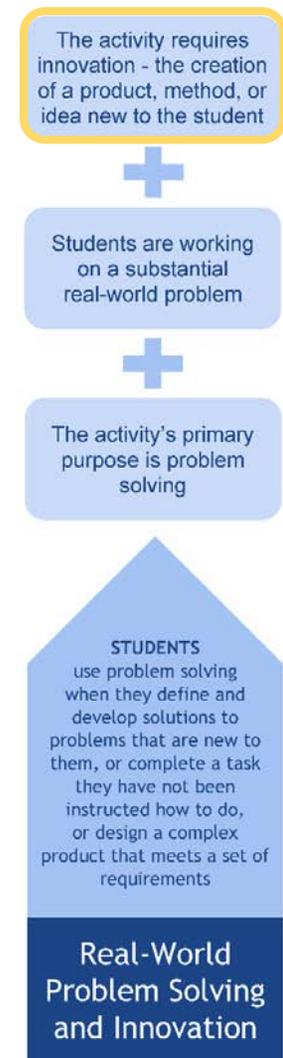
Key considerations:

- When creating learning activities, a broad interpretation should be taken of the requirement of putting solutions into practice in the real world to benefit others. For instance, it also counts as innovation if students submit a written piece to a literature contest because these contests are not teacher-controlled, and they have real-world audiences who are interested in and may benefit from the students' work.

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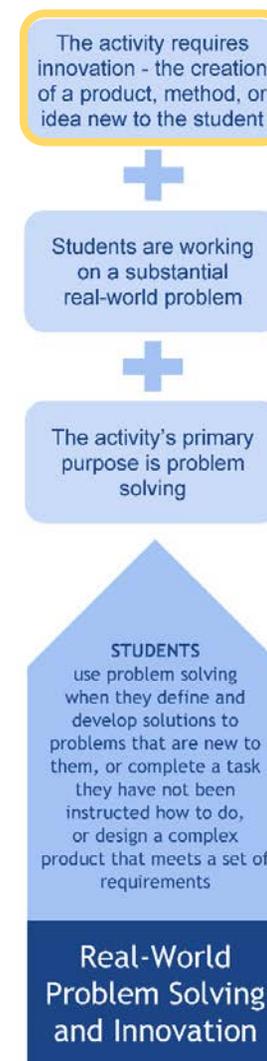Real-World Problem Solving and Innovation

Consider the learning activities in this table. What is different in the "Yes" examples?

(Note: To qualify as *innovation*, the activity must also meet the requirements of *the activity's primary purpose being problem solving* and *students working on a substantial real-world problem*.)

Does the activity require innovation?	
No	**Yes**
Students write letters to the town council about improving pedestrian crossings but only give the letters to their teacher to grade. *The letters are not communicated to others, and therefore cannot be of real-world benefit.*	**Students write and send letters to the town council about the need to improve pedestrian crossings, including possible solutions.** *The letters are communicated to others and therefore have the potential to be of real-world benefit. (Note: this activity may seem virtually identical to the non-example on the left. However, because students have the real-world audience in mind throughout, they are more likely to approach the task with authenticity.)*
As a class, students condense and rewrite a selection of short stories for fifth-grade audience and share their rewritten stories with the class. *Students are not implementing their ideas because they are not communicating them to an audience who will use them in the real world.*	**As a class, students condense and rewrite a selection of short stories for sixth-grade audience. Students then compile their rewritten stories on a website and share the website with teachers and students at local elementary schools.** *Students are communicating their ideas to an audience with the capacity to use this website for its intended purpose.*

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Does the activity require innovation? (Continued)	
No	**Yes**
Students select a website, app, or online game, then create a video, blog entry, or presentation detailing relevant internet safety guidelines of which parents and students should be aware. Students submit their product for a grade. *Students are not communicating their ideas to others.*	Students select a website, app, or online game, then create a video, blog entry, or presentation detailing relevant internet safety guidelines of which parents and students should be aware. Students present their products at the school's parent night. *Students are communicating their products to others with a direct interest in the content.*
Students observe several practice sessions and games for the school's basketball team, collecting data on types of practice drills and individual game performances. Students use a spreadsheet program to graph relationships between drills and individual performances. Students share these graphs with the coaching staff. *Although students are generating substantial data about a real-world problem, and communicating this to a real-world audience, they are not generating an actual solution to the problem—they are leaving this to the coaching staff.*	Students observe several practice sessions and games for the school's basketball team, collecting data on types of practice drills and individual game performances. Students use a spreadsheet program to create mathematical models that illustrate connections between drills and game performances and recommend targeted improvements for individual performances. Students share these models with the coaching staff. *Students are using mathematical modeling to create real-world recommendations about a real-world problem, and communicating these to a real-world audience.*

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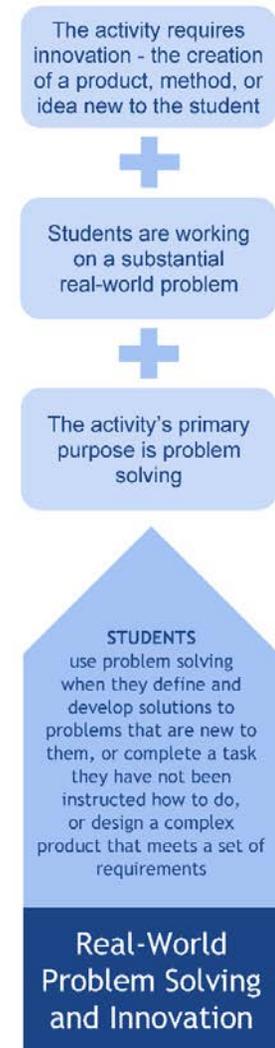**Real-World Problem Solving and Innovation**

Final thoughts on real-world problem solving and innovation

Our communities are improved by those who innovate to solve problems that exist in the real world. We are all engaged in some way in the work of *implementing solutions*—from garbage collection to security for online banking. The work of *creating solutions*, however small, to improve our lives is why real-world problem solving and innovation are important 21st Century skills. Increasingly, we see examples of K-12 students who are addressing real-world problems, and coming up with solutions with the potential to benefit a real audience. Students with more opportunities to grapple with real-world problems are more likely to be engaged in the work of developing viable solutions. It seems important, therefore, that teachers create learning activities that provide students with the opportunity to solve real-world problems, and create products, methods, and ideas that are new to them.

Questions to Ponder

1. Examine the Sample Learning Activity on the next page to see how a collection of NVACS standards might be elevated through Real-World Problem Solving and Innovation (read from bottom to top!). How do the student learning outcomes differ as the activity is modified to meet each Real-World Problem Solving and Innovation competency?
2. What dispositions would an educator need to successfully facilitate students' engagement in real-world problems?
3. How could students who are innovating to solve real-world problems use technology in ways that add value? How does this compare to a student who is NOT using technology?
4. In what ways might an educator formally and informally assess real-world problem solving and innovation among students?
5. How might students with special needs benefit from working on real-world problems? What considerations should educators keep in mind?

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Sample Learning Activity Coming Soon

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