THANKSGIVING STEM CHALLENGE

2nd – 8th
NGSS Aligned

Pumpkin Picker

DIGITAL/PAPERLESS VERSION

FOR USE WITH GOOGLE SLIDES

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I look forward to your feedback. If you have questions or suggestions, please do not hesitate to contact me through any or all of the links below:

Thanks & happy teaching!

~ Kerry

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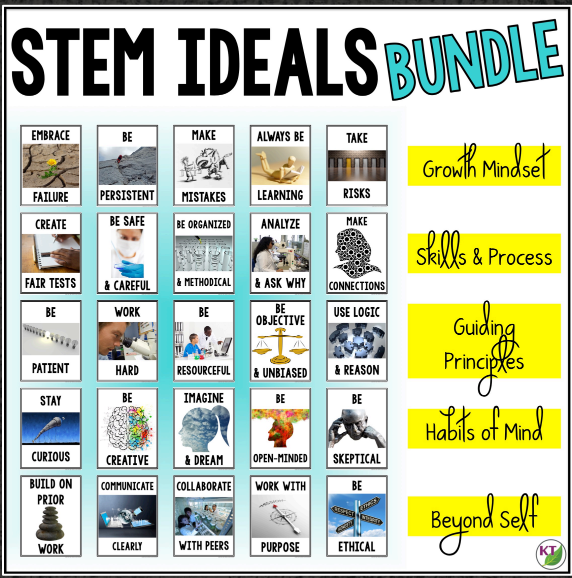
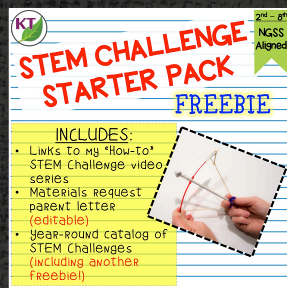
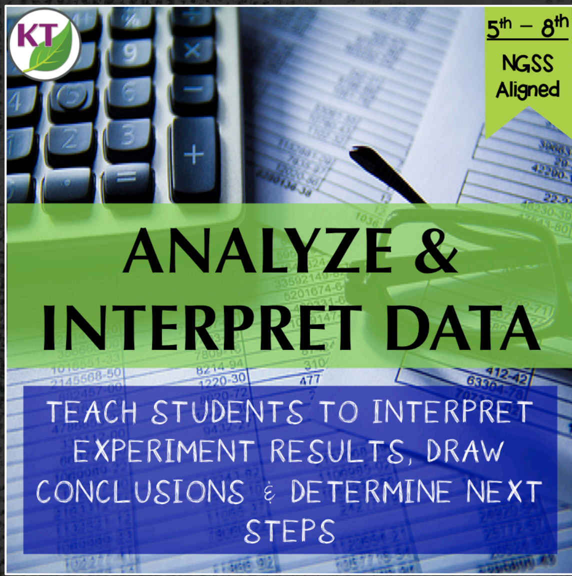
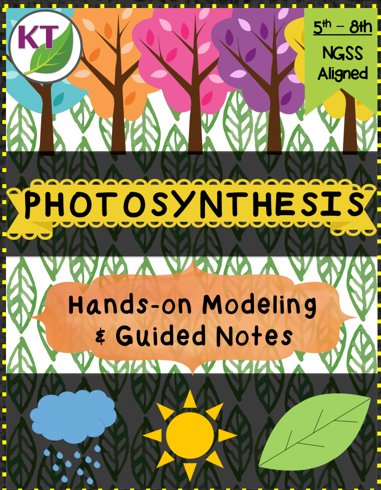








Thanksgiving STEM Challenge: Pumpkin Picker

TABLE OF CONTENTS

Click on any entry below to navigate through the document.

CLICK HERE TO GO STRAIGHT TO THE MASTER FILE IN GOOGLE SLIDES.

GETTING STARTED

1. Your students will need their own Google accounts to access the file in Google slides. If you need help setting up Google Classroom, search for how-to videos on YouTube. I found this one helpful, but there are plenty to choose from!

2. Review the Teacher Tips for this challenge in the following pages.

3. Create a copy of the master Google Slides file. Rename this file "Teacher" or "Master" copy. There is a video on slide 1 that provides a quick explanation of the file contents/layout.

4. Create a second copy of the file for your students. This way, you always have a master copy with all the slides available. In the student file, delete any pages you don't wish to have students complete, or consider breaking the large file into smaller chunks (Day 1, Day 2, etc.) prior to sharing the file with your class.

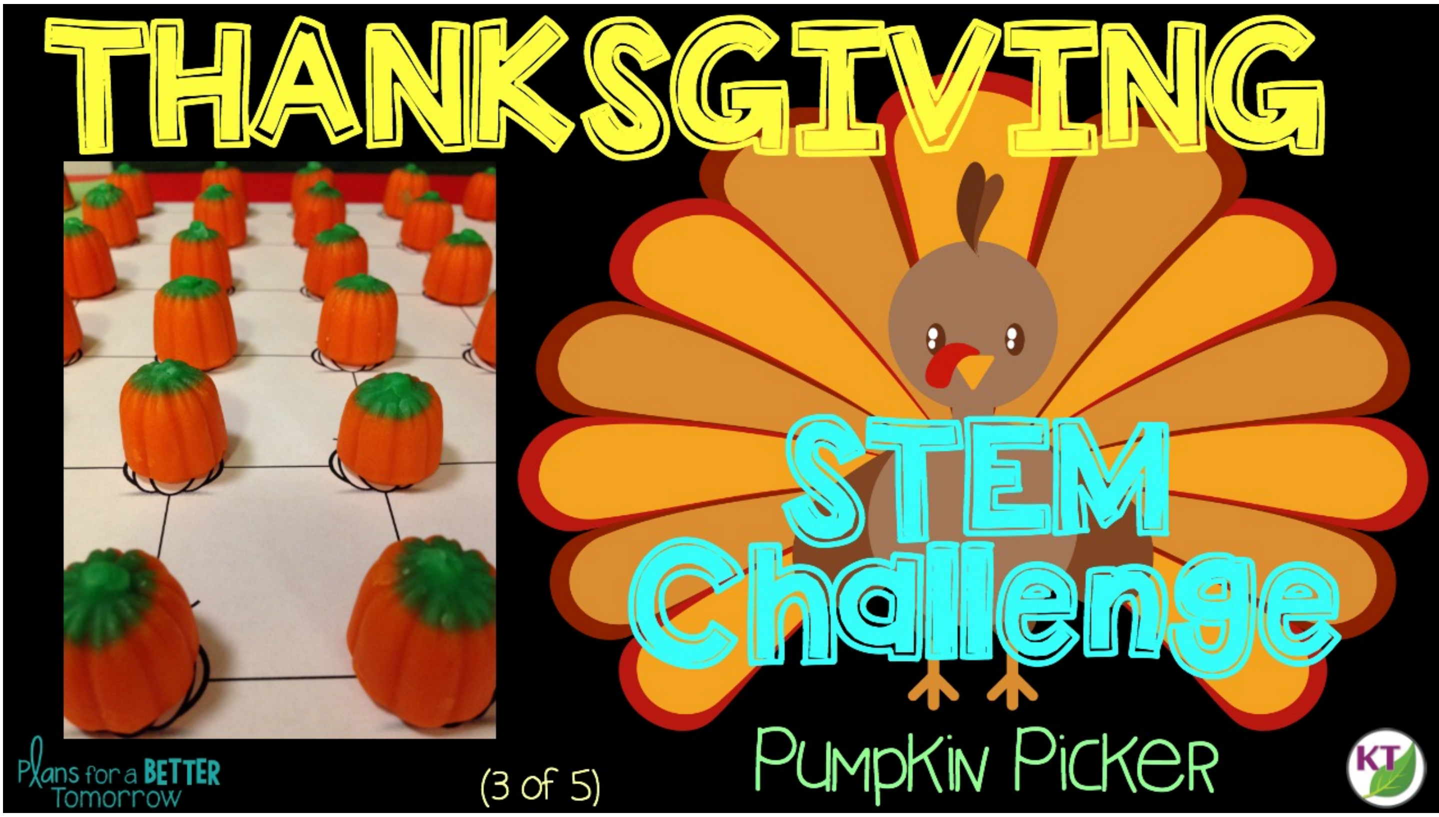
Pumpkin Picker Materials

Select from the list. Most materials can be purchased at you local dollar store or Target/Wal-Mart, etc. Make sure students have an equal amount of each material provided.

- **For each student or group:**
  - Candy pumpkins or candy corn (25 – 36)
    - Rolos or wrapped caramels can be substituted
  - Pipe cleaners (5 – 10)
  - Popsicle/craft sticks (10 – 15)
  - Plastic spoons (5 – 10)
  - Bowl or holding container for harvested pumpkins
  - Scissors
  - Copies of pumpkin patch guide handout or green construction paper
  - Copies of data recording & analyzing handouts
  - Optional:
    - Straws
    - String
    - Rulers/measuring tapes
    - Tape, cable ties, rubber bands

Video Walk-Through

On November 3, 2016, a video walk-through will be posted for this challenge. The image below is linked to the Thanksgiving playlist on my YouTube channel, where it should be easy to find. Or, if you re-download this resource on or after November 3, the link will go directly to this video.



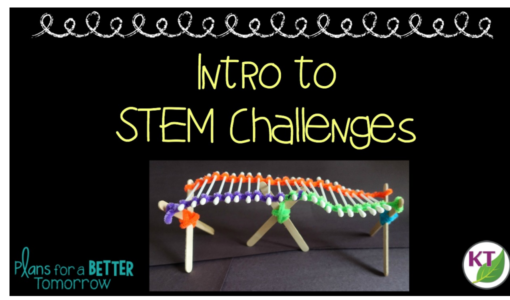
Note to Teachers

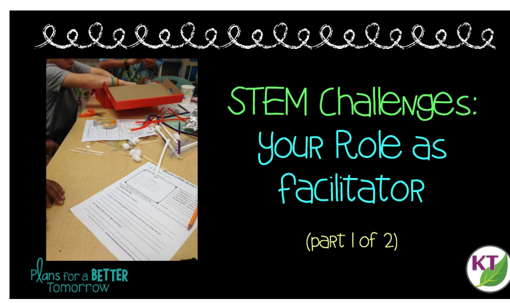
The beauty of STEM Challenges is that they are open-ended and require critical thinking and problem-solving. This is why we don't give students directions to build a specific design. In keeping with the engineering design process, a criteria & constraints list is provided to give students a framework of the design problem and goal. How they choose to address the problem and goal is entirely up to them.

You can tailor the challenge to your students' needs using the editable list provided, but don't make it too easy! Be bold and embrace the *challenge* – it's in the title after all! Understand that the potential to fail is an inherent risk, and in fact, when you're prepared for that possibility, a "failure" can turn into a far richer lesson than a success. Check out the first video linked below for more on what you can do to prepare for – and even look forward to – a potential "fail"!

Videos & PD

Video is such an effective way to share tips and examples for running fantastic STEM Challenges! I've linked a few below to help get you started and cover some troubleshooting topics as well.



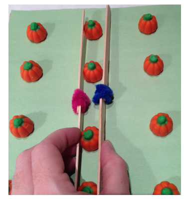


You can also find my full video library & newest PD on:

If you have any questions, please feel free to reach out via email or social media!

Pumpkin Picker Teacher Tips (pg. 1 of 3)

- **Premise**
  - Individually, or in partners/groups, students will design and build a device to harvest a pumpkin patch as efficiently as possible. (Efficiency is measured in amount of time or number of moves needed to clear the pumpkin patch.) Once picked, pumpkins will be deposited in a harvest container.


  - Plan to give students approximately 30 min. to design, 15-20 min. to measure and share results, and 10-15 to complete design analysis slides. Additional time will be needed if you are assigning extension activities.

- **Set up**
  - If you are new to STEM Challenges, you might find it helpful to review one or more of the videos from the previous page.
  - Review the Criteria & Constraints List provided, and decide if you will make any modifications ahead of time.
  - An optional, printable pumpkin patch guideline is provided in order to help students set up identical pumpkin patches; this helps students compare the efficacy of their designs with other groups. A pumpkin patch Google Slide is also included.
    - Another option is to allow students to design their own pumpkin patch layouts that best work with their designs. Be sure to give each group an equal number of pumpkins.

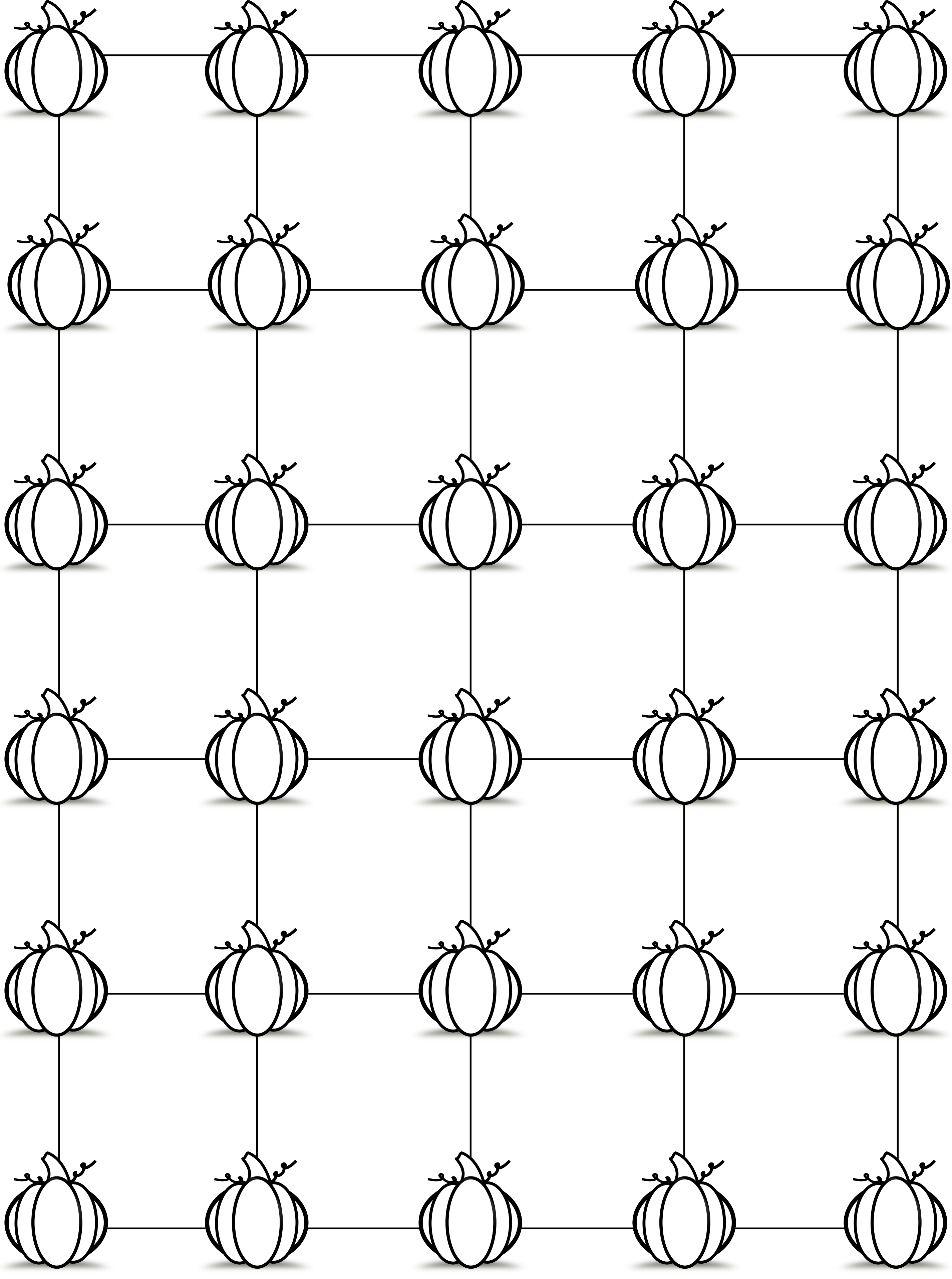
- **Criteria/Constraints**
  - The Criteria & Constraints List slide provided is editable.
  - Increase or decrease the time as needed.
  - Ideas to increase the difficulty of the challenge:
    - Measuring efficiency with number of moves needed to clear the pumpkin patch is more difficult than a time challenge alone. Include it as the primary goal/criterion.
    - Add a criterion for students to set up the pumpkin patch in various configurations/arrays, and test the efficiency of their pumpkin picker design on each.
    - Increase the size of the pumpkin patch (double, triple, or quadruple the pumpkin patch grid slide/handout).
    - Add criterion to create a second design to remove pumpkins efficiently from the harvest container, or require that the same design must be used to both efficiently harvest pumpkins from the pumpkin patch *and* remove pumpkins efficiently from the harvest container.

- **Measuring Results**
  - Students should verify they have met all listed criteria/constraints.
  - One the design analysis slides, students record the amount of time and/or the number of moves needed to harvest the pumpkin patch.
    - **Number of moves:** Students record how many moves it takes to harvest the pumpkin patch, i.e. if a pumpkin picker picks two (2) pumpkins at a time, clearing a field of 20 pumpkins requires 10 moves.

- **Post-Design Options**
  - Design analysis (slides included)
  - Discussion questions (slides included)
  - Re-design and re-test (consider incorporating new, student-suggested materials)
  - Extension activities
    - Generate a list of as many ways to use a pumpkin as possible. (Pumpkin writing template is included in the "Extension Templates" section).
    - Write poems about pumpkins, Pilgrims, Thanksgiving, etc.
    - Students create and solve math problems related to designs (task card problem/solution slides are included in the "Extension Templates" section).

- **Post-Design Options**
  - Extension activities (continued)
    - Have students close read or summarize one or more of the articles linked below:
      - Cooking and Food
      - What's for Dinner?
      - Things Pilgrims Brought on the Mayflower
    - Research the types of food available to the Pilgrims using the websites listed above and/or other sources. Have students create two lists: food that came from the Plymouth and food that was brought over/imported from England.
      - Have students create a menu for a day in the life of a Pilgrim or for an imaginary restaurant. Use the pumpkin writing template in the "Extension Templates" section to create a picture or written menu.
    - Learn about the methods & machines used in modern pumpkin growing & harvesting:
      - Prize Pumpkins: How Do Pumpkins Grow (~3 min.)
      - Prize Pumpkins: Harvesting and Washing (~2 min.)
      - Druv Baker Meets a Pumpkin Farmer (~3 min.)
      - Harvesting Pumpkins in Illinois (~6 min.)
        - » A little slow, but interesting machinery; skip around to save time
      - Seed Processing (~1 min.)
      - Seed Harvesting Machine (~2 min.)
    - Learn about the pumpkin life cycle and giant pumpkins:
      - Life Cycle of a Pumpkin v1 (~2 min.)
      - Life Cycle of a Pumpkin v2 (~2 min.)
      - Life Cycle slides
      - Pumpkin Facts and Quiz (~4 min.)
      - Time Lapse Pumpkin Vines Growing (~3 min.)
        - » Time Lapse begins at 2:01
      - Time Lapse Giant Pumpkin / Giant Pumpkin Boat Race (~2 min.)
    - Students create a process flow map for how to make their pumpkin picker designs. They trade process maps and try to build the other's design (process flow map slide included).

Note: One slide per video/website is included in the student slides with its link, so you can easily assign to students.



Universal STEM Challenge Notes & How to Use the Design Analysis Slides

STEM Challenge Cycle (overview video of the STEM Challenge steps)

Planning

- Try giving students experience with different planning styles on different challenges, so they can begin to understand their own preferences. Several approaches are listed below:
  - Students begin to manipulate materials immediately
  - Students sketch ideas prior to building
  - Students discuss ideas with teammates prior to building
  - Have students jot notes for their plan prior to building
  - Students have 3 – 5 minutes of silence to think about what they will do prior to building (follow with another approach, or go straight into building)
  - Walk & talk: Introduce the challenge, then have students go on a short walk to discuss ideas with teammates prior to building
  - Free choice or mix/combine approaches

Post-Design – Design Analysis Slides

- Multiple iterations are always recommended to allow students an opportunity to apply learning, try new ideas, and to be in keeping with the engineering process. While you might not be able to do so with every challenge, try to do it whenever you can. Never conducting a second or third iteration is akin to never asking students to tell you how they *could* improve their writing, but never actually having them revise it; the execution of ideas is crucial in developing skills!
  - For each new iteration, make a new copy of the design analysis slides.
  - The following analysis question can be used in different ways: "Which was your more/most effective design? What do you think it was about the design that made it superior to the other(s)?":
    - **Option 1:** Have students consider the evolution of their design within the current iteration of the challenge. Frequently, students change aspects of the design right up until time is called. Their final version is not necessarily the best version. If they insist they stuck with one idea throughout and have nothing to compare, select option 2 or 3 below.
    - **Option 2:** Students can select what they think was the most effective design in the class, not necessarily their own.
    - **Option 3:** If you will conduct multiple iterations, students can wait to answer this question until after the final iteration, and answer it only once on the final set of handouts (or use options 1 or 2 to answer the question prior to the last handout set).

Next Generation Science Standards (NGSS)

A Note RE: NGSS Science & Engineering Practices

This STEM Challenge has the potential to hit upon all NGSS ETS standards depending on the depth and number of iterations you choose to implement in your classroom. Take a moment to review the Performance Expectations as well as the Disciplinary Core Ideas (DCIs) included here prior to inform your decisions and approach.

K-2 NGSS
Science & Engineering Practices: Performance Expectations

K-2 Science & Engineering Practices

Students who demonstrate understanding can:

- **K-2-ETS1-1.Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

- **K-2-ETS1-2.Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

- **K-2-ETS1-3.Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

K-2 NGSS Disciplinary Core Ideas (DCIs)

- **ETS 1.A: Defining and Delimiting Engineering Problems**
  - A situation that people want to change can be approached as a problem to be solved through engineering. (K-2-ETS1-1).
  - Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1).
  - Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
- **ETS 1.B: Developing Possible Solutions**
  - Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2).
- **ETS 1.C: Optimizing the Design Solution**
  - Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3).

3-5 NGSS
Science & Engineering Practices: Performance Expectations

3-5 Science & Engineering Practices

Students who demonstrate understanding can:

- **3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**

- **3-5-ETS1-2.Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

- **3-5-ETS1-3.Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

3-5 NGSS Disciplinary Core Ideas (DCIs)

- **ETS 1.A: Defining and Delimiting Engineering Problems**
  - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Difference proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5 ETS1-1).
- **ETS 1.B: Developing Possible Solutions**
  - Research on a problem should be carried out before before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2).
  - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5 ETS1-2).
  - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3).
- **ETS 1.C: Optimizing the Design Solution**
  - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3).

Teacher-Author note: I philosophically disagree with DCI 3-5-ETS1-2. With an iterative design approach, one often produces more innovative designs by *not* researching first. Design first also motivates students to have a reason to research between iterations. It's nice to have the baseline of design results before and after research as well. This challenge reflects my approach.

Middle School NGSS
Science & Engineering Practices: Performance Expectations

MS Science & Engineering Practices

Students who demonstrate understanding can:

- **MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

- **MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**

- **MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**

- **MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**

Middle School NGSS Disciplinary Core Ideas (DCIs)

- **ETS 1.A: Defining and Delimiting Engineering Problems**
  - The more precisely a design task's criteria and constraints can be defined, the more likely is is that the designed solution will be successful. Specification of constraints includes consideration of specific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1).
- **ETS 1.B: Developing Possible Solutions**
  - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4).
  - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3).
  - Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3).
  - Models of all kinds are important for testing solutions. (MS-ETS1-4).
- **ETS 1.C: Optimizing the Design Solution**
  - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process – that is, some of those characteristics may be incorporated in the new design (MS-ETS1-3).
  - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4).

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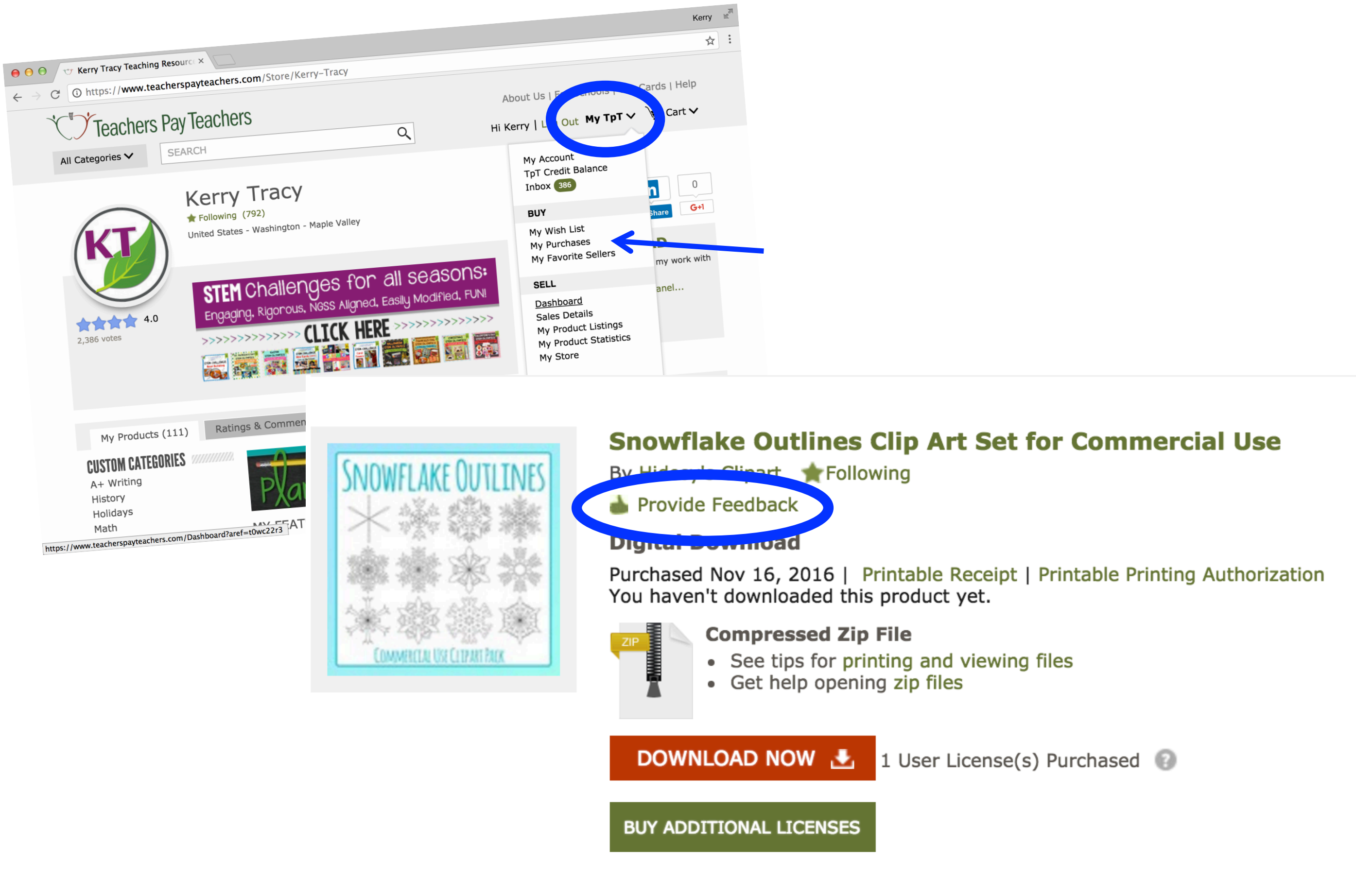

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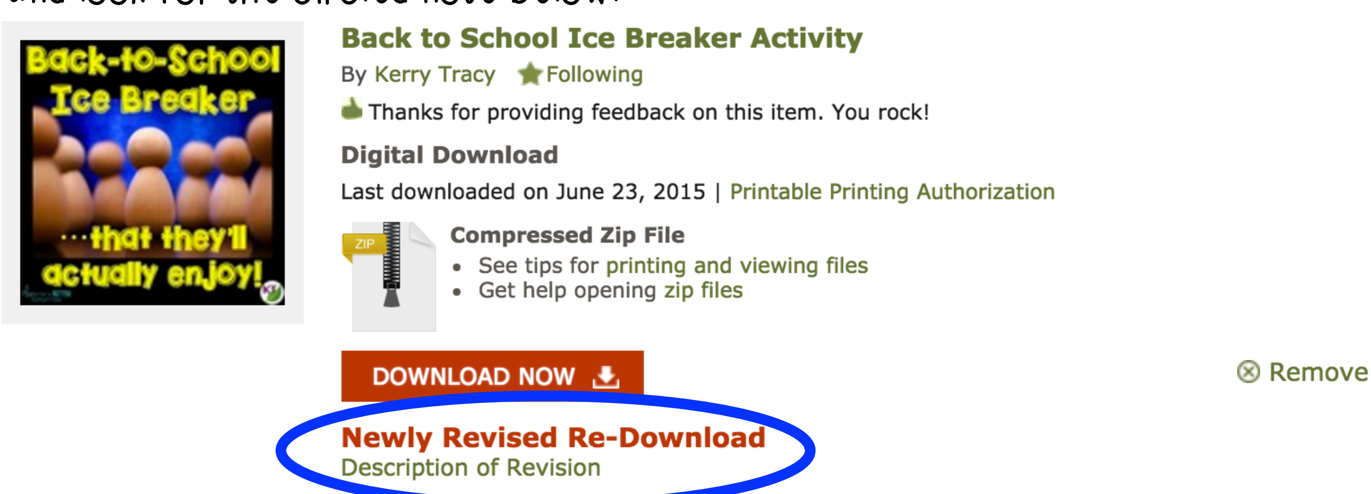

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