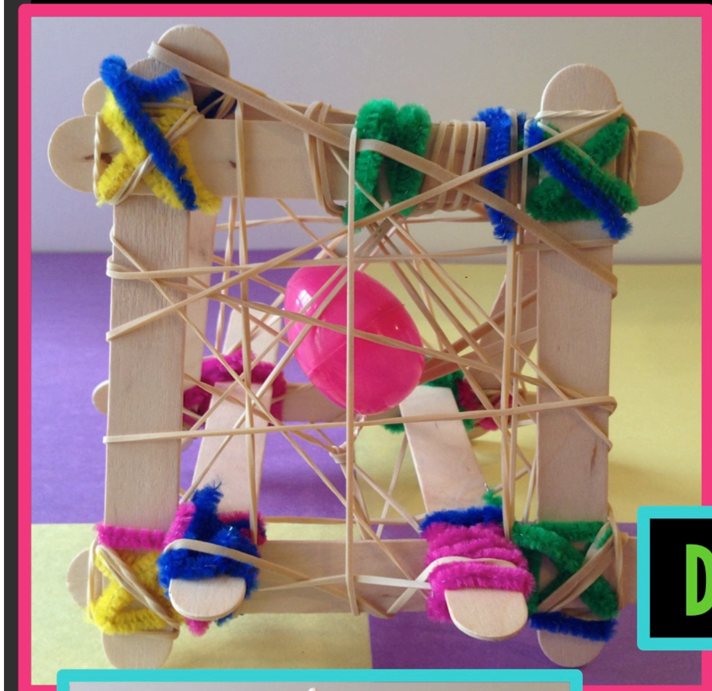
SPRING / EASTER STEM CHALLENGE

2nd – 8th
NGSS Aligned



Egg-hanced

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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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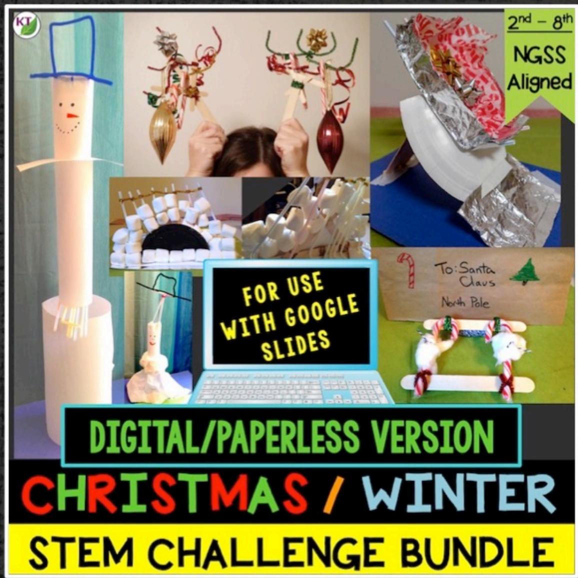

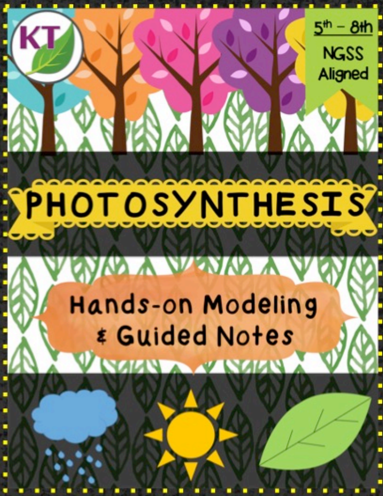

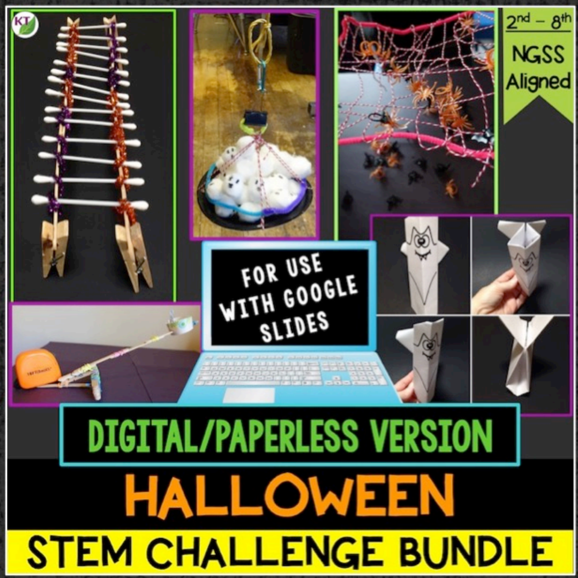

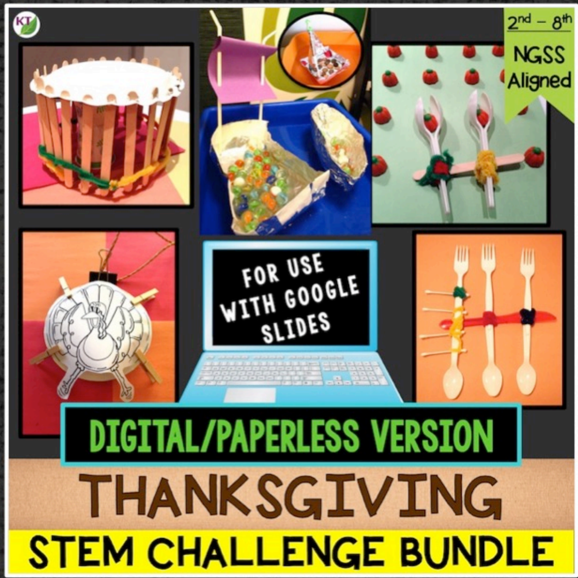

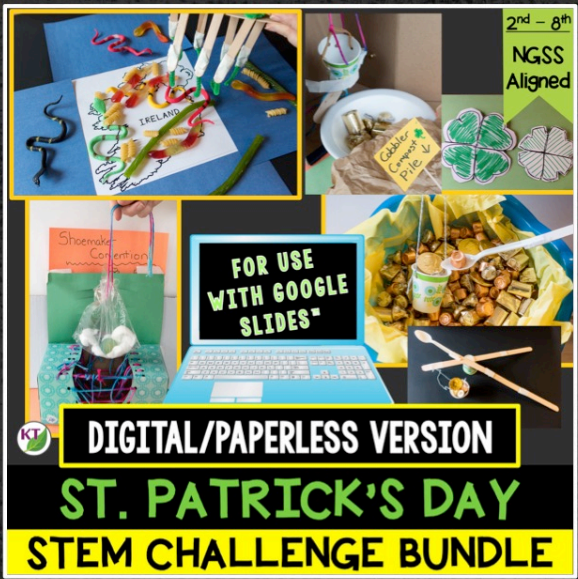

Easter STEM Challenge:

Egg-hanced

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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.

Egg-hanced Materials

Select from the list. 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:**
  - Eggs (1 – 3)
    - Real or plastic
  - Soft/protective materials
    - Easter grass, cotton, tissue paper, floral foam, packing peanuts, etc.)
  - Small cups or bowls (1)
  - Craft sticks (5 – 10)
  - Pipe cleaners (5 – 10)
  - String/yarn (24 – 36 in.)
  - Tape (12 – 24 in.)
  - Rubber bands (5 – 10)
  - Scissors
  - Scale
  - **Optional**
    - Plastic baggies (1 – 2)
    - Paper bags (1 – 2)
    - Coffee filters (2 – 4)

Not pictured:
- scale

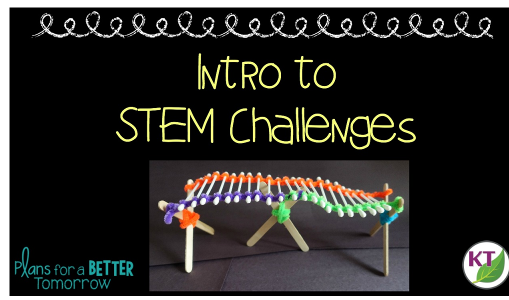
Note to Teachers

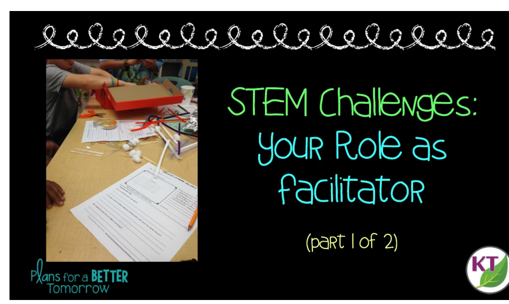
The beauty of STEM Challenges is that they are open-ended and require critical thinking and problem-solving. This is why we don't give students directions to build a specific design. In keeping with the engineering design process, a criteria & constraints list is provided to give students a framework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

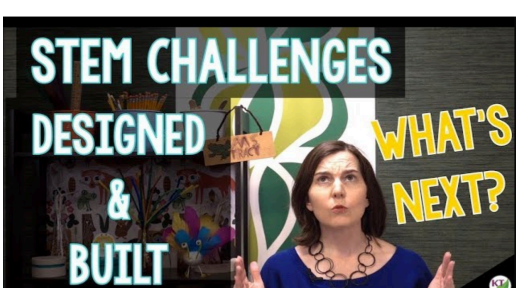
You can tailor the challenge to your students' needs using the editable list provided, but don't make it too easy! Be bold and embrace the *challenge* – it's in the title after all! Understand that the potential to fail is an inherent risk, and in fact, when you're prepared for that possibility, a "failure" 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!

- **Premise**
  - This is a classic egg-drop challenge, with some optional modifications. Individually or in partners/groups, students will design and build a device to protect an egg from cracking when dropped from a predetermined height.
  - Plan to give students approximately 30 - 40 min. to design, 10 - 15 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**
  - Watch the challenge walk-through video linked in the image below.
  - If you are new to STEM challenges, watch one or more videos on the previous page.
  - Determine if you will use real eggs or plastic.
    - If using real eggs, decide if you will hard boil them or use them raw. You may want to have students place designs in plastic bags prior to drop test to contain the mess. The disadvantage to that is they won't be able to see as clearly how the design performed and where to make improvements.
    - If using plastic eggs, decide if you will use them empty or fill them with sand or other objects to increase difficulty and dramatic effect.
  - Decide whether you will make adjustments to the Criteria & Constraints List ahead of time. (The Criteria & Constraints List slide is editable.)

- **Criteria/Constraints**
  - Increase or decrease the time as needed.
  - Ideas to increase the difficulty of the challenge:
    - Increase the height of the drop.
    - Increase the number of eggs to be "egg-hanced" within the same device.
    - Make this an "impossible" challenge by decreasing the materials to what looks – even to you – to not be enough to protect the egg (e.g. one pipe cleaner, two craft sticks, five-to-10 rubber bands and a paper bag).
    - Tighten the weight constraint (e.g. Weigh the egg by itself. The final design - egg included – can be no more than 125% the weight of the egg alone).
    - Add a size constraint (e.g. the final design must be within 6 in. x 6in. X 6 in. or must fit within a paper lunch bag).

- **Measuring Results**
  - Students should verify they have met all listed criteria/constraints.
  - Students will drop their egg-hanced devices from a predetermined height and record whether or not the egg remained intact.
    - Optional: Select three pre-set heights for egg-drops. Students start with the lowest and proceed to the next until their design fails. If the device is successful at the tallest height, have students count how many times they are able to drop from that height until the device fails. If the device is successful after three drops from the tallest height, challenge students to decrease the weight of the device to 75% or less of the original design and attempt the drops again.

- **Post-Design Options**
  - Design analysis (slides included)
  - Discussion questions (slides included)
  - Re-design and re-test (consider incorporating new, student-suggested materials)
  - Extension activities
    - Watch one or more of the following videos:
      - Brush Your Egg ~4 min. (2nd – 4th)
      - Why are Eggs Egg-Shaped? ~4 min. (2nd – 4th)
      - Should You Keep Eggs Refrigerated? ~4 min. (2nd – 4th)
      - Can you Un-boil an Egg? ~4 min. (7th – 8th)

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

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

- **Post-Design Options**
  - Extension activities (continued)
    - Try one or more of these egg experiments:
      - 12 Egg Experiments
      - Alien Egg Experiment 1 ~4 min. (2nd – 4th)
      - Alien Egg Experiment 2 ~3 min. (5th – 8th)
    - Ask students, "If eggs break so easily, how can the parent sit on them, before they hatch, without breaking them?" Have students research to find an answer. Here's a clue:
      - The Double Curve / Egg Strength Demonstration ~3 min. (5th – 8th)
    - Have students research Roman architecture and identify the link between egg strength and arches. Though the Romans weren't the first to use the arch, they have become famous for their extensive use of arches. Have students find out why arches were so impactful to the Romans and modern architecture. (Background for your reference.)
      - Have students write a piece of historical fiction in which an ancient Roman is inspired by an egg to create arches.
    - Protecting the human body – especially the head/brain – is not too unlike protecting an egg. Have students research how bike helmets and safety features in cars work to protect their precious cargo. Students should identify which, if any, features they could incorporate in future egg-hanced designs.
      - Why Don't Woodpeckers Get Concussions? ~6 min. (5th – 8th)
      - How Helmets Work to Protect Your Brain ~4 min. (7th – 8th)
        - » Note: After 3:13, this becomes an advertisement, so you can stop playing it at that point.
    - Read/watch Aesop's Fable "The Goose with the Golden Eggs" (note: this fable goes by various titles). Have students create a modernized version or an entirely new story that shares the same moral.
      - Version 1
      - Version 2
      - Version 3
      - Version 4 (video)
        - » Watch before showing. It may be too blunt for younger age groups
    - Students create a process flow map for how to make their egg-hanced designs. They trade process maps and try to build the other's design (slide included).
    - Students create and solve math problems related to designs (slides included).
    - Students create Easter or egg-related stories or poetry (slide included).

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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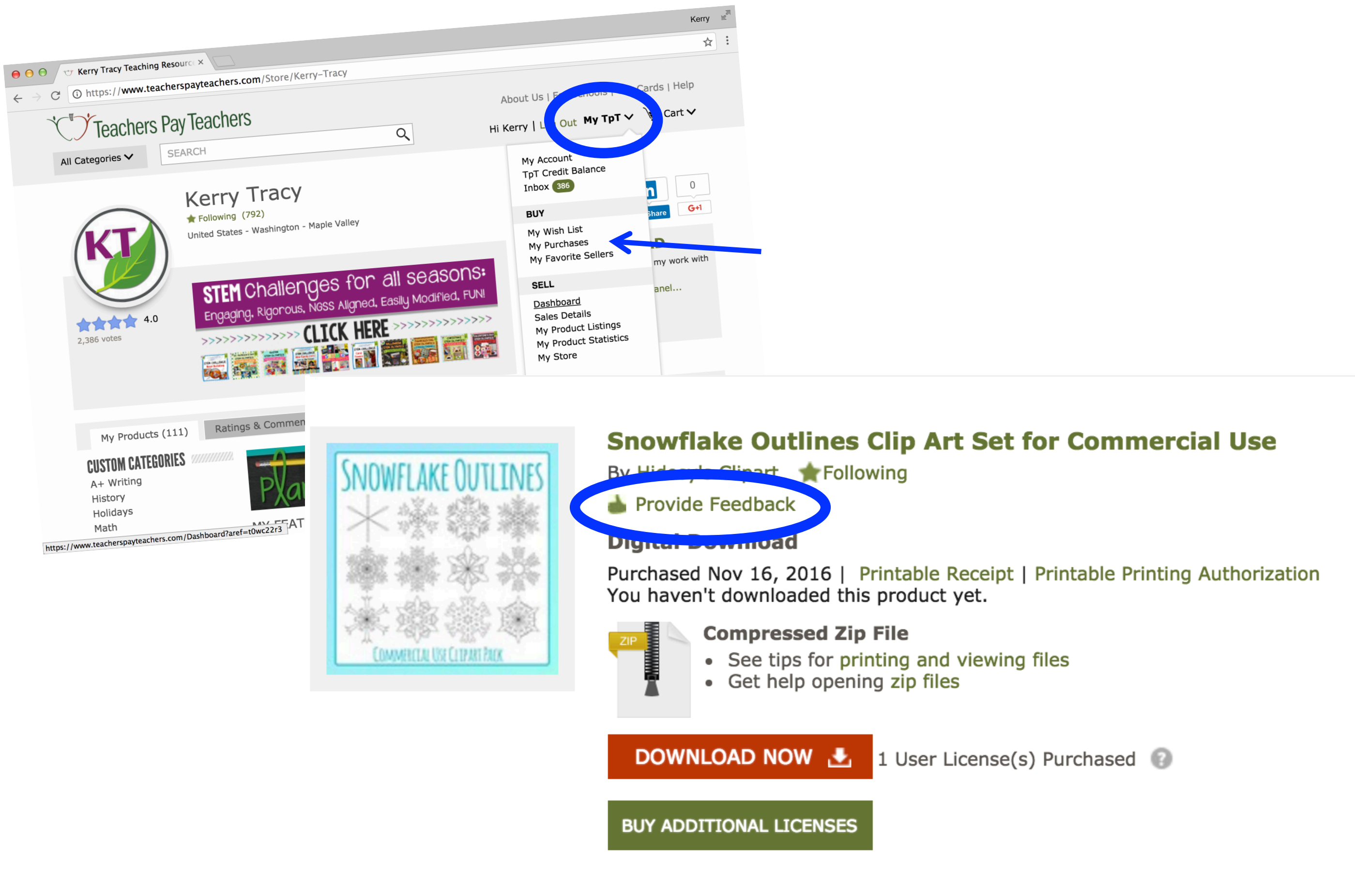

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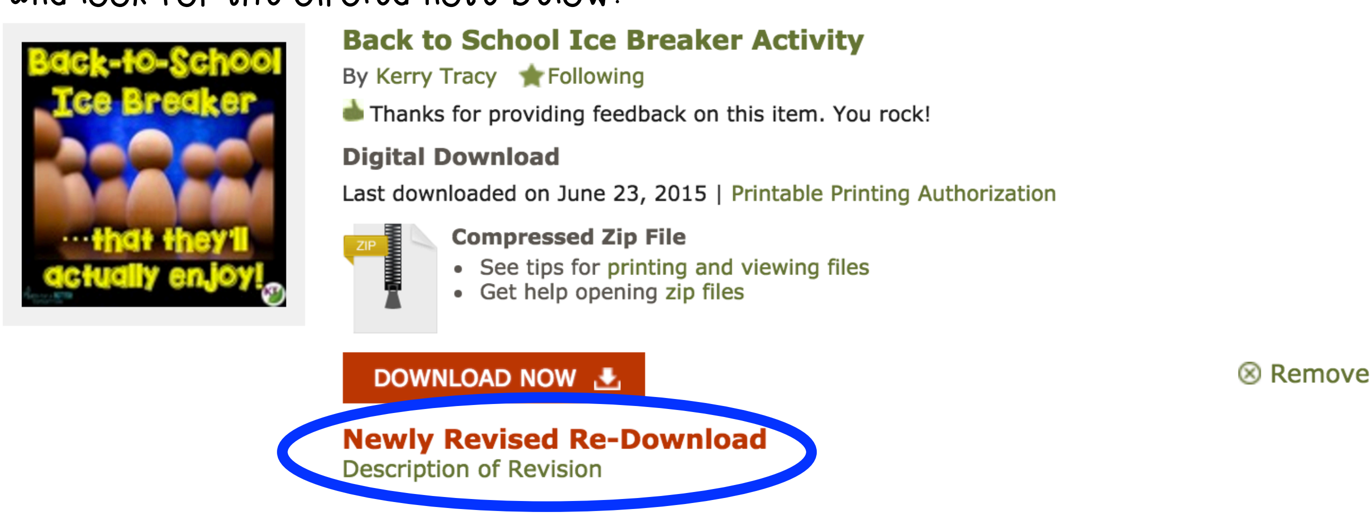

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