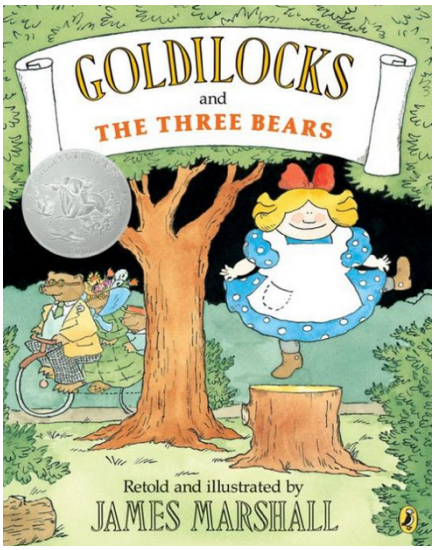
LESSON: Goldilocks and the Three Bears (Grades K-2)

+ OVERVIEW



In this design challenge, students will receive a problem inspired by the story *Goldilocks and the Three Bears* by James Marshall. In the story, Goldilocks is assigned the task of buying muffins in the next village but is warned not to take the shortcut through the forest. However, Goldilocks does as she pleases and ends up finding the home of the three Bears. She walks right into the house without knocking and begins to cause mischief. Having tried the Bear's food, chairs, and beds, Goldilocks eventually falls asleep. When the Bear family returns, they find a sleeping Goldilocks who awakes startled and runs home. Although everyone is safe in the end, the Baby Bear's chair is destroyed.

Students will engage in a STEM challenge to build a chair for the Bear family's guest in 25 minutes. Teams will receive bonus points if a student from the team can sit in the chair.

+ 2021 Science TEKS covered in this design challenge

Kinder TEKS: K.1.B, K.1.E, K.1.G, K.6.A

Grade 1 TEKS: 1.1.B, 1.1.E, 1.1.G, 1.6.A, 1.6.C

Grade 2 TEKS: 2.1.B, 2.1.E, 2.1.G, 2.6.A, 2.6.C

+ Math TEKS covered in this design challenge

Kinder TEKS: K.2.A, K.2.C, K.5, K.6.E, K.7.A

Grade 1 TEKS: 1.3.D, 1.3.E, 1.5.A, 1.7.A

Grade 2 TEKS: 2.2.B, 2.4.A, 2.9.D

+ ELAR TEKS covered in this design challenge

Kinder TEKS: K.7.C, K.8.A

Grade 1 TEKS: 1.1.D, 1.8.C, 1.9.A

Grade 2 TEKS: 2.1.D, 2.6.C, 2.8.C, 2.9.A

TEXAS MOBILE STEM LABS

+ Technology Applications TEKS covered in this design challenge

Kinder TEKS: K.3.A, K.3.B

Grade 1 TEKS: 1.3.A, 1.3.B, 1.5.A

Grade 2 TEKS: 2.3.A, 2.3.B, 2.5.A

+ The students will be able to:

- Read *Goldilocks and the Three Bears* by James Marshall
- Build a strong structure by applying an understanding of the physical properties of objects, and smaller units can be combined to make new objects
- Classify building materials by their physical properties
- Count forward and backward to at least 20 with and without objects
- Use measuring tools to measure the length of objects
- Give an example of a measurable attribute of a given object, including length, capacity, and weight
- Work with a budget
- Solve a problem using the engineering design process
- Describe the elements of plot development, including the main events, the problem, and the resolution for texts read aloud with adult assistance or independently
- Demonstrate knowledge of distinguishing characteristics of well-known children's literature such as folktales, fables, fairy tales, and nursery rhymes
- Work collaboratively with others by following agreed-upon rules for discussion, including listening to others, speaking when recognized, making appropriate contributions, and building on the ideas of others
- Make and correct or confirm predictions using text features, characteristics of genre, and structures
- Explore and collect many types of data, such as preferences or daily routines of people, events, or objects
- Identify and collect non-numerical data, such as weather patterns, preferred reading genres, and holidays

+ Students will use the following STEM fluency skills:

- Communication
- Collaboration
- Creativity
- Critical Thinking
- Resilience
- Time/Resource Management
- Innovation
- Adaptability

+ Materials needed for this design challenge and their cost:

Construction Paper	1 counter per sheet
Toilet Paper Rolls	1 counter per roll
Foam Sheet	1 counter per sheet
Scotch Tape	3 counters per roll
Duct Tape	5 counters per roll
Cardboard	2 counters per sheet
Scissors	1 counter per pair
Chenille Stick	1 counter per stick
Bear Guest	No cost

Teacher's Note: For Kindergarten – Grade 2, students are given counters instead of play money to purchase materials from the store. Students may have some trouble using adhesives and scissors. As a result, extra care and monitoring will be needed to assist students.

+ Facilitator materials needed:

- *Goldilocks and the Three Bears* by James Marshall
- Projector and computer
- Slide deck for the lesson
- Copies of the scorecard for each group
- Timing device

+ FACILITATION GUIDE

SECTION	PROCEDURE
INTRODUCTION	**Slide 1: Goldilocks and the Three Bears** **Slide 2: Read Aloud** > Read *Goldilocks and the Three Bears* ▪ Summarize what happened on each page. ▪ Ask students if they think their chair is *just right*. If not, why? How can the chair feel *just right* for them? ▪ Explain to students that there are jobs that specialize in designing and building furniture. The people who do these jobs are called engineers. They help design and build the things people see and use every day. **Slide 3: Engineering Design 1** > Ask students the question: what is engineering? ▪ Explain to students that engineering is when engineers take what they know and apply it to solve problems by designing a product or process. ▪ For example, phones could once only be used at home or in specific locations. Why is this a problem? (Needing to make a call outside the home). What solution did engineers design to fix that problem? (Cell phones). • *Teacher's Note: Any example can be used here but focus on examples that students are familiar with.* **Slide 4: Engineering Design 2** > Ask students the question: What are some examples of engineering jobs? ▪ *Teacher's Note: If students have trouble giving examples, ask students who makes the things they use. Who makes refrigerators, cars, helmets, cell phones, and sneakers?* **Slides 5-8: Engineering Jobs 1-4** > Show students pictures related to engineering jobs connected to the story. > Architecture ▪ Ask students what they see in the pictures. ▪ Explain to students that the process to build these buildings is called architecture, which is the combination of art and science to design and build buildings.

- Ask students who they think built the Bear's house? Explain to students that an architect would have been in charge of designing the house for the Bear family.

> Furniture Designer

- Ask students what they see in the pictures.
- Explain to students that engineers who design furniture are called furniture designers. Just like architects, furniture designers combine art and science! Some of the work they do can be making furniture look pretty. They also design solutions to make furniture do multiple things at once like a sofa bed! A sofa bed is a couch that can also be a bed.
- Ask students if they remember any furniture from the story. Explain to students that the furniture in the Bears' house was made by furniture designers.

> Computer Numeric Controlled (CNC) Programmer

- Ask students what they see in the pictures. Ask them what they think the machine does.
- Explain to students what they are seeing in the pictures is called a computer numeric controlled programmer, or CNC programmer for short. Engineers who work with CNCs must read blueprints and design models created by architects and designers and then load them into the CNC machine. They also work with the same type of design software architects and designers use.

> Materials Engineer

- Ask students what they see in the pictures.
- Explain to students that the chairs are all made from different materials. Ask students which chair looks the most comfortable. Ask students which chair looks the most expensive. Ask students why chairs are made from different materials.
- Explain to students that engineers need to consider a material's properties and its cost to determine what material would be the best fit for a project. Sometimes a cheaper chair that is less comfortable is the solution. Other times, a more expensive chair that is very comfortable can be the solution. Materials engineers are always trying to figure out how to make the materials used to build things like chairs, shoes, or even the tables in this room better.
- Ask students if the chairs in the Bears' house looked comfortable.

Slide 9: Engineering Design 3

- Ask students the question: who can be an engineer?
  - Anyone!

Slide 10: Engineering Design Process

- Ask students if they think all engineers solve their problems in one try. Explain to students that it takes many tries to get something correct in engineering. In engineering, there is no such thing as a mistake, only opportunities to learn. It is okay to fail. Just find the mistake and correct it. In engineering, there is never one correct solution. There are always many solutions to a problem and always improvements that can be made. The steps that engineers take to find these solutions are called the *engineering design process*.
- The teacher reads the first step to the students. (Identify)
  - What does identify mean? (To point out or find). Engineers design solutions. What do they need to know first before they can find the answer? (The problem)
  - How do people know when they have found the correct answer? In engineering, there are no correct answers, just better ones. Explain to students that there are expectations that engineers must meet called *criteria*. For example, when engineering a football, what does a football need to do? (Bounce, look a certain way, have laces, have air inside, etc.). Those things are all called criteria. By comparing the design to the criteria, an engineer can determine if their solution will work. Is a child-sized football the same as an adult football? The criteria for both footballs include leather, the white laces for fingers, and the shape. However, the two footballs would have different criteria for the size. The footballs are similar but different because of different criteria.
  - Once the criteria are understood for the design challenge, what are some potential challenges that could make it difficult for an engineer to design their solution? (Money, time, materials, etc.) Explain to students that these rules are called *constraints* or rules that engineers must follow. Engineers are given constraints they must follow when finding the solution to a problem. Think about football again. What are college and professional footballs made from? (Leather). What if instead, the rule (or constraint) was to not use leather, could another type of football be made instead? Many of the footballs for sale are made of rubber because the engineer had different constraints.
- The teacher reads the next step. (Imagine)

- Ask students what imagine, or imagination, means. Are these things real or tangible? They may not be real, but they help give us ideas about what things could be. In this step, see what materials are available, then brainstorm, or think about possible ideas/solutions to the problems.
- Explain to students that there are no right answers in engineering. Start with as many ideas as possible.

> The teacher reads the next step. (Plan)

- The third big step of the engineering design process is to plan out the idea. Make sure that what is designed can be repeated. A plan will help an engineer identify where mistakes happen so they can be fixed.
- When planning, begin with the brainstorming phase. Each team member will contribute their ideas, and then the team combines the different ideas!
- Once ideas are combined into a single group idea, determine what materials will be used for the solution and make sure the design has met the criteria and constraints of the project.

> The teacher reads the next step. (Create)

- The fourth step is to create! Since this is the very first creation, it is called a *prototype*. A prototype is a first or preliminary model of something from which other forms are developed or copied. A prototype is created to test the engineer's idea or concept. Engineers ask themselves, "Did the idea work the way we wanted it to?" After testing the idea, the engineer will make improvements to the prototype.

> The teacher reads the last step. (Improve)

- Finally, the last step is to improve. How does an engineer know if the prototype did well on the test? It must meet certain expectations and follow some rules. But how do engineers determine how well it met the expectations and how well it followed the rules? In school, how do you know if you mastered something? (Grades). The prototypes made today will be scored using a scorecard or rubric. By looking at the score, each team will determine if the design could be better. If improvements should be made, then the team will revisit the plan and decide what to do to improve the score. Remember, there are no correct answers in engineering, just better solutions.

IDENTIFY

Slide 11-12: Identify - Problem

- The teacher will read the bolded scenario to students.
  - Ask students what problem the Bear family has.
- Explain to students that they will put on their engineering hat today to help the Bear family build a chair that is *just right* if a Bear guest visits the family.

Slide 13: Identify - Criteria: (Desired Outcomes)

- Explain to students that criteria are what engineers use to determine if they have successfully solved the engineering problem.
- Explain to students that a solution will be successful if the chair:
  - Does not break into pieces when the Bear guest sits on it
  - Is not too big and not too small for the Bear guest
    - *Teacher's Note: Students in K-2 should not be expected to use volume as a form of evaluating space nor measure length using standard measurement. There should be approximately 3 centimeters of space on either side of the Bear guest when sitting in the chair. The teacher may use any object, like an eraser, to demonstrate 3 centimeters or can press their fingers together (pointer and middle finger) on one hand to demonstrate how much is 3 centimeters.*
  - Has the seat at least 15 centimeters off the ground
    - *Teacher's Note: Students in K-2 should not be expected to measure their chairs using standard measurements. The teacher will need to measure and mark a 15 -centimeter-high mark at the station where students are working. If there is no place to mark a height, a teacher could use a 15-centimeter-long string or use a 15-centimeter-long dowel to measure next to the chair. Teachers may differentiate for higher achieving students by setting the criteria to 30 centimeters.*
  - Extension Activity: Bonus points will be awarded if a student can sit on the chair.
    - *Teacher's Note: Success will be determined by a student sitting on the chair for 5 seconds without the chair breaking.*

Slide 14-15: Identify - Constraints (Rules)

- Explain that constraints are the rules that engineers must follow.
- Explain the following constraints for this engineering design activity:

	▪ Time Limit: Students will have 25 minutes to build the chair. • *Teacher's Note: The teacher will time the design challenge and give the students time checks periodically to assist the teams with their time management.* ▪ Materials: Students will be able to use no more than 20 items to build the chair. ▪ Counters: Students will have 20 counters to complete this challenge. • *Teacher's Note: 20 counters will be given to each group. Pre-bag the counters for easy distribution to each group. When students go to the supply table, they will hand the teacher one counter for each item they "buy." They can buy up to 20 items to build their prototype.* ▪ Collaboration: One design element from each team member must be used in the final design. Explain to students that a design element is taking one part of someone's idea and adding it to another. ▪ Redesign: Each team can test their prototype as many times as needed during the 25-minute design phase. Remind students what a prototype is. It is the first creation of our design. • *Teacher's Note: When a team is ready to test their design, they should raise their hand, and the teacher should assist the team with their score. If the team receives a low score on any part of the design, the team should redesign if they still have time.*
IMAGINE	**Slide 16: Imagine -** Explore Materials > Introduce materials to students by showing each item as it is read out loud on the materials list. Explain to students that when engineers describe items, they talk about properties like color, size, and flexibility. Ask students to identify the properties of each material. After each material, ask students if it is similar to any of the other materials they have seen and what the similarities and differences are. ▪ Ask students to reclassify the objects based on what they are made of or how they can be used. > After students have practiced classifying the materials, they will be allowed to combine the materials however they wish to build a chair that meets the criteria for the Bear family.

	Slide 17: Imagine – Brainstorm Ideas > Give students one minute to individually design and draw a plan of what they think the Bear family's chair should look like. Emphasize that students should not talk during this minute or share ideas with each other. Remind students their ideas will be used as design elements for the final design. > After a minute, give students five minutes to present and share their ideas with their group. Let students know that they should focus on key aspects of their idea that they like and want to be used as design elements for the final design when sharing. ▪ *Teacher's Note: If students are struggling with an idea for their design, provide ideas without giving the solution. For example, "This is a design that I tried earlier, but it failed. What could I do to improve it?" Emphasize that the design failed to reinforce that it is okay to fail and to let students know they cannot copy the design and expect success.*
PLAN	**Slide 18: Plan –** Gather Materials > Hand out the scorecard that will be used during the design challenge. Review the testing criteria with the class and answer questions. The testing criteria will inform their design decisions. > Have students collaborate to come up with a final design. Let students know they must include at least one element from each team member for their final design. > Review the design criteria: A successful chair design should include the following: ▪ Does not break into pieces when the Bear guest sits on it ▪ Is not too big and not too small for the Bear guest ▪ Has the seat at least 15 centimeters off the ground Bonus points will be awarded if a student can sit on the chair. ▪ *Teacher's Note: Students will not be expected to rank themselves or calculate their scores, but the teacher should explain how they will earn points. The testing criteria will inform their design decisions.* > They will need to select the materials to be used for the design. Students will have 20 counters to "purchase" materials for their build at the classroom supply table. The prices used in this challenge can be found in the materials list. Students will raise their hands when they are ready to purchase materials and will be guided by the teacher. Students can go over the counter limit if they want but remind them that they will lose points on their scorecard. **Slide 19: Plan –** Team Member Responsibilities > Each team member must be given responsibility, such as materials manager, banker, head engineer, and quality control manager.

CREATE	**Slide 20: Create -** Design Your Chair > Let students know to have fun, be creative with their designs, and work together. > Remind students that being an engineer is not about getting the solution on the first try. There is no right answer, just better solutions. **Slide 21: Identify** – Criteria > Display the reminder slide for students to look at while working. **Slide 22-23: Create –** Test > The teacher will bring the Bear guest to the student teams when they are ready to test. > The teacher will then recap the point total with the students and how many points the team received for each category.
IMPROVE	**Slide 24: Improve –** Redesign/Discussion > Students will reflect on their scores and discuss: ▪ What worked? • *Teacher's Note: Focus on the materials being used and ask what properties of those materials might have helped. Check and see if any students combined materials to make their chairs stronger. Check and see if any students cut or folded the materials to make their chairs stronger.* ▪ What did not work? • *Teacher's Note: Focus on the materials being used and ask what properties of those materials made it not work well. Check and see if any students cut or folded their materials and if that made the chair weaker.* ▪ What do you want to improve? • *Teacher's Note: Focus on engineering aspects with students. Ask students if they found a solution or just part of one. Reinforce that it is okay not to succeed on the first try and that engineering is about making improvements over time. Ask students if they would design their tower differently if they had no rules, how? Ask students if working together was difficult. Learning to work together is very important and it is easier to find a solution with many ideas rather than just one idea.*