

Figure 5.3: Just Right Project Plan

Project Title: Just Right Topic: Design a stool to hold you by exploring ergonomic design; forces on structures	
Grade Level: K-5: Varying levels of prototyping, mathematics content, planning Note: Grades 3-5 students can create full-scale stools from cardboard; it will be a challenge for grades K-2 students to create stools that hold a teddy bear.	Estimated Class Time: K-2: Six classes 3-5: Ten classes
Challenge: Can you build a stool that will be “just right” for Goldilocks (life-size, grades 3-5) or for her teddy bear (grades K-2)?	
Curricular Connections	Skills Focus
English Language Arts —inspiration and connection to children’s literature Mathematics —measurement; 2-D to 3-D planning Social Studies —evolution of design to fit human needs Physical Science —forces and materials Art —aesthetics of furniture design	Critical Thinking —choosing materials; identifying key needs; analyzing effective designs Creativity —aesthetics of design Spatial Reasoning —going from 2-D planning to 3-D models; human interaction with designed environments and objects Collaboration —working as a team; recognizing common human factors Communication —presenting the final structure; key features and ergonomic concerns
Overall Plan	
Hook	<i>Goldilocks and the Story of the Three Bears</i> (Southey, Opie, & Opie, 1980) or any other book where a device or implement needs to fit humans
Quick Build	Twenty minutes—make the best possible three-legged stool from four sheets of printer paper and two large (4 x 6-inch) index cards; 6-inch minimum height; 6-inch minimum diameter or diagonal seat; test the stool to see what it can hold—stuffed animals, books, and so on. Students may use tape and scissors. (See the Three-Legged Stool activity, page 98, for more details.)
Background Instruction	<ul style="list-style-type: none"> • Forces • Center of mass, equilibrium, and stability • Material properties • Ergonomics
Background Research	<ul style="list-style-type: none"> • Different furniture designs • Furniture-building materials • Development of ergonomics; ergonomic standards

Engineering Design Process	
<p>Know Your Problem</p> <ul style="list-style-type: none"> • Know your end user • Identify constraints • Define criteria 	<ul style="list-style-type: none"> • Choose someone to design for (in this case, a child or teddy bear); investigate what the end user likes to sit on, and what sizes are comfortable. • Use the Engineering Happily Ever After worksheet (figure 5.1, pages 129–131) to identify product or project constraints. • What makes the stool one that you or Goldilocks would like?
<p>Know Your Options</p> <ul style="list-style-type: none"> • Research • Brainstorm 	<ul style="list-style-type: none"> • Investigate furniture (chairs and stools) design; principles of ergonomics. • Use a variety of techniques to get students to consider innovative designs.
<p>Develop a Solution—Part One</p> <ul style="list-style-type: none"> • Choose a design • Identify needed materials 	<ul style="list-style-type: none"> • Students settle on the best design; students in grades 3-5 discuss how it meets constraints and criteria. • Stress range of choice and need for planning more with students beginning in grade 2.
<p>Develop a Solution—Part Two</p> <ul style="list-style-type: none"> • Create a plan (make a sketch) • Build the stool 	<ul style="list-style-type: none"> • After some rapid prototyping activities, develop a sketch of the planned stool. • Obtain materials and build the stool; keep material choice simple. (The teacher should suggest using cardboard, white glue, or tape and also provide some items that allow designers to decorate.)
<p>Develop a Solution—Part Three</p> <ul style="list-style-type: none"> • Test the stool • Plan some modifications to make it better 	<p>Depending on the age group and whether a full-size or small-scale stool is built, students should test for the following.</p> <ul style="list-style-type: none"> • How does it look? • Is it stable and level? No tipping allowed. • Can it hold the planned weight? <ul style="list-style-type: none"> + Start with smaller load. + Work up to a full load—teddy bear, teddy bear with weights, student. • If testing a life-size stool, have two spotters present to support the student. • Is it comfortable? Students who make life-size stools should get feedback from a few testers concerning comfort. • Modifications <ul style="list-style-type: none"> + Does the seat need to be made differently, more comfortable? + Are the legs strong? Can they be reinforced? + Is there one thing you can do to make your stool better?
<p>Develop a Solution—Part Four</p> <ul style="list-style-type: none"> • Communicate your results 	<ul style="list-style-type: none"> • Sell your stool to Goldilocks! Have students develop an ad or marketing campaign to convince Goldilocks this stool meets all of her “just right” criteria.

REPRODUCIBLE

Group Size

Grades K-1: Have students work in pairs; teams are not effective at this age.

Grades 2-3: Introduce groups of three or four. In grade 3, begin introducing jobs such as project manager, civil engineer, and architect.

Grades 4-5: Students should begin functioning effectively in teams; jobs are a must.

Assessment

Grades K-2:

- Include an assessment component to reflect how well students make and follow a plan.
- PBLWorks offers a free creativity and innovation rubric (<https://bit.ly/2xnMNZ8>) for this level. Consider using or adapting it.
- Although having individual and group components to grade is unrealistic at this point, emphasize to students that working as a team is important. Formatively assessing and monitoring their teamwork skills are helpful.

Grades 3-5:

- Begin to use a portion of the grade for the project to reflect the need for collaboration and team-work. This should become a more significant assessment component as students do more projects.
- Identify curricular content understandings to assess along with process components. At this age, students should begin to show understanding of elements of problem definition (end user, constraints, and criteria). There should be evidence of students considering various options. There should also be an increasing focus on ways to test, along with using testing information to make modifications by grade 5.

Resources

The Push and Pull activity (at go.SolutionTree.com/21stcenturyskills) is great for learning about materials.