Marin County Civic Center
Pre-Visit Lesson Plan: Science

Grades 3-5

This lesson will prepare students for their visit to the Marin Civic Center, while also reinforcing basic concepts in engineering. The lesson is designed to meet the Next Generation Science Standards for Grades 3–5-ETS1 Engineering Design. The lesson also meets Common Core English/Language Arts Standards for Speaking and Listening for Grades 3-5.

This lesson will take approximately 50 minutes to complete, although more time may be useful with a large or enthusiastic class. Note that a real-world engineering project would allow plenty of time to discuss and draw up plans before construction begins. This activity can work as a quick "intro to engineering" experience, or it can be stretched out over a longer period of time to make it more analogous to the real world.

Standards

- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (NGSS, 3-5-ETS1-1)
- 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. (NGSS, 3-5-ETS1-2)
- Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3, 4, or 5* topics and texts, building on others' ideas and expressing their own clearly. (CCSS.ELA-LITERACY.SL.3.1, 4.1, 5.1)
- Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.(CCSS.ELA-LITERACY.SL.3.2)
- Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. (CCSS.ELA-LITERACY.SL.4.2)
- Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. (CCSS.ELA-LITERACY.SL.5.2)

Advance Preparation
• Students will work in groups of 4-5 for this lesson. Consider the engineering experiment and materials when forming groups. • Each group will need a Builder's Kit (see Materials List). Prepare the Builder's Kits in advance and have them ready to distribute. • Students will need a flat work surface to do their engineering experiments. Depending on the furniture in your classroom, you may wish to have students move their desks together, or you may wish to arrange to hold the lesson in a cafeteria, library, or other work room. • Near the end of the lesson, students watch a brief YouTube video to familiarize themselves with the Marin Civic Center. Make arrangements for a computer with Internet access, a projector, and a screen to be available so all students can view the video.

Materials List

- One Builder's Kit for every 4-5 students, containing:
  - 15-20 large marshmallows
  - 50 mini marshmallows
  - 50 pieces of dry spaghetti
  - 20 plastic straws
  - 1 box of toothpicks (at least 100 toothpicks)
  - 1 container of playdough (approximately 5 ounces)
- Multiple pairs of strong scissors (strong enough to cut through a plastic straw)
- A timer
- A ruler, yardstick, or tape measure
- Copies of the reading "Architects or Engineers: Working Together" (1 per student, or project the reading so all students can follow along)
- A computer with Internet access and a projector to show the video

Task Number	Task Description
1	**Engineering Challenge: Build Time** Before class begins, display the Engineering Challenge where all students can see it. • **Engineering Challenge**: Working in your group, build the tallest tower you can build in 10 minutes, using only the materials provided in your Builder's Kit. The winning tower must be stable enough to remain standing when the challenge is over. At the start of class, assign students to their work groups and seat them at their work tables or have them move their desks. Review the Challenge. Distribute the Builder's Kits, one per group. Answer any questions, but encourage students to get started before they ask too many questions. Set the timer for 10 minutes of building time.

	You may wish to suggest that students take a minute or two to discuss and plan out their ideas before they begin constructing. As an alternative, you may choose not to advise them and allow them to learn from experience what happens if they choose not to plan. Pick the approach that best suits your students and your timeframe. If you wish to allow them time to plan, you may want to increase the amount of time they spend on the Engineering Challenge, and you may want to allow them to use paper and pencils to draw up their plans. Circulate through the classroom, checking on groups' progress. Do not intervene unless absolutely necessary (for example, to enforce the rules of the challenge). Remind students that their tower must remain standing. If their initial design starts to topple, they will need to re-design or re-build it. Encourage students to use their entire 10 minutes of building time. If they find one design which works, suggest they set it to the side and continue to build with their other materials. When the timer goes off, collect any unused materials. If you plan to do the Post-Visit Science Lesson, you may be able to re-use some of those materials.
2	**Engineering Challenge: Discussion and Evaluation** Invite one student from each group to introduce their tower and describe how they built it. Consider taking photographs of each tower while it is standing. Measure each tower and track the results. For each tower, ask the rest of the class to comment on the following: • What does this tower do well? How is its design unique, creative, or effective? Keep the discussions of individual designs brief and focused on the positive characteristics. Even a collapsing tower might have an interesting use of the materials or a creative concept. If time permits, discuss the following questions with the entire class: • Which materials worked best at the base of your tower? Did those materials work as you built upwards, or did you need to find other materials to use? • What materials did not work well? Could you find work-arounds? • What shapes worked well in constructing your tower? What shapes didn't work? • Did you take time to plan your design first? Why or why not? If you did, how did the plan affect your construction? If you didn't, do you think your tower would have worked better if you took the time to plan? NOTE: If time is limited, or if your class is very large, you can simplify this step. Eliminate the measuring unless two towers are very close in height, and skip the discussion of individual towers in favor of a brief class conversation.
3	**Architecture and Engineering** Ask students: What were you thinking about when you were building your tower? Answers will vary, but most students will say they focused on making sure the tower was tall and

	didn't tip over. Tell students they were thinking like engineers. Explain that there are two different jobs which involve being in charge of creating a building: an architect and an engineer. Distribute the reading "Architects and Engineers: Working Together" (attached to this lesson plan) or project it so all students can see. Ask students to follow along as you read it aloud. When the reading is finished, ask them to explain the difference between an architect and an engineer. Answers should reflect student understanding that an architect primarily considers how a building looks and functions, while an engineer primarily considers how to construct the building. Tell students that they are going on a field trip to visit a local landmark designed by a world-famous architect named Frank Lloyd Wright. Show students the introductory video available at: http://bit.ly/2EurzLy. The video is just over two minutes long. If time permits, draw students' attention to the spire seen in the video. Ask students if they notice anything about its design and how its design is similar to/different from the designs they tried. Encourage students to pay attention to the spire during their visit.
4	**Preparing for the Civic Center Visit** Review any specific instructions you have for your students prior to their visit to the Marin Civic Center.

Architects and Engineers: Working Together

You just completed a challenge which asked you to think like an engineer. When a new structure is created, the **engineer** is responsible for making sure the structure will stand up like it's supposed to. Of course, in real life engineers can't keep trying different tower designs until they figure out which one works. Instead, they use math and science to figure out how to build a tower that will stand up straight and tall.

Engineers focus on making the structure safe and strong, but they don't worry as much about how it looks. That's the architect's job. An **architect** designs the structure. The architect thinks about how the structure will look and how it will function.

Of course, architects have to know how to design a safe building. If their designs are dangerous, no one will build their structures. Engineers also have to pay attention to how the building looks and functions. The engineer can't just ignore the architect's designs. They have to work together to make a wonderful new structure.

Sources: New School of Architecture (https://newschoolarch.edu/academics/school-of-architecture/infographic-architecture-vs-engineering/), Wonderopolis (https://wonderopolis.org/wonder/whats-the-difference-between-an-architect-and-an-engineer)