MESA Mathematics Engineering Science Achievement

Lesson Activity

Title	**On-Site Design Challenge: Paper Tower (60-80 Minutes)**
ID Number	MS-E-OS2
Sequence and Duration	• Lead In: 10-15 Minutes • Activity: 40-50 Minutes • Closure: 10-15 Minutes
Age Level	Middle School
Essential Question	**What have I learned about on-site engineering challenges?**
Learning Objectives	• TSW design and build a tower to specs. • TSW reflect on and evaluate their approach to the problem and the strategies they used to address it. • TSW evaluate their comfort level with on-site design challenges. • TSW continue brainstorming strategies to help them be successful at on-site design challenges in the future.
Other Objectives	• TSW develop a working plan with their group to develop a cooperative environment. • TSW communicate with their group by contributing their vocal input. • TSW develop critical reading skills by finding relevant information in given materials. • TSW listen to their peers discuss their approaches to the problem. • TSW contribute to a group discussion about being successful in on-site design challenges.
Key Terms	• On-site design challenge • Approach • Strategy
Materials Needed	Per Class: • Meter stick • On-Site Engineering Design Data Collection Sheet • Scratch paper (different from paper in the building materials) Per Group: • Handout: On-Site Engineering Design specs • 1 sheet of paper • 12 inches clear tape • 1 pair of scissors • 1 ruler
Lead In	26. Remind the students that for the on-site challenge, teams will receive their mission and the specs only when they arrive “on site”, and they must design, build and test their structure within the given time period and with the given materials. So they will essentially be “designing under pressure”, relying on their ability to address the mission quickly by drawing on their prior knowledge and being strategic about their decisions and process. 27. Ask students to think about when they last practiced with an on-site design challenge. Allow time for discussion, using prompts such as the following: What did they learn from the on-site challenge? What kinds of skills and knowledge did they need to use to be successful with it? What did they think they might do differently next time to help them do better? 28. If they are available, have students review what they wrote in their MESA Notebooks for that challenge, in response to the question: “How should I

	approach an on-site engineering challenge?" 29. Tell students they will be doing a practice on-site design challenge today. Once they have their materials, they will have exactly 30 minutes to complete the mission. Remind them to consider the skills and strategies they discussed that will help them to be successful.
Activity	58. Separate students into groups of two and hand out the supplies to each pair. When all supplies have been distributed, hand out the specs face down, instructing students not to turn them over until you tell them to. Tell them they may raise their hands if they need clarification about the rules, but to think of you as the judge, not their advisor. 59. Call out "begin!" and start the 30 minute count-down. 60. After 30 minutes are up, call time and have students clean up their areas and bring their towers and any remaining tape to the testing area. 61. For each tower, measure the perpendicular distance from the testing surface to the highest point. Try to measure to the nearest millimeter. Record the heights on the Data Collection Sheet. 62. Declare the team with the highest tower to be the winners. In the case of a tie, the group that used the *least* amount of tape (i.e. has the most amount of tape remaining) is the winner. 63. Clean up the materials and testing area and have students return to their seats.
Closure	20. Give students time to reflect on their approaches and strategies with this challenge, first with their groups and then reporting out to the whole class. Were they better prepared to approach this challenge after trying an on-site challenge once before? What did they learn from the first challenge that helped them be successful with this one? What did they do differently? What did they do similarly? 21. Ask students what knowledge they used for this challenge, e.g. previous experiences with tower-building; knowledge of structural elements; knowledge of team work strategies; knowledge of the engineering process, etc. 22. Ask students to reflect on their level of anxiety when approaching this challenge. Did trying out two on-site challenges help them feel more comfortable about doing on-site design in the future? 23. In their MESA Notebooks, have students respond to the following conclusion question: *What have I learned about on-site engineering challenges?* They can use the remaining time to complete their Notebooks or finish them as homework.
Informal Assessment	30. Monitor students' participation in the activity. 31. Monitor students' participation in the discussion.
Formal Assessment	• Completed MESA Notebook. • Completed tower.
Trouble Shooting	• Separate out each team's materials and place them in baggies or boxes prior to students' arrival to class. • You can have students build towers with whatever materials you happen to have on hand. Feel free to improvise to create your own challenge.

SEI Strategies Used

Preparation	Scaffolding	Grouping Options
☐ Adaptation of Content	☐ Modeling	☒ Whole class
☐ Links to Background	☐ Guided practice	☐ Small groups
☒ Links to Past Learning	☒ Independent practice	☒ Partners
☒ Strategies incorporated	☐ Comprehensible input	☐ Independent

Integration of Processes ☒ Reading ☐ Writing ☒ Speaking ☒ Listening	Application ☒ Hands-on ☒ Meaningful ☒ Linked to objectives ☒ Promotes engagement	Assessment ☐ Individual ☒ Group ☐ Written ☒ Oral

Arizona Math Standards Addressed	(none)
Arizona Science Standards Addressed	• S3C2: TSW develop viable solutions to a need or problem.

ON-SITE ENGINEERING DESIGN
Middle School Level
Paper Tower

OBJECTIVE:

Your challenge is to design and build the tallest tower out of the given materials. Your team shall compete with other teams in a head-to-head competition.

MATERIALS:

1 – Sheet of paper
12 – inches clear tape

Other materials available for use but not included in the design:

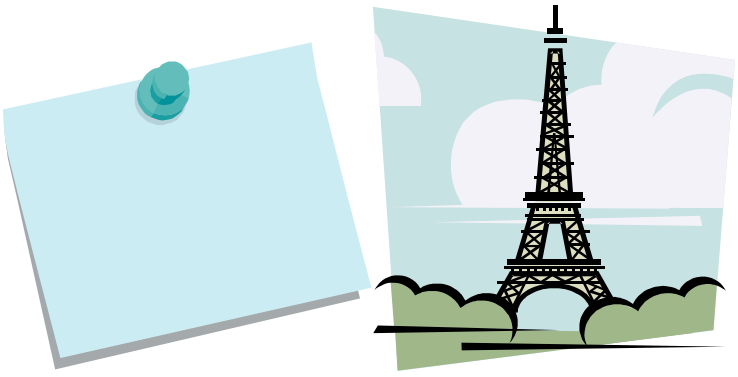
Scissors Ruler Pencil Scratch Paper

RESTRICTIONS and INSTRUCTIONS:

- Each tower must be made out of only the supplied paper and tape. No other materials, including other paper, can be used.
- Each tower must be free-standing. It must not be attached to or leaning against any other surface.
- After thirty minutes, towers must be moved to a judging area. No contact between team members and tower may be made after the tower is moved.

SCORING:

- Towers must stand for 10 seconds.
- All towers, whether straight, curved or sagging, will be measured from the surface of the judging area to their highest vertical point. Neither the judge nor team members may straighten towers.
- The highest tower will be declared the winner.
- In the event of a tie, the team that used the least tape in their design will be declared the winners.



ON-SITE ENGINEERING DESIGN
Middle School Level
Paper Tower

Data Collection Sheet

Group Members	Tower Height (cm)	Remaining Tape (mm)