

MeTEOR Learning Modules

STEM MEA (Model Eliciting Activity)

Designing a New Lifeguard Stand



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MeTEOR
CONNECTING THE DOTS

Designing a New Lifeguard Stand

Reflective Planning

Description/Summary of Lesson:

Students will complete research on current lifeguard stands to see how math is used in a real-world setting for heights and angles. Using prior math skills, the students will make a scale drawing of a lifeguard stand they would like to design and construct to meet the requirements outlined in a given proposal. For their lifeguard stand to be operational, it must have seating for two, be 10 feet tall and have two wheels for easy movement. The model they make will be made from paper. Throughout this activity, students will gain an understanding of how engineers must use scales, angle measures, area and proportional relationships to consider the efficiency and safety of the lifeguard stand they are constructing. In addition, students will gain an understanding of how the math processes they are performing relate to various careers in the world, such as engineering.

Essential Questions:

- How can a lifeguard stand affect a lifeguard's scanning technique?
- How is math used in the building of a lifeguard stand?

Suggested Grade Level: Middle Grades 6-8

Approximate Time: Two days (50 minute class periods)

Teacher's Role: Facilitator

Class Set-Up: Groups of three students at tables or desks put together

Success Standards:

- Students can analyze proportional relationships and use them to solve real-world and mathematical problems.
- Students can solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- Students can solve real-life and mathematical problems involving angle measure, area and surface area.
- Students can 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.
- Students can develop and use models.
- Students can engage in argument from evidence.

Learning Purpose:

- Students will use scale factors, angles and area to create a lifeguard stand out of paper.
- Students will define the problem.
- Students will communicate their problem-solving plan.
- Students will develop a procedure to design and build a lifeguard stand.
- Students will use social, interaction skills for completing projects with peers.

Vocabulary:

- | | |
|------------------|--------------|
| • Area | Scale Factor |
| • Proportion | Megaphone |
| • Spine Board | Platform |
| • Life Ring Buoy | Safety Rope |

Math Practices:

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

Depth of Knowledge:

- DOK Level 3: Strategic Thinking

Materials:

Teacher Materials

- Challenge Letter to Students
- Copies of Rubric
- Exit Slip

Student Materials

Student groups need a zip-lock bag per group with the following items:

- 2-3 Pair of Scissors
- Tape Roll
- 5 Sheets of Copy Paper
- 2 Index Cards
- 2 Straws
- 4 Large Paper Clips
- Ruler

Summary of Tasks/Experiences

Spark Activity:

Have you ever been to the beach or a water park? Did you notice the lifeguard stand? If someone were in trouble while in the water, who would come to help them? Have you heard about undertow, shark attacks and jelly fish stings at beaches? Today you are going to research information about various lifeguard stands and their equipment. Then, you will spend time collaborating with your group on a new design to submit to the MERK Beach Patrol. It must meet the requirements in their challenge. You will be given a zip-lock bag with materials to aid you in your design.

Lesson Descriptions:

Introduction: Day 1

The teacher will:

- discuss the real world challenge listed above.
- hand out the challenge letter to each group.
- show the students the materials in the zip-lock baggies they get to use on day three.
- hand out copies of the rubric for evaluation.
- allow students to collaborate around a plan of action to accomplish their goal.

The students will:

- research information needed on computers or student electronic devices to draw and design their stands.
- apply the thoughts gained from their research to the design of their stand and the scale model, in groups.
- discuss learned information regarding ideas for the new stand construction.
- write their proposal to the company explaining and defending what type of stand they are going to build for both efficiency and safety, along with a scale drawing.

Day 2

The students will:

- build their lifeguard stands.
- answer questions on their exit slip independently. (If needed, students can finish for homework and turn in the next day.)

Teacher facilitates class asking guiding questions as students work in groups:

- What will you do for more support for the stand?
- How will you use scale models, and scale factors to create your stand as a model for your structure?
- What types of materials will you need to construct your design?
- What type of equipment will you store on your stand?

- How will your stand support two lifeguards?
- How will your design be different than any model already out on the market?

Student Engagement

Social/Emotional Engagement: Students will use social, interaction skills for completing projects with peers.

Physical Engagement: Students will collaborate while completing research regarding lifeguard stands through the use of electronic devices and discourse while working in groups of two or three.

Cognitive Engagement: Students will work together using math concepts such as angles, scale drawings, proportions and area to complete their task.

Evidence of Learning

Checks for Understanding/Expected Outcomes:

- Students will complete their written proposal.
 - Proposals should have ten foot tall stands with an explanation of how lifeguards can store equipment. It should include the measurements of the design. The ratio given to their scaled model should match when set up as a proportion.
- Students will build their stand.
 - The ratio needs to match their scaled model and be able to roll.
- Students will complete an exit slip.
 - The exit slip will allow students to show they did some reach as requested and reflect on their success or lack thereof.
- Students will be evaluated using the included rubric.
 - The rubric should be given as a guide to help students as they write their proposal and draw their stand to scale.

Designing a New Lifeguard Stand RUBRIC

CATEGORY	4	3	2	1
Plan and Proposal	Proposal is well thought out. Plan is neat with clear measurements. Scale drawing is neat with the details required.	Proposal is thought out. Plan is neat with clear measurements. Scale drawing is somewhat neat and has some of the details required.	Proposal is not well explained. Plan provides some measurements. Scale drawing exists and has only a few of the details required.	Proposal does not meet requirements. Plan does not show measurements. Scale drawing exists and has only one or two of the details required.
Research	Research shown with much detail about the needs for an effective rolling lifeguard stand.	Research shown with some detail about the needs for an effective rolling lifeguard stand.	Research shown with little detail about the needs for an effective rolling lifeguard stand.	Research shown with little to no detail about the needs for an effective rolling lifeguard stand.
Construction	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but one-two details could have been refined for a sounder product.	Construction accurately followed the plans, but three-four details could have been refined for a sounder product.	Construction appears careless or haphazard. Many details need refinement for a sounder product.
Function	Stand functions extraordinarily well, has flags, storage and is able to roll.	Stand functions well, has flags, stage and able to roll.	Stand functions pretty well, rolls.	Flaws in function, incomplete or unable to roll.
Group Member	The student worked well with team members throughout the entire course of the project and was present each day.	The student worked well with team members throughout most of the project and was present each day.	The student worked with team members on some of the project and was present each day.	The student worked with team members only slightly throughout the project and was absent one day.

Challenge Letter to Students:

Due to near recent drownings and shark attacks, KERM Beach Patrol Unit is looking to purchase a new Lifeguard stand designed to better meet the needs of public safety while visiting their beach and is currently taking bids.

Since lifeguards have the primary duty of supervising the area which they are responsible for, we need to obtain an optimum position for having them able to observe the public and water conditions at all times. This is often best achieved from an elevated position. Current stands are not tall enough to meet these needs.

We are looking for a new lifeguard stand design that would allow seating for two at a height of ten feet. It must be portable so that it can be moved to the most appropriate position when a specific activity is taking place or enable lifeguards to move closer to the water when the tide goes out on the beach.

The stand also needs to be able to act as a storage unit for the lifeguard, holding their important rescue or communication equipment. To aid people in need of assistance, flags must be attached to help in locating a lifeguard stand and give information to the bathers about the conditions for swimming. Umbrellas are nice, but not required.

You are to collaborate with your team and decide what type of stand your team will design and why. Then, you are to submit your proposal, along with a scaled drawing of your stand. In your proposal, you must explain and defend why your team has selected to build this type of stand. Be sure to include why this design would be the most efficient model to build. If we approve your design, you will have one class period to build your submitted stand using any of the materials from the bag you will be given. No additional materials may be used. You must build your model to scale. Include these measurements in your proposal.

Team Members:

Proposal:

Design: Measurements: _____ Height of stand built _____ Seat Area: _____
Scale/Ratio used _____ Accepted: _____ Declined: _____

Designing a New Lifeguard Stand Exit Slip

Name:

Upon completion of this lesson you are to answer the following:

1. List at least three pieces of equipment or items necessary to equip lifeguards at their stand.
2. What is another name for a lifeguard stand or station?
3. Name at least two reasons we have lifeguard stations:
4. Compile a list of suggested improvements on your design of the stand your team built. If your stand did well, what made it a success?
5. Compare and contrast the difference between your design and one that could be found at a pool.

ADDITIONAL TEACHER INFORMATION:

Answers to Proposal:

- Proposals will vary, must make logical argument, include measurements and have a scale drawing. As the teacher, accept all complete proposals that are convincing due to their measurements and design.
- Scale must be able to represent this proportion/ratio to make it ten feet tall in real life.
- They must provide the area of the seat to assure the buyer that two lifeguards will fit. (Would be really cool if they built them back to back, with a circular walk around so lifeguards could look in opposite directions and then walk to other areas of the stand to look around.)

Answers to Exit Slip:

1. Any of these or something that is true: megaphone, first aid kit, spine board, life ring buoy, whistle, breathing mask, gloves, radio, polarized sunglasses, rescue tube, backboard, portable oxygen unit.
2. tower, station, platform
3. to watch and supervise swimmers in order to prevent drownings and other dangers such as sharks and weather conditions
4. Answers will vary depending on the success of their stand.
5. Answers may vary but should include: stands at pools are not as high, may be bolted to the concrete, may be made of plastic and metal and are usually built for one person.



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