<table>
<thead>
<tr>
<th>LOCAL TASK</th>
<th>COMMON TASK</th>
<th>In Development</th>
<th>Reviewed #1</th>
<th>Reviewed #2 (NCIEA)</th>
<th>FINAL APPROVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Task Name</td>
<td>Unique name given to this performance task</td>
<td>Water Tower</td>
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</tr>
<tr>
<td>Content Area</td>
<td>For example: ELA, Science, Math, Social Studies, etc.</td>
<td>Math</td>
<td></td>
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<tr>
<td>Grade-Level</td>
<td>If this is a middle or high school task, indicate grade level and course name if applicable</td>
<td>Geometry</td>
<td></td>
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<td></td>
<td></td>
<td>Surface Area and Volume, High School</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>NH State Model Competencies: Task Targets</td>
<td>List each NH State Model Competency that will be assessed through this task; these are one or two primary task targets</td>
<td>C15: Students will demonstrate the ability to explain, apply, and model geometric measurement formulas.</td>
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</tr>
<tr>
<td>Contributing Author(s)</td>
<td>List the names, emails, and schools or agencies of ALL contributing authors in the task.</td>
<td>Original Authors: Epping High School, Sanborn Regional High School, and Spaulding High School Teachers</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Task Revision Authors: Erica Pappalardo and Rob Lukasiak</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citations/Attributions</td>
<td>If this task is an adaptation of work published elsewhere, list all citations/attributions. Permission to include copyrighted work must be obtained by the author(s) listed above from the originator of the adapted work and documented here.</td>
<td>Adapted from Alex.state.al.us Author: Amy Adams, Shelby Country High School</td>
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</tbody>
</table>
Performance Task Description

Describe the performance task in detail, specifying the context for the task, the anticipated student activities, products and/or presentation and resources, texts, scaffolding, and materials needed. What will the students be asked to do, to produce, and through what actions will they demonstrate mastery of the target competencies? Refer to the NH PACE Accommodations and ELL Guidelines in ensuring that the construction of the task leads to activities that are accessible to all students.

Essential Question: How can geometric measurement formulas for surface area and volume be used to model and describe water towers?

DOK 1 & 2
- Calculate, measure, apply a rule
- Apply formula
- Use models/diagrams to represent or explain mathematical concepts

DOK 3 & 4
- Make and justify conjectures
- Use and show reasoning, planning, and evidence
- Develop a mathematical model for a complex situation
- Design a mathematical model to inform and solve a practical or abstract situation

Summary: Students are able to calculate and analyze surface area and volume and compare their results between various geometric figures: Your town’s population is predicted to increase over the next 3 years. As one of the town planners, you are asked to address this issue in terms of the town’s water supply. In order to meet the future needs of the town, you need to make a proposal to add a water tower somewhere on town property that will be capable of holding 45,000 ± 2,000 cubic feet of water. The town is looking for a water tower to contain the most amount of water while using the least amount of construction material.

Time to Complete: 3-4 class periods (90 minute periods)

Students will know (content) ...
- How to calculate surface area of various geometric figures
- How to calculate volume of various geometric figures
- How to define and create compound geometric figures
- How to create a scale drawing of a geometric figure

Students will be able to (skills) ...
- Explain volume formulas and use them to solve problems
- Apply geometric concepts in modeling situations

Possible Accommodations:
- Students will be allowed to present their proposal in a variety of media formats
- Reading support
- Provide a graphic organizer
- Extra time given
- Quiet work environment

Resources/Texts/Scaffolding Materials: Google Images - Water Towers
**Pre-requisites: Skills and Concepts:**
- Area formulas
- Surface Area formulas
- Volume formulas
- Scale factor
- Create Scale Drawings

**Key Criteria for Performance Assessment:** See Finalized Student Rubric – Water Tower
- At least 2 different water tower designs that meet a given criteria
- Scale drawing/model of each tower
- Description and calculation of each tower
- Analysis of the designs

**Placement in the Curriculum:** At the end of your Area, Surface Area and Volume unit

**Possible Formative Assessments:**
- Cereal Box Activity Formative: Real World application of surface area and volume
- Country Mile Activity
- Deconstructing Geometric Figures Formative: Help to explore surface area
- Exploring Volume of Geometric Figures Formative: Help to explore volume
- Formative Quiz: Apply Surface Area and Volume formulas
- Scale Drawing formative activity
- Comparing ratios activity

Teachers are strongly urged to use the task rubric (or parts of it) when giving any formative assessments

<table>
<thead>
<tr>
<th>Standards Addressed in the Performance Task</th>
<th>Standards: List the complete wording of the target standards associated with the key competencies included above (may copy &amp; paste). There should be a direct and obvious alignment between the standards and the competencies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Standards: List the document(s) from which the standards are drawn i.e. CCSS, NH State Frameworks, NGSS, etc., including any locally developed competencies or standards.</td>
<td>None cited</td>
</tr>
<tr>
<td>NH Work Study Practices</td>
<td>SMP 4: Model with mathematics</td>
</tr>
<tr>
<td>CCSS Standards for Mathematical Practice</td>
<td>SMP 6: Attend to precision</td>
</tr>
<tr>
<td>CCSS Standards for Mathematical Practice</td>
<td>HS-G-GMD 3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.</td>
</tr>
<tr>
<td>CCSS</td>
<td>HS-G-MG 1. Use geometric shapes, their measures, and their properties to describe objects (e.g. modeling a tree trunk or a human torso as a cylinder.)</td>
</tr>
<tr>
<td>CCSS</td>
<td>HS-G-MG 3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).</td>
</tr>
</tbody>
</table>
Rubric(s) Used in Assessing this Task

Include all rubrics to be used in the assessment of students’ proficiency with this performance task. Be specific in the description of the student product(s) and activities to which the rubric will be applied. Cut and paste or upload the rubric document here. Annotate the rubric to make clear which standards and competencies are aligned with each scoring dimension. Rubrics adapted to student-friendly language should be included in the student instructions section. However, they should align with teacher-use rubrics included here.

Listing which part (activity and/or product) of the task is used for assessment through the rubric assists in comparable administration across districts and replication of the task by various educators.

<table>
<thead>
<tr>
<th>Student Activities/Product(s) to be scored using this rubric:</th>
<th>Rubric: (copy or upload the entire annotated rubric to this section)</th>
</tr>
</thead>
</table>

The scoring rubric is attached to the task as a separate document. Students must meet all criteria in one column of the scoring rubric in order to progress to the next (beginning with the elements described under 1).

Teacher Directions

In this section, describe all directions that the teacher needs to use in the administration of all aspects of the performance task, including lesson focus and formative assessment tasks. Bear in mind that teachers other than the original author(s) will need these directions in order to administer the task. Include hyperlinks for online resources.

This task is designed for 3 – 4 class periods (90 min. periods)

Introduction:

- Read the introduction to the problem.
- Review the Rubric – explain terminology such as “Well labeled” diagrams means complete and accurate units, dimensions, and critical measurements required to perform calculations.
- Lead a discussion with students about the purpose of water towers.
- Show a range of images of water towers.
- Remind students we are only considering the tank portion of the water tower - not the supporting structure.
- Allow students to initially collaborate on ideas. Collaboration is intended to be a brief, verbal brainstorming session of ideas of possible design shapes.
- Students are not allowed to take any task materials out of the classroom with them.
- Students are expected to work independently.

Student work time: During this time teachers will only be allowed to answer clarifying questions.

Minimum Resources available for students:

* Formla sheet
* Calculator
* ¼ inch Graph Paper
* Ruler
* Compass/protractor

*Prior to having students engage in the task, it is expected that teachers review and interpret the scoring rubric with students. Teachers are encouraged to practice using elements of this rubric with students during the formative process.

Answer Key: The answer key that is provided supplies you with two possible designs and represents sample solutions. Due to the openness of the task, there will be variety in student responses. Attention should be paid to the reasonableness of the students’ designs.
**Student Instructions**

Describe clearly and in detail all student instructions used in the administration of this performance task. Attach or upload aligned rubrics that have been adapted to student-friendly language.

Your town’s population is predicted to increase over the next 3 years. As one of the town planners, you are asked to address this issue in terms of the town’s water supply. In order to meet the future needs of the town, you need to make a proposal to add a water tower somewhere on town property that will be capable of holding $45,000 \pm 2,000$ cubic feet of water. The town is looking for a water tower to contain the most amount of water while using the least amount of construction material.

<table>
<thead>
<tr>
<th>Artifacts</th>
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<tr>
<td><strong>Optional:</strong> In this section, include links to artifacts depicting student products that may be useful in gaining greater clarity of this performance task. These may be digital pictures, podcasts, websites, etc.</td>
</tr>
<tr>
<td>There are no artifacts aligned to this task at this time.</td>
</tr>
</tbody>
</table>
Teacher Instructions: Water Tower Task

This task is designed for 3-4 class periods (90 minute periods)

Teachers should perform the task before administering.

Introduction:

* Read the introduction to the problem.
* "Review the Rubric – explain terminology such as "Well labeled" diagrams means complete and accurate units, dimensions, and critical measurements required to perform calculations.
* Lead a discussion with students about the purpose of water towers.
* Show a range of images of water towers.
* Remind students we are only considering the tank portion of the water tower - not the supporting structure.
* Allow students to initially collaborate on ideas. Collaboration is intended to be a brief, verbal brainstorming session of ideas of possible design shapes.
* Students are not allowed to take any task materials out of the classroom with them.
* Students are expected to work independently.

Student work time: During this time teachers will only be allowed to answer clarifying questions.

Minimum Resources available for students:

* Formula sheet
* Calculator
* ¼ inch Graph Paper
* Ruler
* Compass/protractor

*Prior to having students engage in the task, it is expected that teachers review and interpret the scoring rubric with students. Teachers are encouraged to practice using elements of this rubric with students during the formative process.
Answer Key: The answer key that is provided supplies you with two possible designs and represents sample solutions. Due to the openness of the task, there will be variety in student responses. Attention should be paid to the reasonableness of the students' designs.
The Purpose of Water Towers: Articles
3. Water Towers by Andrew Boyd (with audio), http://www.uh.edu/engines/epi2578.htm

The Purpose of Water Towers: Videos
2. Tim Facts! – What is the Purpose of Water Towers? [1min38sec] https://www.youtube.com/watch?v=9OssosmgZYc
The Purpose of Water Towers: Pictures

Hampton Beach Water Tower

Hampton, NH

Quick Description: This water tower serves the town of Hampton Beach, New Hampshire on the very small coastline of the state (about 15 miles) and a very popular destination in the summer.
Chelsey Hill Tower

Quick Description: A squat water tower on Chesley Hill Road in the southern part of Rochester, NH.
Bennett Standpipe Water Tower

Quick Description: Water storage for the community of Bennett, NC

Bennett, NC
Old Watertower - Dombasle-sur-Meurthe

Quick Description: A Waterturm build 1884 in a very good condition.
Double Springs Tower

Quick Description: Right next to the courthouse in downtown Double Springs
Water Tower Proposal

The Problem:
Your town’s population is predicted to increase over the next 3 years. As one of the town planners, you are asked to address this issue in terms of the town’s water supply. In order to meet the future needs of the town, you need to make a proposal to add a water tower somewhere on town property that will be capable of holding $45,000 \pm 2,000$ cubic feet of water. The town is looking for a water tower to contain the most amount of water while using the least amount of construction material.

Student Task:
Your job is to prepare a proposal that can be submitted to the town planning committee. The proposal should include:
- A Cover Page - Title, name, date, and goal of the proposal.
- Models/Scale Drawings
- Calculations and Mathematical Strategy
- Communication of Analysis and Recommendation

Criteria for Designs:
- Create two different geometric designs
- None of the designs can be composed of a rectangular prism, which includes cubes.
- The tower must be capable of holding $45,000 \pm 2,000$ cubic feet of water in a realistic space.
- One of these designs must be a composition of at least two different geometric figures.

Proposal Criteria:
- A model/scale drawing for each design
- A detailed description of each design including geometric figures used and their critical dimensions.
- Formulas and calculations of volume and surface area for each design
- A Summary:
  - Using your calculations of surface area and volume for the two designs, describe and analyze the characteristics that lead you to a final recommendation.

Revised 11/24/15
<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>N/S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Models/Scale Drawings</strong></td>
<td><strong>I can create models/scale drawings that are mathematically accurate, realistic, and well labeled with accurate key</strong> and scale factor**.** I can create two different geometric designs that meet the given design criteria.</td>
<td><strong>I can create models/scale drawings that are somewhat accurate, only partially labeled, or may not meet all of the given design criteria.</strong></td>
<td>I can create models/scale drawings that are inaccurate, not labeled, or do not meet the given design criteria.</td>
<td><strong>I can create models/scale drawings that are inaccurate, not labeled, or do not meet the given design criteria.</strong></td>
<td></td>
</tr>
<tr>
<td>C15: HS-G-MG 3 SMP 4 &amp; 6</td>
<td><strong>Calculations and Mathematical Strategy</strong></td>
<td><strong>I can provide accurate calculations/units. I can apply a mathematical strategy that includes the use of algebra with the formulas to determine the value of the independent variable(s).</strong></td>
<td><strong>I can provide calculations/units that contain significant errors. I may use formulas incorrectly but there is some evidence that a mathematical strategy is used.</strong></td>
<td>I can provide calculations/units that are inaccurate or incomplete. Formulas are not used or are not used correctly. There is little or no evidence of a mathematical strategy used.</td>
<td></td>
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<tr>
<td></td>
<td><strong>Communication, Analysis, Recommendation</strong></td>
<td><strong>I can craft a proposal that contains all of the components outlined in the proposal criteria.</strong></td>
<td><strong>I can craft a proposal that contains all of the components outlined in the proposal criteria.</strong></td>
<td><strong>I can craft a proposal that contains all of the components outlined in the proposal criteria.</strong></td>
<td></td>
</tr>
<tr>
<td>C15: HS-G-MG 1 SMP 6</td>
<td><strong>I can craft a proposal that is neat, organized and use accurate mathematical language.</strong> I can create a summary, using my calculations and their ratios to justify and analyze the characteristics that lead me to a final recommendation.</td>
<td><strong>I can craft a proposal that is neat, organized and use accurate mathematical language.</strong></td>
<td><strong>I can craft a proposal that is somewhat organized but may lack accurate mathematical language/structure, or my analysis is incomplete.</strong></td>
<td>I can craft a proposal that lacks organization, I use inaccurate mathematical language/structure, and my analysis is irrelevant or missing.</td>
<td></td>
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</tbody>
</table>

*For example, a Key could be 1 inch = 1 foot (units are different).  
**For example, a Scale Factor could be 1:3, meaning the second length is 3 times as long as the first (units are the same). 
Students must meet all criteria in one column of the scoring rubric in order to progress to the next (beginning with the elements described under 1).