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Sixth graders use engineering to tackle real-world problems

Huntington – Sixth grade students at Gateway Regional Middle School have completed a STEM unit of study designed to have students work in teams and use the engineering design process to solve several real-world problems.

After studying the 8 steps of the engineering design process—identify, investigate, imagine, plan, create, test, improve and communicate—students worked through several problems that teams had to solve.

Using a unit of study and materials purchased from the Boston Museum of Science (and funded by the Gateway Education Foundation) the students first had to first design an insulated transport tank to protect a woolly mammoth from melting, as it was moved from the field where it was discovered to a lab, where it would be studied. Each team received a clear plastic deli container as their transportation tank base and an ice cube to represent the woolly mammoth. Students worked within specific constraints: they had 20 minutes to design their tank and were only allowed to use five items to insulate their 'tank'. Available materials included black foam squares, black felt squares, aluminum foil, colored construction paper squares, rubber bands, paper towels, felt and tape. To test the effectiveness of their design, each team weighed an ice cube before and after a 5-minute test run under a sun lamp.

Students then calculated their percent change in mass to figure out which materials and design had worked best; in Laura Fisk's class, 3 of the 7 teams had no loss in the weight of their ice cube.

Students also completed a self-assessment to learn what skills each person brought to the team, such as creativity, communication, critical thinking, leadership, persistence, teamwork and technical skills. In addition to their engineering skills, students received feedback on their teamwork skills, as observed by teachers Matt Collins and Laura Fisk. "What shouldn't we be seeing happen in teams?" asked Fisk. Students answered that there shouldn't be any fighting and that leaders should not be doing all the work or making all the decisions.

In their final engineering problem, students had to design an insulation system that would effectively heat and cool shipping container homes. Shipping containers (the type you see pulled by tractor trailers or trains) are being repurposed throughout the world into buildings, including houses. In theory, it is a promising idea, especially in parts of the world that have building material or housing shortages. In practice, the 'containers as houses' come with a major design challenge: if the container is not correctly insulated, the inside walls have heavy condensation.

Students created model container homes from paper, using the same-sized template. They were required to create a floor plan for their home for rooms and appliances, and their homes had to include windows. The un-insulated homes were tested under the heat lamp for changes in temperature over time. It was then time to insulate their homes, retest and compare the difference.

"We watched a movie about a man who was renovating his home. Before he worked on it, he used 1400 gallons of heating oil in a year," reported Autumn Hamblin. "After he insulated the home and replaced his windows, he reduced that to 400 gallons of oil."

Students tested several different materials under the heat lamps to measure the change in temperature over time. Teams then had to complete an engineering word search and cross-word puzzle in order to earn up to $1000 to purchase insulation materials for their final design. Available materials included aluminum foil, foam or felt sheets, bubble wrap, cotton balls, transparency sheets (for windows), construction paper and sand and teams shopped for the materials that fit their design.

Once again, the models went under the heat lamp to measure changes in temperature over time, which were compared to the control model. Homes were also tested under lower temperatures over time, to see how well the insulation protected against cold temperatures. Students then reflected on how well their design worked against hot and cold weather, and how they might improve their design.

Hamblin and teammate Cecelia Balboni selected felt, foam, foil and the transparency paper for their materials. They also had 1 piece of white paper for their siding. "We chose white because it was aesthetic and because we didn't think it collected heat the way darker colors would," said Balboni.

"Knowing this would be really useful," reflected Balboni. Hamblin added, "Doing this stuff is really fun. And you use your imagination to figure it all out."

"It was exciting to witness the students' growth," reported Fisk. "They went from knowing very little about the process to become budding engineers eager to collaborate, solve problems and improve technologies of the 21st century."

The event concluded with teams presenting on their findings to the rest of the class.

"We greatly appreciate funding from the Foundation and plan to implement this project yearly," Fisk added.

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Photos: (top) Carson Savery weighs and charts his "woolly mammoth" (ice cube) before and after time under the sun lamp to measure the loss of mass. (center) team members Nevaeh Damon, Annemarie Benson and Jake Cooper consider their options while shopping for container home insulation; (bottom): Autumn Hamblin and Cecelia Balboni show their model home, which is now ready for testing.