

Keeping Cool with Qatar Cool: A Pre-College Education Program Emphasizing Corporate Regional Engineering with Hands-On STEM Learning (Resource Exchange)

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A resourceful science professional with expertise in STEM fields, science communication, laboratory safety, program management, and chemistry, Benjamin Cieslinski manages the science, technology, engineering, and mathematics (STEM) laboratories for Texas A&M University at Qatar's Office of Advancement. He designs and performs demonstrations of science and engineering to local schools via the Science and Engineering Road Show mobile lab and creates programs for local youth to educate and entertain with hands-on projects to challenge students' math and science skills.

Tala Katbeh, Texas A&M University at Qatar

Tala Katbeh is a STEM Instructor and Program Coordinator at Texas A&M University at Qatar (TAMUQ) where she applies her enthusiasm for engineering to create curricula and engineering courses for school students. Katbeh is currently also pursuing her PhD at Texas A&M University, having graduated from TAMUQ with a BSc and MSc both in chemical engineering.

Prof. Hassan Said Bazzi, Texas A&M University at Qatar

Dr. Hassan S. Bazzi is the senior associate dean for research and advancement and professor of chemistry at Texas A&M University at Qatar, a branch campus of Texas A&M University. Dr. Bazzi is also professor of materials science & engineering at Texas A&M University. Dr. Bazzi received his bachelor's and master's degrees in chemistry and organic chemistry, respectively, from the American University of Beirut (1996 and 1998), and his Ph.D. in polymer chemistry with Dean's Honor List from McGill University (2003). He worked briefly with the United Nations as a chemical weapons inspector in Iraq before doing a postdoctoral research fellowship at Université de Montréal. He joined Texas A&M at Qatar as assistant professor in 2004, was promoted to associate professor (2009), and then to full professor (2014). Dr. Bazzi completed the Management Development Program (June 2014) and the Institute for Management and Leadership in Education (June 2018) at Harvard University Graduate School of Education.

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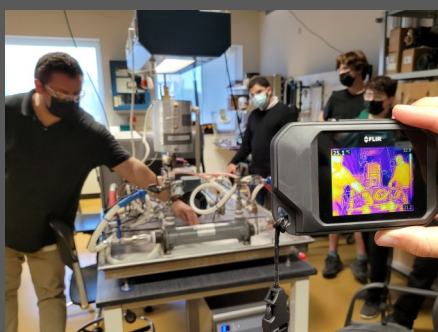


Objectives

- ★ Use Qatar Cool's corporate goals as an introduction to engineering at Texas A&M University at Qatar.
- ★ Recognize the importance of local engineering, district cooling, and resource conservation.
- ★ Allow students to work directly with a local corporation to understand engineering objectives, business goals, and local infrastructure.
- ★ Understand and implement the engineering design process.
- ★ Work cooperatively to research and present novel solutions to real engineering problems.

How to create partnerships with local businesses to engage high school students.

STEM outreach demonstrates career opportunities, creates community goodwill, positive marketing, and opens doors for further collaboration.



1. Break down the topic into learning objectives

Regional cooling technology is complex, therefore the overall engineering was broken down into learning objectives that build upon each other.



2. Educate via play and discussion with experts

Brief lessons on the learning objectives included lectures from experts, playful experimentation, and personal interactions.












3. Task with creating working models

Using basic supplies and tools, students created working models of learning objectives with measurable engineering goals.

Qatar Cool utilizes regional cooling to efficiently pump supercooled treated sewage effluent to surrounding buildings into heat exchanges for cooling; reducing water waste, electricity use, and CO₂ emissions.

Use corporate statements as a guide to creating lessons that can grow in complexity over time and have a hands-on component of learning.

Lesson Topics	Objectives	Activities	
Engineering Design	Sketching Brainstorming Teamwork	Building Towers	
Pump Physics	Forces Displacement Power	Creating a Water Fountain	
Water Conservation	Scarcity Security Waste	Building a Hydroponic System	
Energy Conservation	Consumption Loss Cooling History	World Energy Demand Research	
Heat Transfer	Heat Capacity Systems Surroundings	Calorimetry	
Evaporative Cooling	Latent Heat Intermolecular Forces	Building Swamp Coolers	
Refrigeration	Compressor Condenser Evaporator	Deconstructed Refrigerator	
Heat Exchangers	Heat Transfer Fluids Types	FLIR on Heat Exchangers	
Water Treatment	Contaminants TDS & TSS Filtration	Build Mini Water Treatment Plants	

Students successfully researched an issue facing district cooling (fluid contamination with Refrigerants) and modeled possible solutions for engineers at Qatar Cool for evaluation with an engineering rubric based on feasibility, cost, and presentation skills.

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