Capstone Challenge

2023-2024

Grade 10 -Semester 1

Theme: Matter, form, and function

Egypt Grand Challenges: Manage and increase the sources of clean water, deal with urban congestion, recycled garbage and wastes for economic and environmental purposes, and reduce the effect of climate change.

Capstone Big Idea: All over the world, the implications of climate change can be catastrophic at times. Therefore, protecting our homeland is critical to mitigate its impact. Egypt has suffered from flood discharges in many areas in recent years, particularly in the Red Sea Mountains and Sinai, as well as in Greater Cairo and the towns along the coast. In general, dams are used to impound (store) water, flood control, human water supply, irrigation, energy generation, etc. It is necessary to build a dam that restore water and discharge extra water and a specified amount of it at a certain rate.

Essential Question: How can we mitigate the destructive effect of flood discharge caused by climate change and profit from its beneficial aspects?

Design Challenge: Your team will design, construct, and test a dam to save water and protect populations and infrastructure of the Egyptian cities. Research, deeply, dam structures and their components. Before designing and constructing your prototype, try out two different design alternatives using paper or any other suitable material. Concerning the dam structure, at least water-retaining (heel, toe, crest/roadway of dams, etc..) and water-releasing (as crest gate/spillway gate, radial gate, slide gate, rolling gate or any similar system of gates) structures should be included in the prototype. On the dam body, the position and elevation of the dam gates should be considered to meet the requirements below. To construct your prototype, only one manufactured material (such as cement or any other suitable material) may be utilized, this material is coupled with additional materials recycled from available waste or by employing materials from natural resources. In your capstone portfolio, document all your work, including your research, recommendations, dam design, and dam tests.

Design Requirements: Your dam prototype must fulfil the following requirements to be successful:

- Your design should have a target stored capacity of your choosing between a minimum of 50 and a maximum of 60 liters.
- The minimum height of the stored water is 25 cm.
- The minimum height of the dam structure is 30 cm.
- The crossroad in the crest of the dam should support a concentrated load in its middle point not less than 10 kg.
- The thickness of the dam in the bottom should not be less than 10 cms while in the top it should be not less than 3 cm.
- The prototype dam should be able to discharge water to both 25% and 50 % of the stored water target amount.
- Determine the flow rate of the discharged water through the dam gates. Students should include a graph that represents your measurements and the data you used to determine flow rate.
- Any water exceeding the designed stored water capacity should be discharged automatically using an appropriate method for your dam design.

Constraints: during the construction of your prototype, the student will be confronted with the following constraints:

- Avoid any bending in the dam components.
- The minimum storage time, of the maximum designed capacity, during testing your prototype should be at least 2 hrs.
- The dam should be constructed of no more than one manufactured material along with recycled materials from available waste and/or materials from natural resources.
- The maximum diameter of the reinforcing bars should not exceed 3 mm while the maximum length should not exceed 100 mm.
- Reinforcing bars have the same material constraints in that they must be recycled materials or the one manufactured material.