



## Capstone Challenge 2023-2024 Grade 2- Semester 1

**Grade 2, Semester 1:** Change, Equilibrium, and Cycles (Re-equilibrium of water resources)

### Grand Challenge(s):

- 1- Manage and increase sources of clean water.
- 2- Recycle garbage and waste for economic and environmental purposes.
- 3- Increase the industrial and agricultural bases of Egypt.
- 4- Address and reduce pollution fouling our air, water, and soil.

### Capstone Big Idea:

Egypt is facing water limitation as its population grows. The government is working on a number of projects to increase water supply for agricultural expansion. Another issue that can be addressed by treating effluents from various home, agricultural, and industrial uses is water quality.

**Essential Question:** How can we optimize (least number of water treatment processes) the use of wastewater for agricultural purposes?

### Capstone Design Challenge:

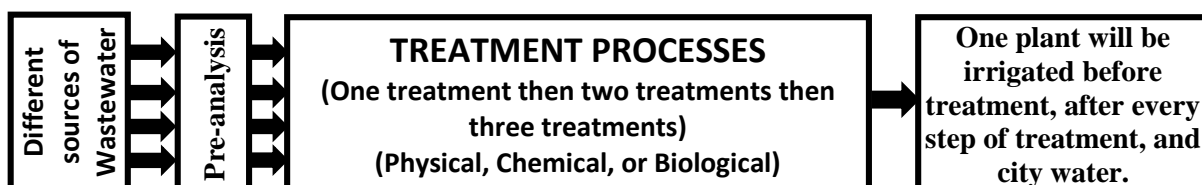


Figure 1. *Capstone challenge block diagram*

Students will determine and demonstrate the least number of water treatment processes that will still result in a grown plant compared to the control plant. The minimum amount of treatment necessary to overcome threshold level of treatment. Below the threshold level of treatment leads to obtain unhealthy plants.

- The multiplicity of recorded data related to the content of water samples used to irrigate plants and its impact on plant growth and toxicity must be considered.
- Students will conduct research for different ideas to treat wastewater for different sources of contaminated water (sewage water, car wash stations, gas station outlets, etc.) **except factories.**
- Students must research the nearby **highly polluted** wastewater. Water samples should be analyzed prior to treatment (pre).
- The analyzed wastewater sample will be treated using at least two different remediation methods (physical, chemical, or biological).

- According to the pre-analysis of wastewater sample, one or two of the recorded highly toxic elements can be traced later in the growing plant itself. This is an example helps to be somewhat sure about how the least number of wastewater treatment is sufficient to be say the plant is safe to be used. **Other creative ideas also are acceptable from student's teams.**
- Students will select one species of plants to irrigate with treated water based on plant requirements. For example, your team might choose a **plant that is very important to Egypt** or a plant that has a known susceptibility to water quality parameters such as salinity, pH, or dissolved solids, for example.
- Each team will use small planting pots or planters to grow several seeds of the same plant in several different pots. One or more plants will be given a measured amount of water available in your community as a control. Several other seeds (number chosen by the team) will be irrigated with wastewater and treated water at different levels. The goal is to demonstrate the minimum amount of treatment that will still result in a healthy plant compared to the control plant. Note, this minimum amount of treatment can only be demonstrated successfully if a level of treatment below this threshold results in an unhealthy plant sample. Your plants' measurements should indicate an unsuitable level of treatment as well as suitable levels of treatment so you can conclusively claim a minimum level of acceptable treatment.
- All the pots/planters in the experiment should be filled with soil that is 50% clay and 50% sand.
- Measurements of growth parameters of plants must be taken in consideration (root and shoot length, plant fresh weight, plant dry weight, numbers of leaves per plant, chlorophyll content..... etc.). Be sure to do suitable number of replicates of pots that makes your measurements be reasonable and representative.
- Prepare to share your data, which will include gradual changes in the plants as a result of irrigation with both treated and water available in your community. This data should also indicate a level of treatment below which plants do not grow well and levels of treatment above which they do grow well.

### **Design Requirements:**

1. The collected wastewater samples must be in enough quantity to irrigate plants in the agricultural experiment.
2. Factory wastewater is not allowed to be used.
3. Each team should have **at least** three samples of treated water besides the untreated and city water; one of them is that treated with only one processes, the second one is that treated by two processes, the third sample is that treated with three processes.
4. Each team will trace two toxic elements which highly recorded in the pre-analysis in the most successfully grown plant.
5. Students should use the same plants for all test cases.
6. Plants should be a part of the prototype.
7. Students should follow the gradual growth of plants in all pots each 5 days.

### **Constraints:**

- Don't add fertilizer in your experiment.
- Seeds should not be from grocery stores but from trusted scientific research centers and institutes.
- Cost may not be used as a design requirement.