الإدارة المركزية للتعلبم بمصروفات

الإدارة العامة لشئون مدارس المتفوقين في العلوم و التكنولوجيا STEM





# **Capstone Challenge**

2023-2024

# Grade 11- Semester 2

Theme: systems and feedback

## **Egypt Grand Challenges**

- Recycle garbage and waste for economic and environmental purposes.
- Improve the scientific and technological environment for all.
- Reduce and adapt to the effect of climatic change.
- Increase the industrial and agricultural base of Egypt.

You may include any other Egyptian grand challenge according to your design requirements.

## **Capstone Big Idea:**

Building a smart, sustainable building that leverages renewable energy and eco-friendly materials offers an approach to mitigating climate change impacts and enhancing environmental sustainability.

#### **Essential Question:**

How do we create smart buildings that are also eco-friendly?

#### **Design Challenge:**

Students should use natural eco-friendly materials to construct a prototype building with inner volume ranging between 0.1 and 0.2 m<sup>3</sup>. The prototype shape using the materials mentioned above must reduce the inner temperature to at least 3 degrees C in the shade compared to the outside of the building. The prototype should be fed only by renewable energy sources such as solar, wind, etc. The prototype should be provided with a smart system that includes at least two (2) sensors, controllers, and at least two (2) actuators. Sensors may include motion, gas, water leakage, smoke, presence, wind speed, temperature, light, humidity, air pressure, etc. Actuators may include electrical, mechanical, etc. Your smart system should send a notification message to selected cell phones.







The schematic chart of the capstone idea is shown in Fig 1.



Fig. 1: Schematic chart of the capstone idea.

# Design requirements:

Students should select at least three measurable design requirements. One of these design requirements is the measurement of 3 degrees C cooler in the building compared to outside the building. The other two design requirements are chosen by the team. (More than three design requirements will not improve your grade)

The obtained sensors' measurements (temperature, humidity, air pressure, ...... etc) should be represented using tables and graphs, and those tables and graphs should demonstrate the results of the actuating systems on those sensor measurements.

## **Constraints**:

- Using any manufactured material in constructing your prototype is not allowed except for windows or doors if required.
- 2- It's not allowed to feed the prototype using traditional electricity or battery such as plugging into the wall or a single-use battery. A rechargeable battery is acceptable if you are recharging it with renewable energy associated with the prototype (not recharged separately).
- 3- If a solar cell is used as a renewable power source for the prototype, it is allowed to use an external light source such as a filament lamp that works with a traditional electric source as a light source to activate the solar cell.





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- **4-** Buzzers can be considered as an additional actuator rather than the two required actions.
- **5-** Using adhesive materials is allowed.
- **6-** Cost is not permitted to be used as a design requirement.
- 7- Fabricated wood is not permitted as a construction material.
- 8- You must follow ALL School Safety rules and documents in your Capstone Portfolio. Failure to do so will
  result in a reduced grade.
- 9- No equipment or materials that belong to the laboratories can be removed from the laboratories at any time. You must conduct those tests that require this equipment in the labs. Failure to do so will result in a reduced grade.
- **10-** No help outside the school may be obtained for the actual construction of this prototype.