Sensing Capillary Action in Soil

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Research

Title: Sensing Capillary Action in Soil

Capillary action in soil is the rising of the water level through openings in the soil. The study of capillarity is essential in the field of geoengineering and agriculture. The research objective is to build an interactive capillary chamber that can accurately quantify capillary action in soil. The potential product, incorporating built-in LED, sound, and robotic arms, will be marketable to educators and students. The capillary chamber was designed using a rectangular box made of acrylic and a touch sensor was interface to an Arduino to detect water level increase in different soil samples. The probe was inserted into the soil to test increases in the water level due to capillary action. Once the probe comes in contact with water, the Arduino activates the LEDs and piezo buzzer. A conductivity sensor interfaced with an Arduino was also used to measure current flow at different heights of the sand profile. The rate of capillarity was measured using a straw. At the conclusion of this research, the touch sensor was discovered to have successfully detected water in the soil. The data collected via the conductivity sensor indicates that current increases as the distance to the bottom of the chamber decreases and rates of capillary action occur fastest in coarse sand, i.e. colored crab sand.

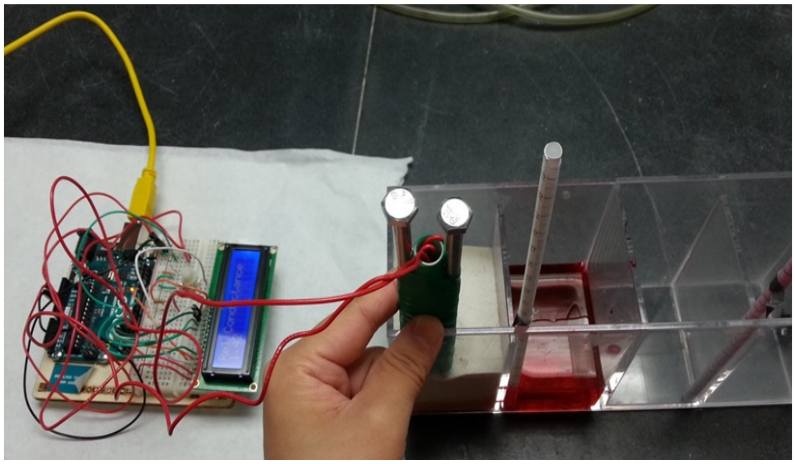

Figure: Arduino conductivity sensor with LCD

Lesson Plan

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Students will design and conduct a controlled experiment to quantify capillary action in soil. Like engineers and entrepreneurs, students will use affordable materials to design and construct a model to measure the rate of capillary action in four types of sand - coarse, medium, fine, and mixed. In the design process, students will be given a budget and calculate the final cost of their product. After the construction of their design, students will take measurements using their device to quantify rate of capillary action. Next, students will use

graphs and photo images to analyze their collected data and present their findings to the class. Finally, groups will compare data and discuss the pros and cons of their design as a class.

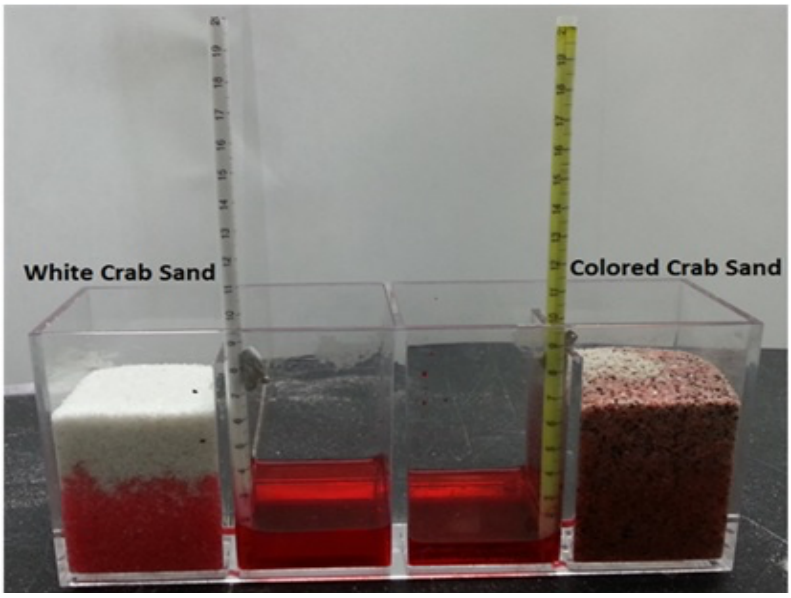

Figure: A capillary chamber measures rate of capillary action in coarse sand