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Howard High School
Physical Science and Biology



Doctoral Candidate
"Role of heparanase in bone
development"
Biological Sciences
Dr. Mary C. Farach-Carson



HOW TO SUCCEED

HOWARD HIGH SCHOOL OF TECHNOLOGY



Funded by National Science Foundation [Graduate Teaching Fellows Program
in K-12 Education](#) (GK-12) DGE 0538555

As a GK12 fellow, it was my responsibility to create an “exciting” learning community to examine and reflect on current issues in science in accord with the curriculum of the science education in New Castle County Vocational Technical High Schools



Incorporated my scientific research into classroom lectures/ activities

Developed activities that focused on constructing visuals highlighting different biological processes using unusual materials

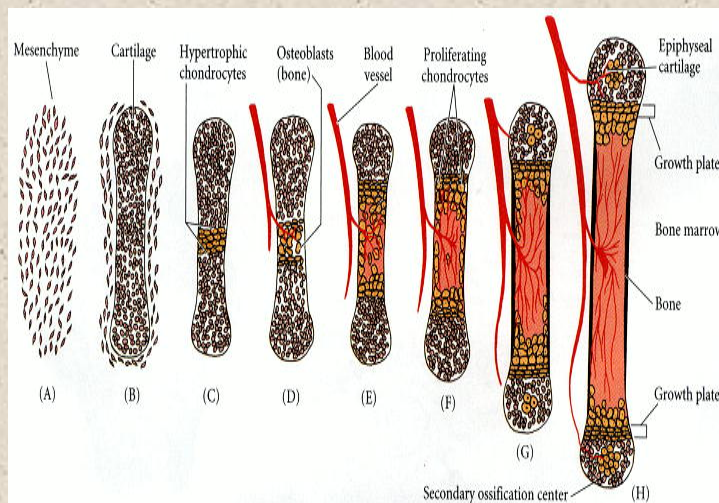
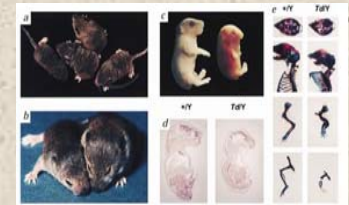
Evaluated student understanding through “Journaling”

Created activities emphasizing study skills that can be applied to all subject areas and establishing connections between various units

Remember:

- Structure is dependent on function
- Homologous structures allow one to make an inference of the common ancestor and determine evolutionary relationships

More importantly, the similarity between structure and function allows scientist to use various animal models to understand human diseases



2day old metatarsal
from ICR mouse

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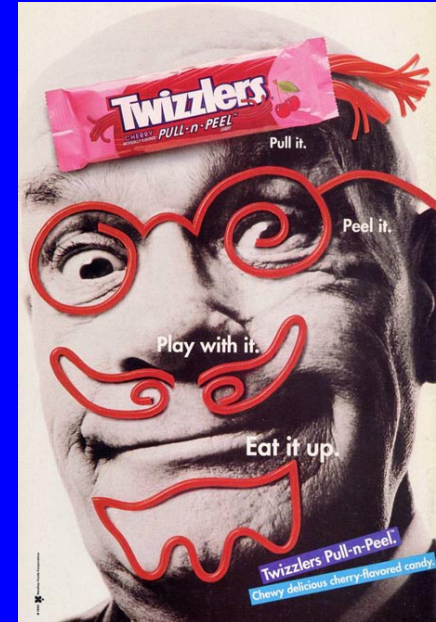
Develop activities highlighting study skills that can be applied to all subject areas and creating connections between various units

Making a Mitosis model using Twizzlers

(Working in pairs)

Materials:

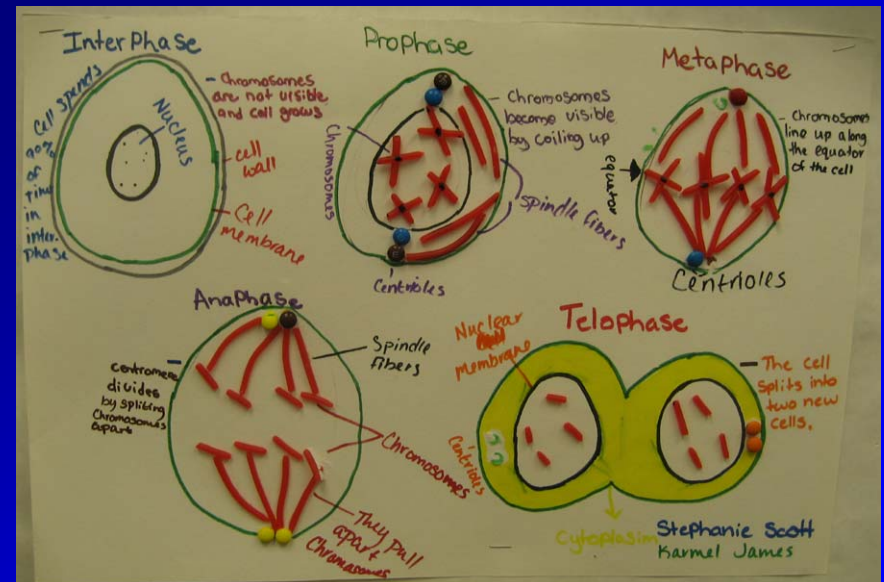
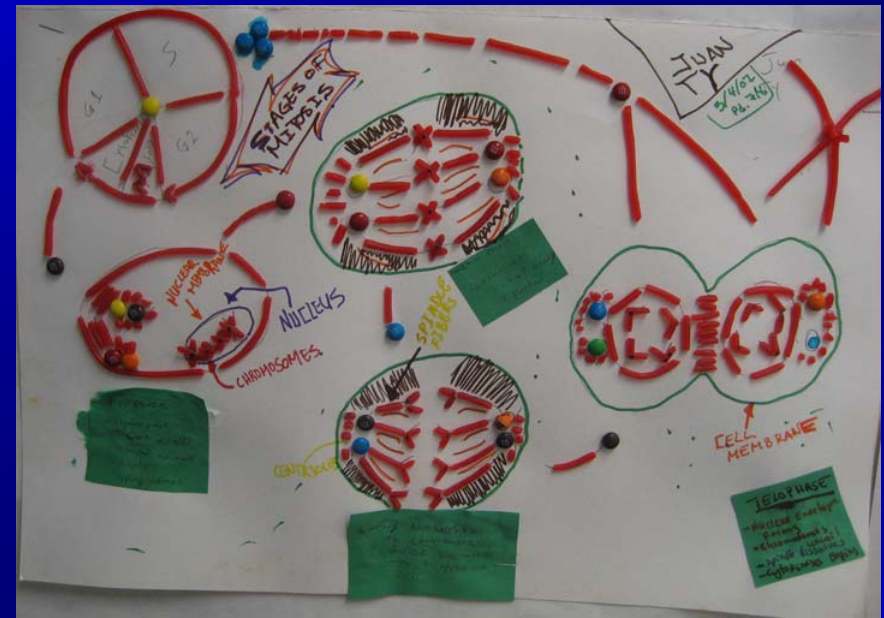
- ☐ plain white paper
- ☐ 1 twizzler rope
- ☐ 24 red hots
- ☐ Writing utensil



Resources:

- Biology: Principles & Explorations text (p130)
- "Cells Alive" website cellsalive.com

Using visuals to model basic concepts of science



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"Cancer Cell: Mitosis Gone Wild"

As an oncologist, you must explain what is happening to their cells?
Cancer cells?

“The cells are growing bigger. Cells are controlled by an internal clock. Cancer causes change in DNA. Protooncogenes and tumor suppresser genes affect the cell cycle and they became uncontrollable, uncontrolled growth. Cell checkpoints not working and DNA replicating to fast causes cancer.”

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"Making the Connections"

Scientific Method
1. Observations- an observation made about the giraffes is that they are becoming a target.

2. Problem- more giraffes are becoming extinct.
3. Hypothesis- if giraffes are put into good care and watched over then the population will grow.
4. Dependent variable- the giraffe's environment.
5. Independent variable- putting the giraffes in someone's care and make sure that they are watched and an example is a zoo.
6. Experimental group- putting 10 giraffes in a zoo and 10 in the wild.
7. Control group- my standard for comparison is having 10 giraffes in a zoo and 10 in the wild.
8. Constants- the things that don't change are the amount of giraffes.

substances that increase the speed of chemical reactions.

Enzymes
uses energy from glucose
an example is potatoes
glycolysis
Chloroplast
uses light energy to make glucose from carbon dioxide and water
Cell organelle connected to
Houses the DNA of Eukaryotic cells
Nucleus

Diffusion
- Is the movement of substance from an area of high concentration to an area of lower concentration caused by the random motion of particles of the substance. This is connected to active/passive transport.

Osmosis
- Is the diffusion of water through a selectively permeable membrane. The giraffe only lets certain liquids across the cell membrane.

Active Transport
- Is the movement across cell membrane that doesn't require energy from the cell.
Giraffe stores nucleotides and hereditary information for cell function an example is DNA and RNA
Nucleic Acids
One of the four
Organic Compounds
Also brings out chemical energy from food molecules that are released in enzymes assisted in chemical reactions
Gets energy from food
Cellular Respiration
 $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$
Takes place in the cell organelle called the "Mighty Mitochondria"
Cell organelle connected to
Cell organelle connected to
Cytosol
Holds everything in the cell in place

Passive Transport
Opposite of passive transport
Active Transport- is the movement across the membrane that requires energy from the cell. An example is ATP.
Reactants from food used to make energy
Carbon, Hydrogen, Oxygen are used by living things as an energy source
Oxygen
ATP
Energy
Both are connected to Energy
Cell organelle connected to
Cell organelle connected to
Cytosol
Holds everything in the cell in place

Mitosis
- Is the division of 2 diploid daughter cells.
2 somatic cells in the giraffe divide in the stage of mitosis.
Mitosis and meiosis are related because they are both the division of cells.
Meiosis
- Is the division of 4 haploid daughter cells.
An example is the sex cells in the giraffe divide in the stage of meiosis.

Prokaryotic Cells
- Are cells that lack a nucleus and other internal compartments. An example is bacteria.

Eukaryotic Cells
- Is an organism whose cell has nucleus. An example is a cell in the giraffe (animal cell).

Cell Theory
1. All living things are made up of 1 or more cells.
2. Cells are the basic unit of structure function organisms.
3. All cells arise from existing cells.
The Cell Theory and the Cell Cycle are related because the cell cycle follows the cell theory. Cells are copied from others. The cells are the function of an organism.

Cell Cycle
Connects to the Giraffe because the cells of the Giraffe in the G1 phase rapidly grows and carries out its routines functions, in the Synthesis phase the DNA is copied, and in the G2 phase preparations are made for the Nucleus to divide. Mitosis is the stage when the nucleus of a cell is divided into two nuclei. Also Cytokinesis is the part of the process during cell division in which cytoplasm divides.

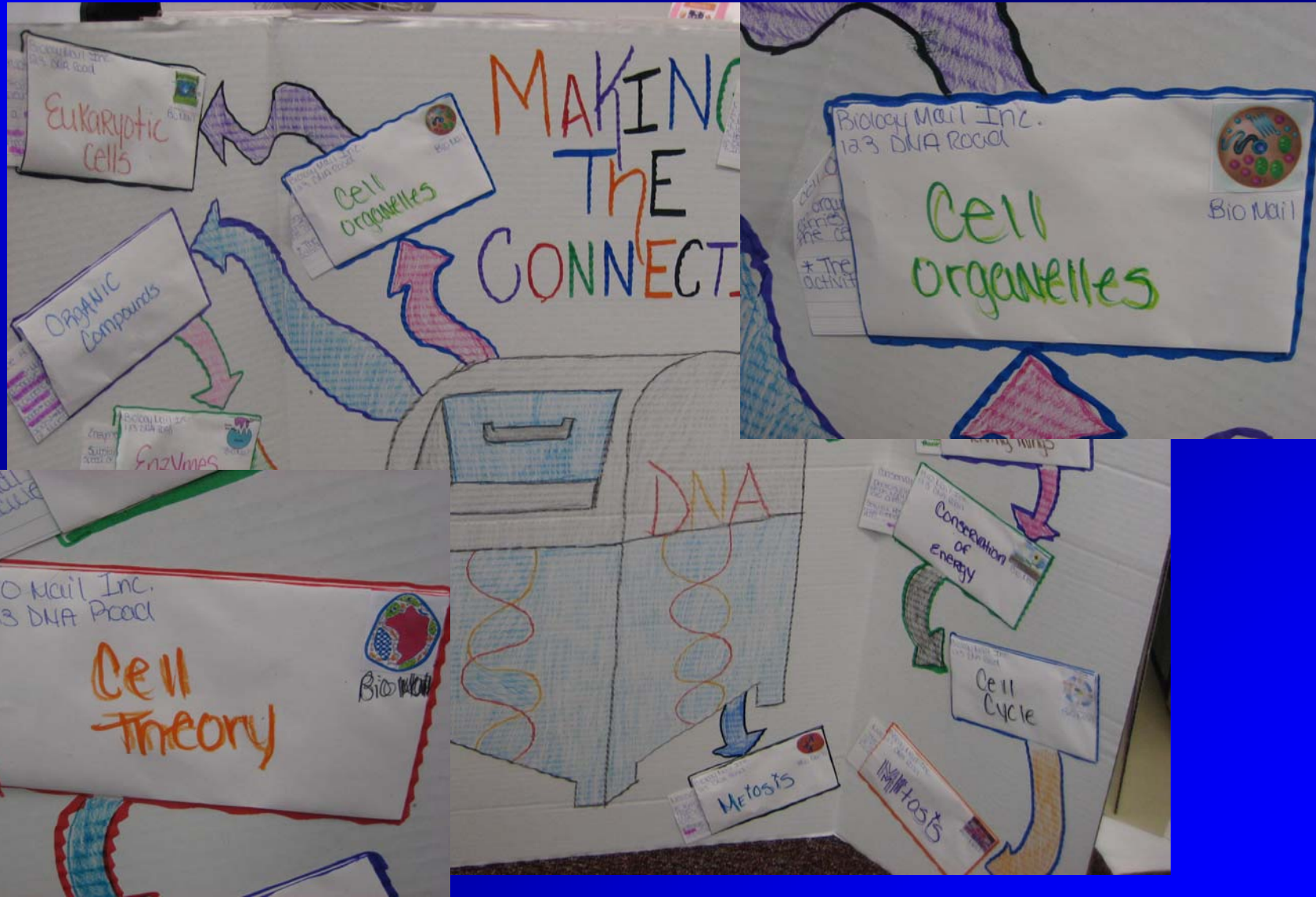
Variation
- The species of the giraffe vary so that if something happened the whole race isn't wiped out. Mutation and Sexual Reproduction lead to variation within the giraffe species.
Adaptation- Giraffes must adapt to their surroundings to survive. For example they can't live in a place without any trees because they have to eat. When the Natural Selection- This is when the giraffes pass down the dominant or favorable traits. Species moves to a new location the characteristics change and new species evolves.

Characteristics of Living Things
1. Cellular Structure- Cells are highly organized tiny structures with thin coverings called the membrane. The giraffe's cells are small because things have to move across the membrane in an efficient amount of time.
2. Reproduction- Reproduction is the process by which organisms make more of their own kind from one generation. The reproduction of giraffes has slowed down due to the environment.
3. Metabolism- Metabolism is the sum of all of the chemical reactions carried out by an organism. The metabolism energy for the giraffe comes from the plants they eat like trees.
4. Homeostasis- Homeostasis is the maintenance of stable internal conditions in spite of changes in the external environment. The environment of the giraffe is harsh. There are people out there killing them to eat and to use them for other things.
5. Heredity- Heredity is the passing of traits from one parent to offspring. Some genes passed from a parent giraffe to the offspring is that they are tall and have a certain amount of spots.
6. Evolution- Evolution is the change in the inherited traits of species over time. The species of giraffes changes because if they just had one species a virus could break out and every giraffe would die because they are all the same.
7. Interdependence- Has to do with ecology which is the science that studies the interactions of living organisms with one another and with the non-living part of their environment. A non-living part of the giraffe's environment is the trees and bushes they are surrounded with.

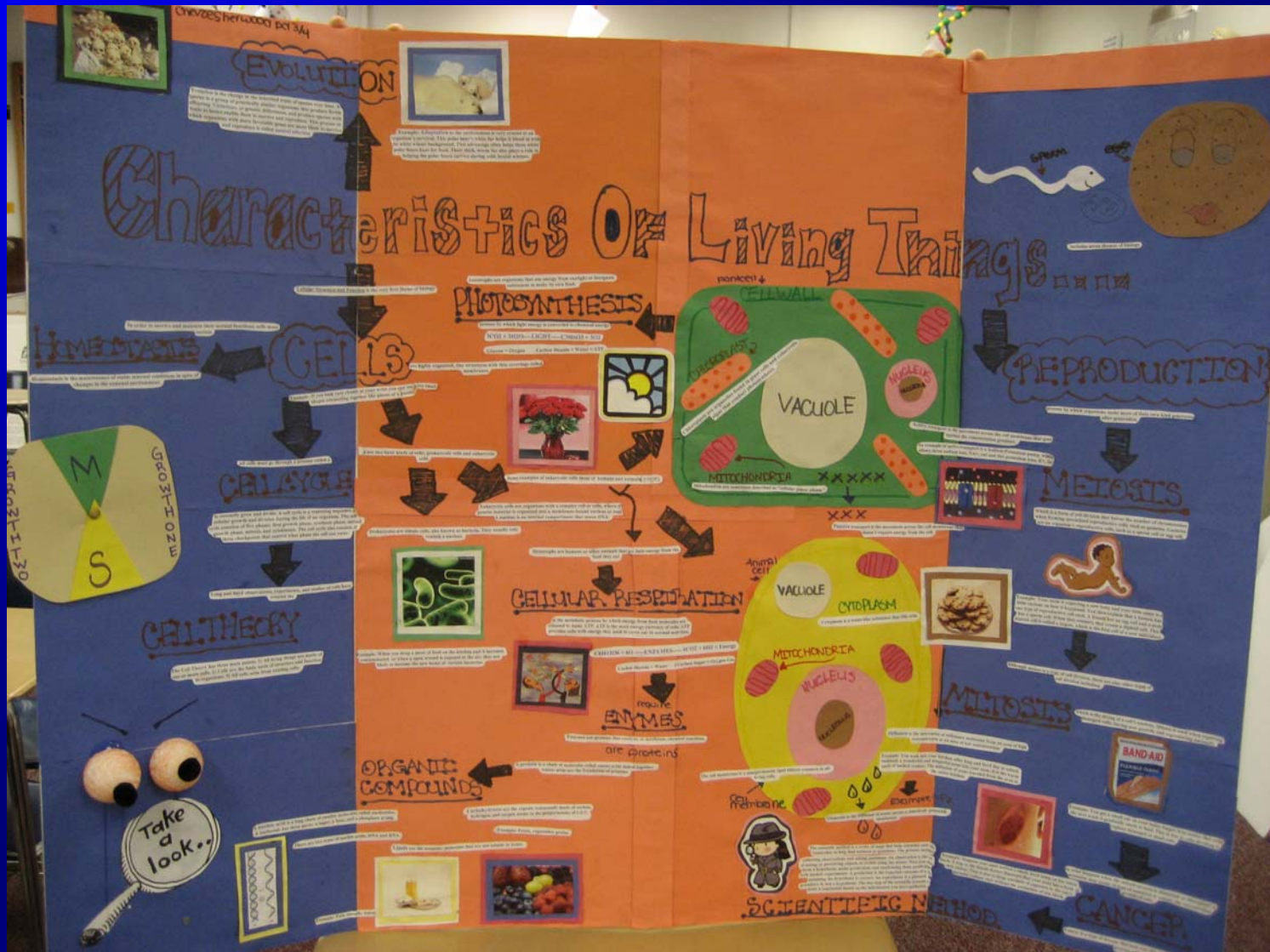
Giraffe eating leaves off a tree

Cell Membrane
Cells have a lipid bilayer made with proteins that enclose the cytoplasm an example is the cell membrane.
Lipids and Proteins
What goes in and out the cell.
Cells need amino acids

"Making the Connections"



"Making the Connections"



Additional tasks completed

Working with students one-on-one with classroom assignments, notebook organization, and developing good study habits

Grading test and assignments to identify students that may need more one-on-one assistance

Providing written and oral feedback to students on classroom assignments and projects

Web searching to answer questions that come up during classroom discussions

Interacting with students in regards to their academic future

Benefits as a GK12 Fellow

Learning to communicate my scientific research to a broader audience

Developing creative ideas to deliver basic scientific concepts

Obtaining a better appreciation for teachers and their responsibility within the classroom

Improving my leadership and team building skills

Networking

Serving as a mentor for students



Benefits as a GK-12 Student

"Ok, better understanding, science turned out to be some fun this year even if it is 1st thing in the morning."



"She explains things slowly until I understand"

"Thanks for being here and helping me to understand clearly."

"I still feel that science is fun and very interesting but sometimes it does need for you to be very focused"

Acknowledgments

Dr George Watson

Michael Kittel

Amy Quillen

GK12 Staff and Co-PIs

GK12 Fellows

GK12 Teachers

Howard High School of Technology Staff

Howard Students

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Dr Daniel Carson

the Farach-Carson/ Carson Lab

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