Bay Area Scientists in Schools Presentation Plan

Lesson Name: A Whole New World of DNA and Proteins
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Grade Level: 5th Grade

Next Generation Science Standards:

MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Science & Engineering Practices	*Disciplinary Core Ideas*	*Crosscutting Concepts*
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (**MS-LS1-2**) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation to produce data to serve as the basis for evidence that	**LS1.A: Structure and Function** All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (**MS-LS1-1**) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (**MS-LS1-2**) In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems. (**MS-LS1-8**) **Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale. (**MS-LS1-1**) **Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (**MS-LS1-3**) **Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural and designed structures/systems can be analyzed

Common Core Standards:

ELA/Literacy:

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.
MP.4 Model with mathematics.

FOSS Connections:
Middle School Module: *Chemical Interactions Course*

Teaser: During this class period, students will learn about DNA and what it does in our bodies through 3 hands-on activities. They will learn about how the pieces of DNA fit together and how different pieces of DNA act as the road map for our bodies to make different proteins. Lastly, the students will get to learn and complete a 'lab technique' of extracting DNA from fruit.

Objective: As a result of your lesson, what will students learn? What will they be able to do?
●What DNA is, what it is made of, and why it is important?
●What proteins are, what they are made of, and what they do?
●What is the connection between DNA and proteins?

Vocabulary/Definitions:
●**Protein**: A molecule in your body that can do all sorts of things.
●**Amino acid**: Little chemical building blocks that proteins are made of.
●**DNA**: Long molecule found in cells which are the blueprints for everything in your body.
●**Gene**: Words written in DNA, spelled by base pairs that your cells use to know how to make proteins out of amino acids.
●**Bases**: Four different DNA "letters" that spell out genes.

Materials:
What will you bring with you?
○Amino Acid Puzzle
- Cut-out amino acid puzzle pieces
- Tape
- Laminated sheet with schematic of amino acid/codon pairing
- 5 laminated sheet with amino acid chart

○DNA Extraction:
- Banana
- SDS detergent
- Salt
- 2mL Eppendorf tubes
- 90% ethanol
- eye dropper
- Ice + ice chest
- Yarn
- Scissor
- Markers
- transparent plastic cup
- ziploc bags

- Puzzle Piece DNA:
  - DNA puzzles (10 pieces)
  - Worksheets

What should students have ready?
- Scissors
- Pens/pencils

Classroom Set-up:
Student grouping (3 groups) after introduction

Classroom Visit

1. **Personal Introduction:** ___3____ Minutes
   Each person gives 1 sentence on name, what they do

2. **Topic Introduction:** ___7___ Minutes
   What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

   What are living things made out of? Cells (Write cells under vocab)
   Are all cells the same? No Why? b/c made up of different parts
   Cells are made up of proteins. Who knows what a protein is? (Protein=vocab)
   Proteins are made up of amino acids (amino acid=vocab). There are 20 amino acids.
   What tells you how to make proteins? DNA (DNA=vocab)
   DNA is a code that tells your body to make your eyes blue and hair brown, etc. It's in all cells. (gene=vocab). We'll see in a later activity how this code works.
   (Will have a picture showing cell/protein/DNA relationship)

   Show picture of DNA
   DNA is made up of bases. The order of these bases tell you how to make a protein (bases).

   Go over Vocabulary

3. **Learning Experience(s)**: __30___ Minutes
   What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

   <u>Amino Acid and Protein Puzzle (Amy & Dave)</u>
   Introduction (2 min)
   - Protein are the building blocks of people
   - Proteins are coded by DNA/amino acids
   - Amino acid chart with codons
   - Demo with our names

   Activity (6 min)
   - Spell out name with amino acid puzzle pieces
   - Cut strands apart
   - Exchange strands
   - Partner figures out "mystery" word

   Wrap Up (2 min)
   - Summarize activity
   - Re-emphasize DNA-protein connection
   - How many bps to make 100 proteins, etc?
   - How many ways to spell out each amino acid?

   <u>Puzzle Piece DNA (Elaine & Adrienne)</u>

Introduction (2 min)

--Use poster questions as kids fill in their worksheet (which has the same questions):

+How many different bases are there in DNA?

Ans: 4!

+Which bases pair together?

Ans: A=T, G=C

+What do engineers use to cut DNA?

Ans: Proteins

--Between each question, briefly discuss each of the vocab words.

--Also, explain that DNA is found in two strands that zip up by forming base pairs.

Activity (6 min)

- Bring out puzzle pieces on the floor

  +10 pieces of double stranded DNA with one strand ends sticking out

  +Now everyone is going to work together and put this DNA puzzle together!

  +Remember how strands of DNA zip up and forms base pairs? Can someone remind everyone? ans: A goes with T, and C goes with G!!

- Distribute puzzle pieces (one per student!)

  + Now everyone has one piece of DNA! All the pieces that you guys have should come together to make a full piece of DNA code! Please work together to put the puzzle together!

Wrap Up (2 min)

- DNA is found in every living thing around us! Do you remember which of the 4 DNA bases form base pairs? (Ans:A=T, G=C)

  Now you know how scientists, like we are, cut up DNA using proteins in our labs, like scissors, to form DNA pieces just like these puzzle pieces. If we cut up DNA and put it together like a puzzle, we can make new DNA that fixes diseases that people have!

<u>DNA Extraction (Mike & Yun Suk)</u>

Introduction (2 min)

- DNA is a long molecule found in the nucleus of the cell.
- DNA contains all the codes for proteins.
- Every organism has DNA, including humans, animals, plants, and... strawberries!

Activity (6 min)

* 2mL Eppendorf (EP) tubes with small pieces of banana are prepared in advance.
* Solution A (SDS + salt + water solution) and solution B (90% ethanol) are prepared in advance.

Instructions for students:

- Take one EP tube and one coffee stirrer.
- Open EP tube and squish banana using the stirrer.
- When done, instructor will add solution A (500uL) to it.
- Stir some more, then close EP tube and shake for 10 seconds.
- When done, open EP tube and instructor will add solution B (600uL) to it.
- Close EP tube and shake for 10 seconds.
- Hold still and wait for DNA to precipitate! (the mixture should divide into two layers, a clear top layer and a darker mixture in the bottom.)
- Observe DNA. (it should be seen near the top of the solution, as a white substance.)

- Use marker to put initial and date on the EP tube. (teach students the importance of labeling.)
- Students may use yarn to make a necklace with the EP tube of DNA.

* These instructions are given while one instructor is doing a demonstration using a larger scale plastic cup.
* The other instructor helps the students with adding solutions and any other difficulties they may be having.
* While shaking, instructors explain what each solution is doing to the DNA. (solution A - breaking down the cells of banana to get DNA out. solution B - to separate DNA from the rest of the solution).

Wrap Up (2 min)

- Banana has DNA. Do you think strawberry has DNA?
  Answer: YES!
- Give me other examples of things that have DNA.
  Answer: (could be anything really; the point is to get across to the students that every living organism has DNA)

4. **Wrap-up: Sharing Experiences** ___7___ Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

DNA is found in every living thing around us! Do you remember which DNA bases form base pairs? (Ans: A=T, G=C).

Although DNA is only composed of 4 different bases, the order these bases combine together is very important. What is it a large piece of DNA that codes for proteins called? (Ans: a gene) There is a gene for eye color, but does everyone have the same color eyes? Even within a gene, bases can be in different orders that cause different eye colors!

DNA is like the instruction manual for proteins. A DNA gene codes for proteins. Do you remember what the building blocks of proteins are called? (Ans: amino acids).

Guess how many cells are have in your body?? You have 100 trillion cells in your body!! There are also 3 billion DNA base pairs in your cells that are in charge of all the proteins in your body! ISN'T THAT EXCITING???

5. **Connections & Close:** ___3____Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Cam the Chameleon – pictures of Cam in each of our labs. Also take pic of Cam with all of the kids!

Total 50 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to extract the DNA. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students think of and write down additional hypotheses about DNA. Students should explain their predictions.

Follow-up Possibilities

ELA Activity:
Students respond to the following prompt:
"Write a letter to a friend explaining what you learned about DNA."

Reading Connections:

- Genetics: From DNA to Designer Dogs by Kathleen Simpson. Illustrated with photographs from various sources. National Geographic Society. 64pp. Trade ISBN 978-1-4263-0361-6, $17.95; Library ISBN 978-1-4263-0327-2, $27.90. (I, A) Portraying the work of scientists in the quickly advancing field of genetics, the stories in this book tell about researchers sequencing a mummy's DNA and investigating the use of human stem cells. It includes an interview with a DNA investigator and superb photographs.
  http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=18798

- Genes and DNA by Richard Walker - Explores modern genetics, from an investigation of genes and their function, to forensics, therapy, and cloning. http://www.amazon.com/Kingfisher-Knowledge-Genes-Richard-Walker/dp/0753456214/

- DNA is Here to Stay by Frances Balkwill - From the moment of conception, the DNA strands contained in the chromosomes of our cells are hard at work duplicating themselves, so that the body can make and maintain all the different parts it needs to function efficiently. What DNA does and how it does it is explained by Dr Balkwill's straightforward text and Mic Rolph's illustrations. This is the third book in a series which introduces microbiology to young readers. The first two titles, "Cells Are Us" and "Cell Wars", won the 1991 Copus Science Book Prize.
  http://www.amazon.com/DNA-Here-Stay-Cells-Things/dp/0876146388

Mathematics Activity:
Have students write variable equations for the DNA extraction solution. Students can then substitute different values for the variable to find out the amount of materials needed for different quantities of the solution.

Other:

Students will have several take-home items after this project:
Amino acid name tags from amino acid / protein puzzle activity.
Worksheets from the puzzle piece DNA activity.
Microcentrifuge tubes with DNA extracted from fruit from the DNA extraction activity.

Students can go home and figure out whether their families and siblings have the same traits as them or different traits and see how genes are passed down.

Have Your DNA and Eat it Too (University of Utah Genetic Science Learning Center) - In this activity, learners build edible models of DNA, while learning basic DNA structure and the rules of base pairing. Learners construct the models out of licorice and colored marshmallows and create labels for the base pairs and backbone. This is an excellent activity to use at the end of a unit on DNA. http://teach.genetics.utah.edu/content/begin/dna/eat_DNA.html

Origami DNA - In this activity, learners create an origami model of DNA, demonstrating its double helix structure. Two templates are available as PDFs: a standard template with the base pairs already colored or a blank template where the learners have to color the four bases A, C, T and G and mark them in the correct location on the template. http://www.yourgenome.org/teachers/origami.shtml

Family Traits and Traditions (University of Utah Genetic Science Learning Center) - In this activity, learners play a matching game with their families to discover common inherited traits and traditions. Learners distinguish between inherited traits and learned traditions. This genetics activity is available in English and Spanish. http://teach.genetics.utah.edu/content/begin/traits/familytraits.html
Handout: http://teach.genetics.utah.edu/content/begin/traits/familytraitsandtraditions.pdf