Bay Area Scientists in Schools Presentation Plan

Lesson Name DNA Discovery
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Grade Levels 5th **Standards Connection(s)** Cells, molecules

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.6-8.1 Write arguments focused on discipline content.
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: DNA is what makes us who we are. But what does it look like and where can we find it? Do plants have it too? Discover more about this exciting molecule!

Objective: Students should understand that DNA is responsible for heritable traits that are passed down from parent to child. Our DNA is like a recipe book that has instructions on how to make everything our body needs. Our bodies are made up of tiny cells and each cell has its own DNA. DNA can be extracted from cells; it appears to be a white fibrous mass (like a jellyfish). Today we will test if plants have DNA too.

Vocabulary/Definition: *3-6 important (new) words*

- **Trait**: A special feature or characteristic that can be used as a description
- **Inheritance**: The process by which traits are passed from parent to child
- **DNA**: Long molecule found in cells that is responsible for inheritance
- **Cells**: The smallest living pieces that make up all living things
- **Genes**: Parts of DNA that contain the information that results in a trait
- **Molecules**: Groups of atoms that together make up non-living and living things (such as cells)
- **Hypothesis**: An idea that offers an explanation based on what we know so far

Materials:

What will you bring with you?

Reagents for a DNA extraction:

- 100% alcohol
- Dishwashing liquid
- Plastic tubes
- Salt
- Strawberries
- Plastic bags, cheesecloth, other items

What should students have ready (pencils, paper, scissors)?

- Pencils

What should the classroom have ready (pencils, paper, scissors)?

- One blackboard/white board to write on
- One table per group of about 5 students so that students can do the experiment
- Access to a sink and paper towels for clean up
- Ice (if possible)

Classroom Set-up:

Students will be divided into groups of 5 or more (depending on class size – there should be at most 5 groups) and given the chance to do a DNA extraction from strawberries and maybe even other fruit. The reagents used are safe and the children will be supervised by a volunteer at all times.

Classroom Visit

1. **Personal Introduction:** 5 Minutes

Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

"We are all graduate students – introduce selves, names. Ask questions: Who here likes exploring? Who likes learning new things about our world? All us volunteers do and that's why we are scientists. We will each say a sentence about what we do."

2. **Topic Introduction:** 10 Minutes

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

"Who knows what a "trait" is? (It is a word that describes a special feature we have – eg. curly hair, 5 fingers etc.). You can say that people who look different have different traits. But why do we look different from each other but look like our parents? (Get ideas from kids) This is because of inheritance. The stuff that make us who are is passed down to us from our parents – this is called DNA. It is a long molecule (ask kids what a molecule is). Where can we find our DNA? (All over us – our bodies are made of tiny cells and each cell has its own DNA). If we all have DNA, why do we look different from each other? (Each of us has different traits because we have different DNA, this is the DNA we get from our parents and why we look like our parents). But if all our cells have the same DNA, why do they not look the same? In other words, why don't our noses look like feet? (DNA is like a recipe book where the recipes are called genes – different cells in our body have the same recipe book but are different because they cook different meals out of it by using different genes). Are we (humans) the only living things to have DNA? What about plants? Let's make a hypothesis – this is an idea that can be tested in a scientific experiment. Today you are going to be scientists and test your hypothesis about whether plants have DNA or not!"

Some of this time will be taken to set up reagents.

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.

Activity one: Hypothesis building in groups. Divide into groups if not already seated in groups. Talk to your group about whether you think plants have DNA. Why do you think they might or might not? Write this down.

Activity two: DNA extraction in groups. Experiment time! Now we get to test our hypothesis. We are going to see if we can search for DNA in plant cells from strawberries and bananas. Outline of DNA extraction from strawberries: To get DNA out of cells, first we need to break the cells and then use soap to clean away all the gunk (pulverize strawberries, use detergent and salt solution). Then we strain the mush to get rid of the gunk (use cheesecloth)– the clear liquid has DNA

dissolved in it. Now to see the DNA we can "undissolve" it – we can do this by adding 100% ethanol – this disturbs the DNA and we can see it come out of solution. This needs to be done slowly and carefully. Look at the DNA!

Activity three: Discussion of experimental results (whole class). Did we see DNA in strawberries? (yes). Did we see DNA in bananas? (yes). Do they look the same? (yes). What do you think our DNA would look like if we got it out of our own cells? (same). Why does it look like fluffy white stuff? (Really long molecules that fold together – kind of like a plate of spaghetti. Can show the class a poster of what a DNA molecule looks like). – This merges into the wrap up.

4. ***Wrap-up: Sharing Experiences*** 10 Minutes
Putting the pieces together – how will students share learning, interpret experience, build vocabulary?
Does anyone have any questions? Did DNA look the way you expected it to? What makes us different from strawberries if we both have DNA? Where do strawberries get their DNA from? Can we see genes on the DNA? Do all fruits have DNA in them? Do we eat this DNA?

5. ***Connections & Close:*** 5 Minutes
What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Genes are what gives us that traits that make us, plants, animals and all living things who we are. Because genes are passed down on DNA from our parents, we can actually see traits being passed down – this is called inheritance. Have a look at families of people, plants or animals and see if you can figure out if traits are being passed down from parents (suggested take-home activity with family is a start).

Total 60 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:
Suggest students write a letter explaining "How we learned about DNA and Inheritance…"

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. Timeline, Glossary, Bibliography, Index. PLB (IV, VII, VIII) 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 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. More ideas of traits to look for from website resources.

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

Strawberry DNA extraction Protocol

Materials

- Strawberries
- 1 ziplock bag
- 1 small plastic cup (Zilberman lab property)
- 1 paper towel
- 7.5 ml room temperature isopropanol in a 15 ml tube
- Skewer (optional)
- 10 ml Extraction Buffer (EB) in a 50 ml tube
    - 500 ml EB = 450 ml water + 10 g salt (1 tsp) + 50 ml dishwashing detergent

Method

1. Take a strawberry in a ziplock bag
2. Squeeze out air, seal bag and then carefully crush.
3. Add 10 ml of extraction buffer
4. Seal bag again and mix gently
    a. Avoid creating bubbles from the soapy detergent – a possible technique is to gently tilt back and forth while crushing the strawberry pulp
5. Set up a paper towel in a small cup for filtering the solution
    a. Moisten the paper towel with some water
    b. Wrap the towel around your finger and then insert it into the cup, creating a well
6. Pour the solution into the towel and let it filter
    a. Do not squeeze the towel or bubbles will be created
    b. This step may take upto 5 minutes
7. Transfer 5 to 7.5 ml of the strawberry solution from the cup to the empty falcon tube that had the extraction buffer
8. Slowly add 2 ml of the room temperature isopropanol to the tube by pouring down the side of the tube
    a. DNA will precipitate at the interface
9. Add the rest of the isopropanol to the tube and mix the two layers together by either shaking or inversion
10. DNA will precipitate in the 50% isopropanol solution at room temperature and form a big jelly-fish like blob. Fibres are still visible at this stage though not as pretty as at the interface, but you see a lot more DNA.
11. Optional: After 2-3 minutes, insert a skewer into the tube and spool the DNA (this can be transferred to any remaining isopropanol and left with the students)- the DNA should easily stick to the blunt end of a skewer
12. Collect cups and remaining ml falcon tubes (for reuse)

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