|  |  |
| --- | --- |
| **TEAM Lesson Plan Template** | |
| Teacher: Andrew Morency | |
| Subject/Grade: High School Biology 1 | |
| Lesson Title: Creating DNA Model | |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| BIO1.LS1.4 Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes  This lesson emphasizes:  Science practice: Developing and using models  CCC: Structure and function  Learning performance: Students will construct a model of DNA and use it to demonstrate how information is decoded through transcriptional and translational processes highlighting the structure and function of the DNA molecule. | |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledge  Student-Friendly (I Can Statement) |
| I can correctly use K’nex pieces to represent sugars, phosphates, nitrogenous bases, and hydrogen bonds in a DNA molecule.  I can construct a nucleotides using K’nex pieces  I can construct a DNA molecule from K’nex pieces with correct bonds and correct strand orientation | |
| **MATERIALS AND RESOURCES** | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook. |
| **Activities & Materials**  \_x\_ Whiteboard/markers or Computer/projector/Smartboard  \_x\_ Manipulatives K’NEX DNA model kit \_x\_ K’NEX model instructions  \_x\_Internet Resource <https://simple.wikipedia.org/wiki/Hershey%E2%80%93Chase_experiment>  <https://scaleofuniverse.com/>  <https://www.sciencehistory.org/historical-profile/james-watson-francis-crick-maurice-wilkins-and-rosalind-franklin>  **Routine for distributing materials** Separate parts of the K’NEX kit into bags. There should be one bag per group, with at least 16 deoxyribose pieces per bag. Include a set of instructions from the end of this lesson in each bag. Pass out the bags.  [A way: Use both the gold and yellow pieces as deoxyribose to have more pieces per group of students. In each bag, put 16 yellow/gold sugars, 16 purple/blue clip phosphates; 5 white, 5 black, 5 gray, 5 teal rods; 5 orange bonds, and 5 brown bonds. ] | |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners *(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **Differentiation**  **----- Content** Most students will build their nucleotides from instructions and pictures. For some students it may be appropriate to build a nucleotide from K’nex pieces for them to have a physical example rather than a picture.  **----- Process -----Product**  **----- Tiered Assignments** Most students will start with individual pieces, build nucleotides, and move directly to a DNA strand in a single lesson. It may be appropriate to build nucleotides during one lesson and then build DNA strands later using the previously built nucleotides.  **----- Flexible Grouping**  **----- Learning Centers \_\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Accommodations**  **\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring**  **\_\_\_ Modified Assignments \_\_\_ Other**  **Early Finishers:** Early finishers should move on to constructing RNA from their DNA strand | |

|  |  |
| --- | --- |
| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Write on the board what each part of the K’NEX kit represents, by color (or project this information using the K’NEX Colors PowerPoint presentation).  Use the scale animation <https://scaleofuniverse.com/> to help students understand the scale of the molecules represented by the model.  Optional: Describe the work of Rosalind Franklin, Maurice Wilkins, James Watson, and Francis Crick. Perhaps use photos from the website <https://www.sciencehistory.org/historical-profile/james-watson-francis-crick-maurice-wilkins-and-rosalind-franklin>, but the website is not suitable simply for display during class. Read it in advance and summarize. Emphasize how recently (fewer than 75 years ago) people discovered the structure of DNA (as of this writing James Watson is still living). | |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| ***Introductio*n*.***  As we just saw in the scale of the universe animation, the DNA in our cells is really small. On the other hand, it contains an enormous amount of information. Today we are going to create a model of DNA to study its structure. In an earlier lesson we discussed the helix shape. What is a helix?  Before we get to the helix, we have to create some nucleotides. Look at the descriptions on the board of what the pieces represent. We will use a yellow/orange deoxyribose, a purple/blue clip phosphate group, and one final piece to represent a nitrogenous base. Assign group roles by having students count off in groups. 1s become readers, 2s become piece sorters, and everyone else is a builder.  Pass out bags of K’nex pieces and instructions. Display picture of nucleotides from the PowerPoint presentation. Insist that groups construct individual nucleotides first.  Middle: Monitor student work. When most groups have finished assembling their nucleotides, display an example DNA strand from the PowerPoint presentation. Instruct students to construct a strand using their nucleotides. Ensure that students are correctly pairing nucleotides. Verify the anti-parallel direction of their strands. Ensure that they are using the correct hydrogen bonds between the base pairs.  When strands are assembled, ask students to look at the strands of other groups. What is similar between groups’ strands? What is different? Invite to groups to link their strands to make a 16-pair strand. Twist this strand into a double helix.  Ending: We have just modeled DNA. What features of DNA does this model represent well? What are some simplifications made in this model? Later, we will use a K’nex model of DNA to construct a model of an RNA molecule. Then we will see how the RNA molecule encodes proteins.  **Motivating Students**  \_x\_ Verbal Reinforcement Encourage students as they create their models  \_x\_ Relate to Real World The K’nex pieces are a model of actual DNA which provides the code for constructing plants, animals, and us.  **Presenting Instructional Content**  \_x\_ Lecture/Notes A brief lecture at the beginning reminds students of DNA’s structure. Drawn or projected images orient students to the features of the K’nex model.  \_x\_ Discussion is ongoing as students construct their models. The teacher will discuss nucleotide pairing, direction of the strands, and the types of hydrogen bonds between base pairs while observing each group’s work.  ***Instructional strategies:***  **Modeling and Guided Practice *–*** Observe students’ construction of the model. If necessary, help them assemble a nucleotide or a portion of the DNA strand.  **Check for Understanding (CFU) –**  ***What am I doing for students that progress at different rates?***  ***What do I do if they get it?***  ***What do I do if they don’t get it?*** | |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning**  **Knowledge:**  What are the components of a DNA molecule [deoxyribose (sugar), phosphate group, nitrogenous base ]  What are the nitrogenous base names in DNA? [cytosine, guanine, thymine, adenine ]  What are the nitrogenous base names in RNA? [ cytosine, guanine, uracil, adenine ]  Show me a cytosine-guanine pair in your model.  What are the purines? [ adenine, guanine ]  What are the pyrimidines? [ thymine, cytosine ]  **Comprehension:**  Are hydrogen bonds weak or strong?  Which bases form pairs in DNA **[** [cytosine & guanine, and thymine & adenine ]  What bases are in this base pair, and is that a realistic pairing?  How many hydrogen bonds exist in a C-G (T-A) pairing? [C-G has 3, T-A has 2]. Show me where those would be in your model.  What is a helix? What is a right-hand twist?  **Application:**  How many hydrogen bonds exist in a C-G pairing?  Should the sugars run in the same or in the opposite direction?  **Analysis:**  Why are weak bonds between the bases a good thing?  What are some simplifications made in this K’nex model? [the model ignores the molecular structure of the sugar and of the nitrogenous bases. The model uses color, not shape to represent these differences in molecular structure].  **Synthesis:**  What features of DNA does this model represent well?  **Evaluation:**  **Thinking*(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***    \_x\_ **Practical** – Assembly of the K’nex pieces is real-world assembly from a set of plans, regardless of whether students understand DNA from the model.  \_x\_ **Creative**– Instructions do not tell students the sequence in which to assemble their nucleotides. They can arrange 3 AT pairs and then 5 GC pairs, or they can assemble alternating GC,AT,GC, . . . pairs, or other combinations.  \_x\_ **Analytical** – Students compare and contrast the DNA strands made by the different groups.  \_\_ **Research-based** – Students explore the structure of a DNA model  **\*What am I going to do to give Ss opportunity to?**  **1. Generate variety of ideas:**  **2. Analyze problems from multiple viewpoints:**  **Problem Solving**  **\_x\_\_ Categorization** Students have to arrange nitrogenous bases into categories, place nucleotides in appropriate pairs, and associate the correct hydrogen bond with each of these pairs.  **\_x\_\_ Identifying Relevant/Irrelevant Information** Students have to identify the phosphate groups as providing *orientation* to their nucleotides, not just a connection.  **\_x\_\_ Creating and Designing** Students have to choose a sequence of nucleotides to design their DNA. The instructions do not provide the sequence. | |

|  |  |
| --- | --- |
| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Use heterogeneous groups of 4 or 5. * Roles are Reader/time keeper, Piece sorter, and builders. The reader focuses the group’s activities. The piece sorter holds the bag, sorts the pieces, and passes them to the builders as needed. The builders assemble the nucleotides and the DNA strand. * Have students count off in groups. 1s become readers, 2s become piece sorters, and everyone else becomes a builder. * Students begin class seated with their groups. * Each group produces an 8-pair DNA strand. | |
| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction. |
| ***Assessments: aligned with state stds; measurement criteria; measure student performance in more than 2 ways (project, experiment, presentation, essay, short answer, multiple choice test) (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **\_\_\_ ThinkLink Probe \_\_\_ Study Island \_\_\_ Teacher Made Test \_\_\_ Unit/Chapter Test \_\_\_ Project \_\_\_ Quiz**  **\_\_\_ Group Assignment \_\_\_ Study Guide \_\_\_ Oral Presentation \_\_\_ Graphic Organizer \_\_\_ Exit Ticket**  **\_\_\_ Journal \_\_\_ Questions/Answers**  **\_\_\_Teacher Observation *(thumbs up/thumbs down, etc.)*\_\_\_ Solution to Real World Problem**  **\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *\****Students should achieve \_\_\_\_\_% mastery of this objective: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| ***During the conclusion part of creating an effective lesson plan teachers must sum up the ideas learned from the lesson. A teacher should also relate this information to future and past coursework to provide students with a broad understanding of the ideas learned. It is important to allow students enough time to ask questions, assert assumptions, and summarize the lesson during this part of the lesson plan.***   * ***Review/Summary: wrap up what has been learned and accomplished in the lesson (even if they are in the middle of an exercise, it is still important to summarize to the point where they are now). Ideally involve students in this synthesis.*** * ***Preview for next lesson: link what they did to day with where they are going next.*** * ***Upcoming assignments: remind them of any upcoming assignments.***   ***Here is your exit ticket for today…..*** Fill in the blanks. Each Adenosine-Thymine nucleotide pair is connected by a \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ bond. Each Guanine-Cytosine nucleotide is connected by a \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ bond.  **Follow-up Activities/Extension *These may be designed to create a longer or more intense lesson. For example, if the class is able to cover the material in a lesson much faster than expected, extensions may prove helpful. Extensions may also be useful in various parts of a lesson where the teacher (and class) decides they should spend more time on a skill or topic.***  ***Reflection: You must reflect on every lesson you teach.*** | |

**NOTES:**

This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

Instructions for DNA bags:

Group 1

1. Make the following nucleotides:

3 Adenine, 3 Thymine, 5 Cytosine, 5 Guanine

1. Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.

Group 2

1. Make the following nucleotides:

5 Adenine, 5 Thymine, 3 Cytosine, 3 Guanine

1. Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.

Group 3

1. Make the following nucleotides:

4 Adenine, 4 Thymine, 4 Cytosine, 4 Guanine

1. Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.

Group 4

1. Make the following nucleotides:

3 Adenine, 3 Thymine, 5 Cytosine, 5 Guanine

1. Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.

Group 5

1. Make the following nucleotides:

5 Adenine, 5 Thymine, 3 Cytosine, 3 Guanine

1. Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.

Group 6

1. Make the following nucleotides:

4 Adenine, 4 Thymine, 4 Cytosine, 4 Guanine

Assemble the nucleotides into a DNA molecule. Pay attention to the correct pairing of nucleotides, direction of the strands, and correct hydrogen bonding.