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| **TEAM Lesson Plan Template** | |
| Teacher: Andrew Morency | |
| Subject/Grade: High School Biology 1 | |
| Lesson Title: K’nex transcription | |
| **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: Cause and effect  [ some slight changes bring in the CCC: Using mathematics and computational thinking by calculating the possible number of codons, comparing this number to the number of amino acids, and describing how the disparity is dealt with in practice in the cells ]  [ A teacher could bring the CCC: stability and change into any of these DNA/RNA lessons. Which one endures? Which one is transitory? Are there changes (mutations) over time in a largely stable structure? ]  Learning performance: Students will construct a model of mRNA and use it to represent transcription including the role of RNA polymerase and promoters on the DNA strand to highlight the CCC of cause and effect. | |
| **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 replicate the DNA-RNA transcription process using K’nex pieces to construct a model of mRNA. | |
| **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, K’nex DNA Replication and Transcription Kit. Have a completed DNA molecule beginning TAC. With this beginning, the mRNA will contain the correct start codon for a later transcription activity.  \_x\_ Internet resource <https://en.wikipedia.org/wiki/RNA_polymerase_II>  **Routine for distributing materials** Place materials at centers and have students move to the centers. | |
| **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**  **----- Process**  **----- Product**  **----- Tiered Assignments**  **----- Flexible Grouping**  **----- Learning Centers \_\_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Accommodations**  **\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring**  **\_\_\_ Modified Assignments \_\_\_ Other**  **Early Finishers:** | |

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| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| DNA is in the nucleus. Our bodies, made of cells, contain lots of parts that are not in the nucleus. How does the information from DNA get out? What causes DNA to “spread the word?” What effect does “spreading the word” have?  Show a picture from  <https://en.wikipedia.org/wiki/RNA_polymerase_II> This is a picture of RNA polymerase, which unzips DNA. It attaches to the DNA molecule at a promoter, a 100-1000 base pair chunk of DNA that provides a secure binding site for the RNA polymerase. This binding is what starts transcription. | |
| **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*.***  Write the key points on the board (or display on a projector) while making the following description out loud. DNA is a plan for constructing our cells and tissues, and organs. mRNA carries the plan from the nucleus to the cytoplasm where protein construction can occur. DNA sticks around. mRNA gets created and then degenerates. An mRNA molecule is formed from a copy of half a DNA strand. This process is called transcription. For transcription to occur, double stranded DNA has to “unzip” to expose a single strand. What causes this unzipping?  The protein RMA polymerase [cause] breaks the hydrogen bonds in a DNA molecule, causing it to unzip [effect]. A new mRNA molecule forms based on the exposed DNA strand. How does the RNA polymerase know where to begin?  There are special areas along a DNA molecule called promoters [cause], which provide a site at which the RNA polymerase can attach [effect] to the DNA molecule. The RNA polymerase [cause] then breaks the hydrogen bonds between base pairs in the DNA molecule, making it unzip [effect]. Now ribose nucleotides can match up with corresponding bases in DNA to form an mRNA molecule.  We will replicate this process with our K’nex pieces. As we do, remember to copy the DNA from the 3’ end to the 5’ end.  Middle:  Provide each group of students with a K’nex DNA molecule that begins with TAC. Write what each color represents on the board, or project the colors from KNEX\_colors2.ppt. Have students use the gray/silver sugar pieces to represent the ribose in RNA. Remind students that purple pieces represent Uracil, while purple pieces with a blue clip represent a phosphate group.  Have students work in groups to complete transcription using their K’nex kits. They should first unzip their DNA molecule and then begin constructing a complementary mRNA strand starting with a 5’ (capped) piece of RNA. When they are through, have them disconnect the mRNA strand and re-zip the DNA strand. For emphasis, twist it back into a double helix (observe, and then set it aside, where it will return to a flat).  Ask: Where does all of this take place? [ cell nucleus ]  End:  Discuss: Our new strand of mRNA is still not ready to create proteins. Parts of it have to be cut out. Portions called exons stay in. Portions called introns are cut out. (Exons are excellent; introns are inferior).  In this model, what represented RNA polymerase? [ The students did; they unzipped the DNA ]  What controls where on a DNA strand that mRNA begins to copy the DNA? [ Promoter, a sequence of DNA to which RNA polymerase can attach ]  For our next activity, we will need a longer strand of mRNA. Each group find a partner group and connect your strands of mRNA to make a longer one. Set those aside. Separate the DNA molecules and return them to their bags.  **Motivating Students**  \_x\_ Verbal Reinforcement Encourage students as they create their models  **Presenting Instructional Content**  \_x\_ Lecture/Notes A brief lecture at the beginning describes how RNA polymerase begins the transcription process.  \_x\_ Hands-on. \_x\_ Modeling This is a hands-on activity to understand how DNA nucleotide sequences are transcribed by mRNA using a model.  ***Instructional strategies:***  **Modeling and Guided Practice *–*** The teacher will model (pedagogical verb) some steps of the model (SEP noun) construction, particularly mountain and valley folding.  **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 do we call the parts of mRNA that must be cut out after transcription but before protein formation? [introns]  What do we call the parts of mRNA that are not cut out after transcription but before protein formation? [exons]  What controls where on a DNA strand that mRNA begins to copy the DNA? [ Promoter, a sequence of DNA to which RNA polymerase can attach ]  **Comprehension:**  Does transcription begin from a 3’ end or 5’ end of a string of DNA nucleotides?  Where does transcription take place (in eukaryotes] ? [in the nucleus]  What in our model represented RNA polymerase? [the students]  What in our model represented the promoter? [ there was no representation of the promoter; we have a partial strand of DNA and simply started at the end.]  **Application:**  If transcription happens in the nucleus, how does the information get outside the nucleus? [ the mRNA molecule has to leave the nucleus somehow (the mechanism is beyond the scope of this lesson)]  **Analysis:**  What features of transcription does this model ignore? [DNA strand is much longer, we did not represent the promoter; we did not represent RNA polymerase with little plastic parts . . .]  What was the point of using this model? [ we see how RNA nucleotides get to interact with a strand of DNA and then form a string of mRNA ]  **Synthesis:**  What makes transcription stop? Why doesn’t mRNA copy the entire strand of DNA?    **Evaluation:**  **Thinking*(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***    \_x\_ **Practical** – Students have to read and follow instructions to create their model  \_x\_ **Analytical** – Students compare and contrast DNA and RNA using different sugars and matching Uracil to Adenine even though they are still matching Adenine to Thymine.  **\*What am I going to do to give Students the opportunity to?**  **1. Generate variety of ideas:**  **2. Analyze problems from multiple viewpoints:**  **Problem Solving**  **\_x\_ Predicting outcomes** Students are asked to explain how the information from transcription becomes usable outside the nucleus.  **\_x\_\_ Categorization** Students have to categorize parts of their models as either DNA or RNA  **\_x\_\_ Identifying Relevant/Irrelevant Information** Students are asked which features of transcription are ignored in this model, that is, which are not relevant. They are asked to acknowledge that much of the transcribed mRNA is irrelevant information (introns) and must be excised before protein formation. | |
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| **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. |
| * Heterogeneous groups of 4 or 5. * Roles include Reader/task focuser, Unzipper, Nucleotide builder, mRNA assembler. The mRNA assembler should tell the Nucleotide builder something like “give me an adenine; now a uracil” and so on, then snap the pieces in place. * Have students count off in groups. 1s become Readers, 2s become Unzippers, 3s become nucleotide builders, 4s become mRNA assemblers, and any 5s become additional nucleotide builders. * Have K’nex pieces at centers and have students move to the centers or have pieces in bags to pass out. * The group produces a model of mRNA that they then combine with the mRNA strand from another group. | |
| **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…..***  **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:**

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