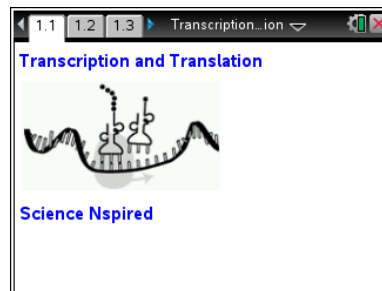## Science Objectives

- Students will understand what the Central Dogma of Biology entails.
- Students will identify the locations and outcomes of transcription and translation in eukaryotes.
- Students will describe the key cellular machinery used in transcription and translation.

Vocabulary

- DNA
- Protein
- Nucleus
- Translation
- Polymerase
- Amino acid
- Anti-Codon

- RNA
- Enzyme
- Transcription
- Ribosome
- Nucleic acid
- Codon

About the Lesson

- Using simulations and models, students will interact with both the transcription and translation machinery. Assessments are embedded in the activity to engage discussion and gauge learning.
- As a result, students will:
  - Learn the components involved in transcription of RNA, including DNA and RNA polymerase.
  - Be introduced to three types of RNA and their functions: mRNA, rRNA, and tRNA.
  - Learn the components involved in translation, including the ribosome and amino acids.

TI-Nspire™ Navigator™

- Send out the *Transcription_and_Translation.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to have students demonstrate how to negotiate the simulations and to spotlight student answers.
- Collect student responses from assessment items that are embedded throughout the document.

Activity Materials

- *Transcription_and_Translation.tns* document
- TI-Nspire™ Technology

TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Explore Hot Spots
- Open Directions Box
- Answer assessment questions within a document

Tech Tips:

Make sure that students know how to move between pages by pressing ctrl ◀ (left arrow) and ctrl ▶ (right arrow).

Lesson Materials:
Student Activity

- Transcription_and_Translation _Student.doc
- Transcription_and_Translation_Student.pdf

*TI-Nspire document*

- Transcription_and_Translation.tns

Discussion Points and Possible Answers

Allow students to read the background information on pages 1.2 and 1.3 of the .tns file.

Part 1: The Central Dogma
Move to pages 1.3 – 1.4.

1. Students are to read the information about the Central Dogma on page 1.3. Then they will move to page 1.4 to explore the different stages of the Central Dogma. When the small magnifying glass icon appears, students are to click the image and an information box will appear. They can click ☒ to close the box. Be sure that they have clicked all **five** information hot spots. If needed at any time during the simulation, students can press [menu] if they would like to view the directions again.
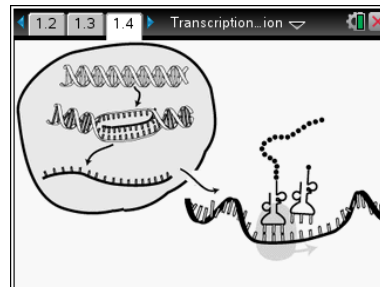
Move to pages 1.5 – 1.7.
Have students answer questions 1-3 on the handheld, the activity sheet, or both.

Q1. Where does *transcription* happen?

   Answer: A. Nucleus

   DNA is stored in the nucleus, and never leaves this organelle.

Q2. Which statement is correct?

   Answer: B. RNA is translated into protein.

   Be careful to use transcription and translation properly. DNA and RNA are the same code- so the language of DNA is *transcribed* into RNA. This must be *translated* into the new language of amino acids.

Q3. Which enzyme(s) is/are used in transcription and translation? (Select all that apply.)

   Answers: B. Polymerase and D. Ribosome

   The polymerase transcribes RNA, and the ribosome (a ribozyme made of catalytic RNA) translated mRNA.

Part 2: DNA and RNA – Two Nucleic Acids

Move to pages 2.1 – 2.2.

2. Have students read the information about DNA and RNA on page 2.1. Then they can move to the simulation on page 2.2 to explore characteristics of DNA and RNA. Clicking the right arrow ▶ of the clicker, students will see the similarities and differences. There are three categories of characteristics; bases, shape, and types.
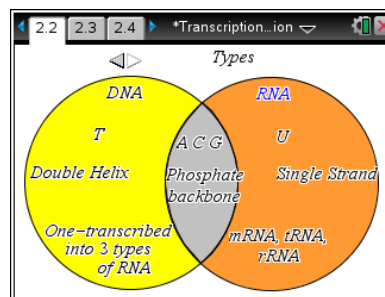
Move to pages 2.3 – 2.4.

Have students answer questions 4-5 on the handheld, the activity sheet, or both.

Q4.   State one difference between DNA and RNA.

    Sample Answer: Structure (double helical or single stranded), Bases (U and T) functions,

Q5.   What do RNA and DNA have in common?

    Sample Answers: Both are nucleic acids, both use the bases A, C and G, both have a phosphate backbone.

Part 3: Transcription

Move to pages 3.1 – 3.3.

3. Have students read the information about the process of transcription on pages 3.1 and 3.2. Then they are to move to page 3.3 to simulate transcription of a DNA strand. Students should follow the directions on the screen, grabbing the indicated slider. Be sure that they only move the slider indicated and that they release the slider at the end.
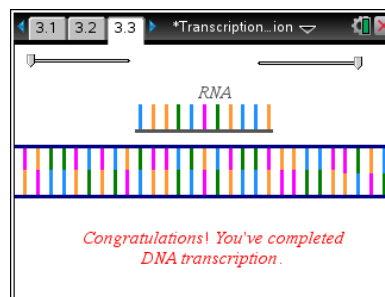
Move to pages 3.4 – 3.5.

Have students answer questions 6-7 on the handheld, the activity sheet, or both.

Q6.   What is the product of transcription?

    Answers: D. New RNA

Transcription creates new RNA based on a sequence of DNA (often a gene).

Q7.   What is one purpose of transcription?

**Sample Answer:** Make new RNA for ribosomes, new messages to create new protein

The key machine to create proteins is the ribosome, cells can use many ribosomes to make more protein (including during cell division).

Part 4: Translation
Move to pages 4.1 – 4.3.

4.   Have students read the information about the translation on pages 4.1 and 4.2. Then they are to move to the simulation on page 4.3 to explore the components of translation.

They can click ❌ to close the Directions box. If needed at any time during the simulation, students can press menu if they would like to view the directions again.
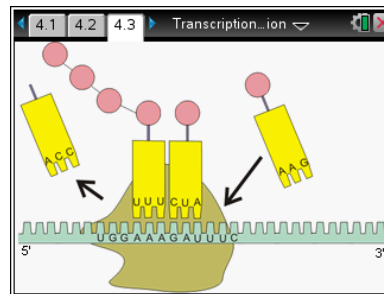
When the small magnifying glass icon appears, students can click the image and an information box will appear. Be sure that they have clicked all **seven** information hot spots.

Move to pages 4.4 – 4.7.
Have students answer questions 8-11 on the handheld, the activity sheet, or both.

Q8.   Which type(s) of RNA is/are essential for translation? (Select all that apply.)

Answers: A. rRNA, B. tRNA, C. mRNA

All three types of RNA play an important role in translation, not just the message being translated.

Q9.   What does the ribosome do? (Select all that apply.)

Answers: A. Translate mRNA into protein, C. Match tRNA anti-codons to mRNA codons

The ribosome is a large machine that performs many important functions, including quality control of tRNAs and building protein from amino acids.

Q10.   What is the product of translation?

Sample Answers: New protein

Q11. Based on what you know about the Central Dogma, which molecule will be affected by a mutation in DNA?
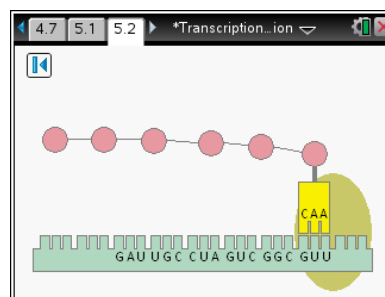
Sample Answers: RNA, and if applicable, protein as well

This is how mutations in DNA can lead to diseases, the mutations is incorporated into other molecules as well.

Part 5: Translation Game
Move to pages 5.1 – 5.2.

5. Have students read the additional information about the process of translation on page 5.1. Then they can move to page 5.2 to play the translation game. Students are to click the up and down arrows in the top right corner of the screen to choose a tRNA to match the mRNA codon in the ribosome. Then they should grab and drag the tRNA to the ribosome. When they release it, either the ribosome will move to the codon or the tRNA will be rejected. Students can click the Reset button ⏮ in the top left corner to go back to the beginning of the game.

You may want to remind students that while DNA pairs A to T and G to C, RNA will pair A to U (or U to A), and G to C.

TI-Nspire Navigator Opportunities

Choose a student to be a Live Presenter to demonstrate how to negotiate each simulation. The questions in the activity may be distributed as Quick Polls or used as a formative or summative assessment

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Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

*   Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.