



**Learning DNA Using
Augmented Reality**

Lesson 1 & 2

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Before You Begin

It is critical that students have basic understanding of DNA prior to beginning the lessons. We suggest you use your own lesson plans to make sure students have prior knowledge on the subject. To give you an idea of what students should know, they should be able to answer the following:

- What is DNA?
- What is the purpose of DNA?
- What is the structure of DNA?
- Where is DNA located?

Additionally, using Augmented Reality apps quickly drains battery power on phones and tablets. Make sure that devices are fully charged and/or back ups are available for students to use.

Lesson 1: Introduction to DNA Transcription and Translation Using AR

Lesson Concept

In this lesson students will learn about the process of DNA transcription and translation. This lesson builds up on prior lessons on the structure and function of DNA.

Objectives

Students will be able to:

- Summarize the steps of DNA transcription and translation
- Explain the purpose of DNA transcription and translation
- Use a model to understand how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells

Duration

Depending on your class schedule, this lesson should take 1-2 class periods to complete.

Resources

- [DNA Basics Kahoot Quiz](#)
- [DNA Transcription & Translation Video](#)
- [DNA AR Simulation Student Worksheet](#)
- [DNA Transcription & Translation AR Simulation](#)
- [Claim, Evidence, Reasoning Rubric](#)

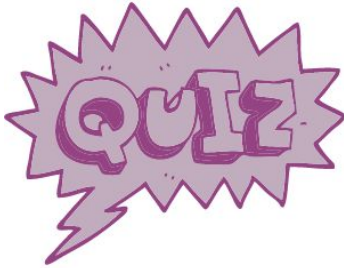
Teacher Notes

This lesson is an introduction to transcription and translation. At least one more class (or more depending on level of detail) would be needed to teach the specifics of transcription and translation, for example the enzymes involved, mRNA, tRNA, etc. That said, the NGSS assessment boundary states that students do NOT need to know the biochemistry of protein synthesis.

Additionally, this lesson is very detailed and teachers do not need to execute it in exactly the way it was written. The most critical pieces are that students use the AR app for Activity 4 and Activity 5.

Activity Overview

Day 1



Activity 1: Engage

Students will understand the basics of DNA by taking a 3-minute Kahoot quiz.



Activity 2: Explore

Students will watch an introductory video on DNA Transcription & Translation.



Activity 3: Explain

Students will participate in an open-table discussion regarding their take-aways from the video.

Day 2



Activity 4: Elaborate

Students will interact with an Augmented Reality Experience and begin to fill out a worksheet.



Activity 5: Evaluate

Students will use Claim, Evidence, Reasoning to complete the worksheet.

Activity 1: Engage

During this activity, students will be taking a brief Kahoot quiz on the [Basics of DNA](#). Students should be given **three minutes** to complete the quiz, although they will most likely complete the quiz well before that.

Once every student has completed the quiz, you may use the answer key below to go over all of the questions and answers. Encourage student participation during this time. If a student got a question wrong, ask about their thought process and be sure they fully understand the correct answer.

DNA Basics Quiz - Answer Key

1. What is the purpose of DNA?

- a. To provide the instructions for life
- b. To make cells
- c. To support the skeleton

2. Adenine, Thymine, Cytosine, and Guanine are

- a. Proteins
- b. Nitrogen bases
- c. Cells

3. Which two base pairs do NOT go together:

- a. AT
- b. CG
- c. AG

4. Where is DNA located?

- a. In the cell membrane
- b. In cell chloroplasts
- c. In the cell nucleus

5. What shape is the DNA molecule?

- a. Triple helix
- b. Double helix
- c. Circle

Activity Tip

Highly encourage students to ask questions if they thoroughly do not understand the answer to any of the questions. Putting that extra time and focus in now will only benefit the student.

Activity 2: Explore

With a basic understanding of DNA, now it's time for them to learn how DNA makes us...us. Since DNA is the 'instructions for life' - let's see how these instructions are made, and how they tell our body what to do.

Either on their own or as a whole class, have the students watch the video below on the Introduction to DNA Transcription and Translation. As students watch the video, they should be encouraged to write down notes or questions they may have because the video is just under **eight minutes** in length.



Activity Tip

When students are taking notes, if possible, have them include the time it appears in the video. This will make it easier for the teacher to reference the segment during the discussion.

Activity 3: Explain

After watching the DNA Transcription & Translation video, students should discuss their take-aways. The teacher should moderate the discussion. If students are having trouble getting started, you can jump-start the conversation by asking the following questions:

What is the purpose of DNA transcription and translation?

- The purpose of DNA transcription and translation is to create proteins. The proteins created in this process are then used to do/make stuff (ex: hair, digestive enzymes, etc.). Transcription makes a copy of the directions, and translation is when the directions are read to make something. Once the thing is made, it is called 'gene expression'.
 - *Remember: Transcription >> translation >> expression*

How is the process of DNA transcription and translation like making a hot pocket?

- Both a hot pocket and DNA transcription and translation...
 - Pack the exact same thing into a special bundle over and over
 - Are created according to special instructions
 - Are made/happen in a certain place
 - Can have different versions depending on the 'recipe'

Activity Tip

As students are discussing the DNA Transcription & Translation video, it could be helpful for the teacher to display the video. This way when a student is referencing the video, the teacher can bring up the related section of the video to show to the class.

Activity 4: Elaborate

To build on their knowledge of DNA Transcription & Translation, students will complete Exercises 1 and 2 of the [DNA AR Simulation Worksheet](#). In order to complete the first two Exercises, the students will have to interact with a **DNA Transcription & Translation Augmented Reality (AR) Experience** and record their findings on the worksheet.



Activity Preparation

Prior to starting the worksheet, students should download the **Zappar app** to their phone or device. This app is how the students will engage with the DNA Transcription & Translation Augmented Reality (AR) Experience.

Activity Preparation

This **3DNA Poster** (pictured to the right) must be scanned from a flat surface like a table and not from a vertical surface like a computer screen. You can scan it with a phone from a tablet or you can print out the image but it must be flat to work properly.



Activity Tip

If students are sharing devices, make sure they take turns. It's important each student gets an opportunity to interact and engage with the AR Experience.

Activity 5: Evaluate

As the final activity of Lesson 1, students will be completing Exercise 3 of the [DNA AR Simulation Worksheet](#). In this exercise, students will need to determine the following; *“How does the structure of DNA determine the structure of proteins that are essential for life processes?”*

Students can:

- create a written response using **Claim, Evidence, Reasoning** format. The evidence and reasoning should come from the [DNA Transcription & Translation video](#) and [DNA Transcription & Translation AR Experience](#).

Student Sample Answer	
CLAIM	The structure of DNA is a double helix. The double helix is made of genes, which code for (tell the cell to make) specific proteins.
EVIDENCE	The double helix structure of DNA allows it to be ‘unzipped’. Once unzipped, the genes on the DNA can be transcribed (copied) and translated (using the copy to make something, usually proteins).
REASONING	For example, in red blood cells, the translation and transcription process can result in the creation (gene expression) of hemoglobin. Hemoglobin is a protein needed to carry out the essential life function of carrying oxygen to all parts of the body.

Activity Tip

Students could use [PhET Gene Expression Essentials](#) to explore how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells; this is a [worksheet](#) to scaffold students through the simulation.

Teachers can grade student responses using the [Claims, Evidence, Reasoning Rubric](#). Use the sample answer above as a guide.

Lesson 2: CRISPR - Transcription & Translation

Lesson Concept

In this lesson students will learn about the modification of DNA through CRISPR. Students will consider the potential benefits and pitfalls of gene modification.

Objectives

Students will be able to:

- Summarize an example of how gene transcription, translation, and expression can be modified
- Plan an interactive model to show how the structure of DNA determines the structure of proteins, and how the process can be manipulated.

Duration

Depending on your class schedule, this lesson could take 3 or more class periods to complete.

Resources

- [Ellen Jorgensen: What You Need to Know About CRISPR Video](#)
- [ScienceAlert: Amazing Things We Achieved With Help From CRISPR Article](#)
- [Fast Company: The Ethics of CRISPR Article](#)
- [DNA Augmented Reality Challenge Worksheet](#)
- [Challenge Rubric](#)

Teacher Notes

This lesson has the potential to ignite strong opinions and spark conversations about ethics. Be prepared to moderate a healthy debate and conversation with students emphasizing that all opinions should be heard and considered and there is no correct answer to the ethics around CRISPR.

Activity Overview



Activity 1: Engage

Students will be asked three questions and they must decide whether they agree or disagree.



Activity 2: Explore

Students have an open-table discussion on what they currently know about CRISPR.



Activity 3: Explain

Students will watch and take notes on a video called What They Need to Know About CRISPR.



Activity 4: Elaborate

Students discuss takeaways from the video and decide whether or not they believe CRISPR is GOOD or BAD.



Activity 5: Evaluate

Students will create Augmented Reality Experience to explain whether CRISPR is GOOD or BAD.

Activity 1: Engage

In the first activity of Lesson 2, the teacher will ask the class the three questions (one at a time) listed below. After asking each question, the teacher should randomly choose a few students to explain their stance on the question. Additionally, there are two different class instructions depending on what your learning setting is like.

Activity Questions

- Should we bring back the woolly mammoth?
 - If you prefer blue eyes to brown, should you be able to edit the DNA of your baby before it's born so it has blue eyes like you prefer?
 - Should humans be able to wipe out an entire species that we consider harmful (ex: mosquitos)?
-

Activity Instructions

- **If you are meeting in person:**
 - After the teacher asks a question, students should line up according to their level of agreement. One side of the room is a 1 - 100% agree; the other side of the room is a 1 - 100% disagree. Students must talk with each other and share opinions to determine where on the line they fall.
- **If you are meeting virtually:**
 - After the teacher asks a question, students should physically raise their hand or virtually raise their hand to show they agree with the question. Should a student only 50% agree, they can either raise their hand halfway or raise their hand and verbally express they are only 50% in agreement with the question.

Activity Tip

If a class is meeting virtually, teachers may allow students to utilize the chat feature for students to announce their position on the question and to expand on their reasons.

Activity 2: Explore

The first activity in this lesson should have gotten the students engaged and talking. Now we want to continue the conversation and gauge what their knowledge is on CRISPR by asking, “Has anyone heard of CRISPR?”

Scenario A: Students Have Heard of CRISPR

This is a chance for the students to share what they know about the topic. If multiple students have heard of CRISPR, allow each one of them an opportunity to share and allow for an open-table discussion amongst the class.

Scenario B: Students Have Not Heard of CRISPR

There is a possibility that none of the students know what CRISPR is at this time. Should this be the case, the teacher may step in and kickstart the conversation.



Activity Preparation

- It would be a good idea for the teacher to have a few visuals relating to CRISPR on hand in case the conversation stalls or students are not fully understanding the topic.

Activity Tip

Highly encourage students to ask questions if they do not fully understand what CRISPR is. This is the opportunity to make sure each student grasps the subject. This is where visuals will become beneficial, if you have them.

Activity 3: Explain

After having an introductory conversation around the basic definition of CRISPR, we want the students to watch the video below titled *What You Need to Know About CRISPR*.

As students watch the video, they should be encouraged to write down notes or questions they may have because the video is just under **10 minutes** in length. After watching the *What You Need to Know About CRISPR* video, have the students discuss and understand the following questions.

- What is CRISPR?
- How does CRISPR work?
- What can CRISPR be used for?



Activity Tip

When students are taking notes, if possible, have them include the time it appears in the video. This will make it easier for the teacher to reference the segment during the discussion.

Activity 4: Elaborate

With a better understanding of what CRISPR is and its uses, we want to hear student opinions on CRISPR and its uses. The students should read the articles below. One article takes the stance that "CRISPR is GOOD" and the other takes the stance that "CRISPR is BAD." After the students read both articles, the teacher will ask the students to make a decision on whether they believe CRISPER is indeed Good or Bad, then allow them to explain their stance.

Activity Articles

- CRISPR is GOOD: [ScienceAlert: Amazing Things We Achieved With Help From CRISPR Article](#)
 - CRISPR is BAD: [Fast Company: The Ethics of CRISPR Article](#)
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Activity Instructions

- **If you are meeting in person:**
 - After the teacher asks the question, students should line up according to their level of agreement. One side of the room is a 100% GOOD; the other side of the room is a 100% BAD. Students must talk with each other and share opinions to determine where on the line they fall.
- **If you are meeting virtually:**
 - After the teacher asks a question, students should physically raise their hand or virtually raise their hand to show they think CRISPR is GOOD. Should a student only 50% agree it is GOOD, they can either raise their hand halfway or raise their hand and verbally express they are only 50% in agreement with the question. If a student thinks CRISPR is BAD, they should not raise their hand.

Activity Tip

The teacher should moderate the discussion and be sure to call on students from both sides of the debate. Encourage students to share their thoughts and allow for rebuttals or follow up questions.

Activity 5: Evaluate

To close out Lesson 2, the students will complete the [DNA Augmented Reality Challenge Worksheet](#). They will have to decide, “*Is CRISPR GOOD or BAD?*”, then create an Augmented Reality (AR) Experience explaining their stance. The students can either work in small groups or individually on the worksheet.

Activity Instructions

- Students will choose whether they believe CRISPR is either GOOD or BAD.
- They will either conduct their own research or reference any of the resources below to back their stance.
 - [Ellen Jorgensen: What You Need to Know About CRISPR Video](#)
 - [ScienceAlert: Amazing Things We Achieved With Help From CRISPR Article](#)
 - [Fast Company: The Ethics of CRISPR Article](#)
- Students will now create an AR Experience to showcase their research on [ZapWorks](#).
- The teacher should distribute the ZapWorks login credentials.
- For their AR Experience, students should use Widgets (the simplest way to create an AR app).



Activity Tip

To mirror the NGSS standard: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis. Here is an [example of a project that meets standards](#).