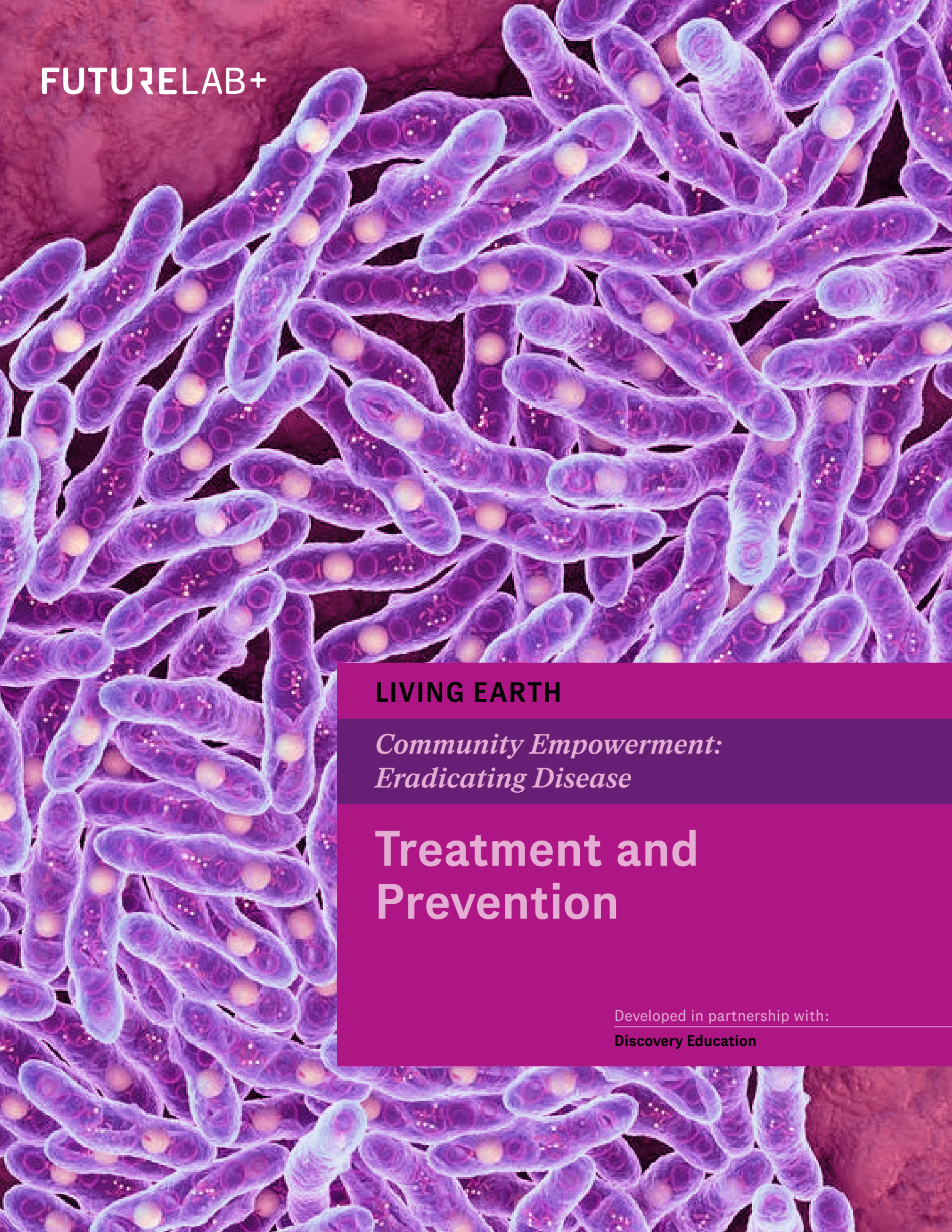
FUTURELAB+



LIVING EARTH

Community Empowerment: Eradicating Disease

Treatment and Prevention

Developed in partnership with:

Discovery Education

In this Lesson Plan:

Print the **Teacher Section** →

01 For Teachers	Page
Lesson Overview	1
Make Connections!	3
Pedagogical Framing	4
Slides	
Day 1	5–6
Day 2	7–8
Day 3	9–10
Day 4	11–14
Day 5	15–16
Day 6	17–18
Day 7	19–20
National Standards	21
Educator Resources	22–23

Print the **Student Section** →

02 Student Resources	Page
Traditional Vaccines vs. mRNA Vaccines	
Part 1—Types of Vaccine Notes	1
Part 2—Venn Diagram Compare and Contrast	2
DNA, Genes, and Proteins	
Part 1	3
Part 2	4–5
Transcription Investigation	
Part 1—My Transcription Observations	6–7
Part 2—My Transcription Questions	8
Part 3—My Transcription Research	9
Translation Investigation	
Part 1—My Translation Observations	10–11
Part 2—My Translation Questions	12
Part 3—My Translation Research	13
Put It All Together	14–15
Current Treatments for Infectious Disease	16
Treatments to Fight Disease Research	17

The image shows vibrio cholerae bacteria, which causes cholera disease and is transmitted by contaminated water, (illustration).

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Cover Image
Tuberculosis bacteria, (illustration).

This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

Page Range (use a hyphen): T3–T6

LIVING EARTH / COMMUNITY EMPOWERMENT—ERADICATING DISEASE

Treatment and Prevention

ACTIVITY DURATION

Seven days

DRIVING QUESTION

How can an effective outreach campaign educate and empower a community to help eradicate an infectious disease?

ESSENTIAL QUESTIONS

How is mRNA similar and different from other types of vaccines?

How do vaccines cause the body to generate antibody proteins that target a specific disease?

How does protein synthesis produce specific antibody proteins to fight a specific disease?

OVERVIEW

To prevent epidemics and pandemics, researchers must stay on top of disease trends of the past and present. A great example is that of cholera, a bacteria that causes severe diarrhea and cramping. If left untreated, it can even cause death. The bacteria was first discovered in India, and within the century spread to many other countries, one of which was England. It took the dedication and persistence of one man, John Snow, to determine that cholera was a waterborne illness and not spread by air like many other deadly bacteria and viruses of the time. He was able to successfully map outbreaks of cholera in London and determined that a single contaminated water pump was responsible. Scientists can use historical data collections as well as emerging scientific findings on pathogen structure and function to determine where and how a potential outbreak could occur and who it will affect. Epidemiologists, microbiologists, geneticists, virologists, public health officials, doctors, and even government agencies all play roles in the study and prevention of disease.

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OBJECTIVES

Students will be able to:

Discover how vaccines are made and help the body develop immunity to a disease.

Analyze the similarities and differences between mRNA vaccines and traditional vaccines.

Describe how vaccines cause the body to generate antibody proteins that target a specific disease.

Explain how protein synthesis produces specific antibody proteins that target a specific disease.

OVERVIEW *Continued*

According to the Centers for Disease Control and Prevention (CDC), there are two types of immunity in humans: active and passive immunity. Active immunity is created when a person contracts a disease and their body creates natural antibodies against it. Active immunity can also occur when a person is given a vaccine that contains a weakened or inactive form of the disease to create antibodies. Passive immunity is created when a mother passes antibodies to her unborn child or when a person receives antibody-containing blood products. Active immunity may take days to weeks to develop while passive is immediate. However, active immunity lasts longer (even a lifetime) while passive immunity lasts only weeks to months. Immunity to disease helps reduce transmission. However, one of the most effective ways to reduce disease transmission is to practice prevention measures, such as hand hygiene, access to safe drinking water, proper cleaning and disinfection, and self-isolating when ill.

In this lesson, students create their fourth community outreach campaign post or community outreach product. The groups will create communication that states their disease treatment recommendations for their community. Additionally, students will describe their recommendations in greater detail in their Disease Education Report. In order to do this work, students will learn about the different types of vaccines, how vaccines create antibody proteins through protein synthesis, and other types of disease treatments such as antibiotics.

STUDENT TASKS

Day 1	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6*	*Day 7*
Explore how about how vaccines are developed and how they enable disease immunity.	Identify different types of proteins with an emphasis on the defense proteins antigens and how they fight disease. Begin to investigate how mRNA vaccines cause the body to create disease-specific antigens by learning about the first step in protein synthesis—Transcription.	Finish the investigation into how mRNA vaccines cause the body to create disease-specific antigens by learning about the final step in protein synthesis—Translation.	Describe current treatments for disease. Research specific treatments used for people infected by their disease.	Continue to develop their Disease Education Report, by completing the "Disease Treatments" section where they recommend which treatments can best help eliminate the disease from the community.	Begin to develop the fourth post of their community outreach campaign. Work together in their community outreach campaign role to develop a post to raise awareness around which treatments can best help eliminate the disease from the community.	Participate in a Gallery Walk Feedback of posts. Use feedback from other students to revise and finalize posts. Add their post or community communication to their Disease Education Communication Posts.

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

This lesson focuses on disease structure and function. Students will analyze data and observe historical trends in diseases. They will discover people who have helped with disease prevention and eradication, and investigate the structure and function of bacteria and viruses. Students will also explore how to stop or slow transmission of diseases.

In this lesson, students create the fourth post of their community outreach campaign or community outreach project to help eliminate the infectious disease in the community they have identified.

How does this connect to careers?

Epidemiologists study the patterns, causes, and effects of diseases in order to suggest prevention and treatment.

Microbiologists study microorganisms, including bacteria and viruses, and the processes involved in their structure and function.

Geneticists study the components of a bacteria or virus, including their DNA or RNA, and how they interact with host cells.

Virologists study specific viruses, their structure, and how they infect organisms. They can be researchers or even doctors.

Public health officials work to help educate and communicate disease prevention and outbreaks to the public.

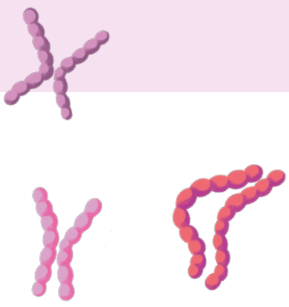
Doctors work to help treat and manage people who have contracted diseases.

Government agencies such as the CDC, WHO, and FDA work to study various diseases. They analyze transmission methods, trends, and treatments for disease. They help educate and provide resources to people affected by disease outbreaks.

Phlebotomists collect blood samples to be tested for disease.

How does this connect to our world?

Diseases are everywhere and are part of the cycle of life. Everyone is affected in some way by disease-causing organisms. Today, many diseases have treatments, vaccines, and cures. However, new diseases can still arise and it takes time to understand their structure and how best to eradicate them. Therefore, it is crucial to understand the biology of diseases, the transmission of diseases, and the prevention of diseases.



Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

Students create their fourth post of their community outreach campaign to help eliminate the infectious disease in the community they are trying to help. This requires the use of empathy for those infected with the disease, as well as social awareness of the perspective of the target audience. Students must also practice self-management skills like delaying gratification to pursue the goal and persevering in the face of any setbacks or frustrations while working with their group and receiving feedback. In groups, students create a community outreach campaign that must relate to people of various ethnicities and socioeconomic backgrounds.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Students reflect on their experiences with COVID-19 in their community in order to set-up their learning about different types of vaccines, protein synthesis, and gene therapy. Students learn this content collaboratively through a variety of student-centered learning activities. Additionally, the lesson offers opportunities for the growth of critical consciousness of self and community around the health issues faced by their communities. Students' will need to consider the health literacy issues people in their community face and through their community outreach campaign utilize communication strategies to overcome these issues.

ADVANCING INCLUSIVE RESEARCH

Immune systems are complex and their function differs from person to person. During the COVID-19 pandemic, it was essential to recruit diverse participants for vaccine trials in order to examine how the vaccine impacted people with different genetic backgrounds and personal characteristics.

COMPUTATIONAL THINKING PRACTICES

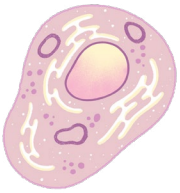
This lesson invites students to explore vaccines and immune response by utilizing the computational thinking strategies of collecting data, decomposing problems, and developing algorithms. Students examine the process of transcription, which is much like computer coding, and identify how the body reads the algorithm embedded in an mRNA vaccine and follows the instructions of the algorithm to develop disease antibodies.

CONNECTION TO THE PRODUCT LIFE CYCLE

This lesson examines the various vaccines developed for COVID-19. As students explore the different vaccines that are available, they are gathering information about the Manufacture phase of the product life cycle.

Day 1

Slides 1–8



Slides 1–6

Students reflect on treatments for COVID-19. (10 minutes)

1 In their groups, students generate a list of different ways to prevent or treat COVID-19. Tell students to include all preventions or treatments that they heard about on social media, the news, word of mouth, or another source.

2 Have students share their lists. When a list has been generated, ask students the following prompts:

- Which preventative methods or treatments were not effective? Why?
- Which preventative methods or treatments were the most effective? Why?
- Which preventative methods or treatments are connected to health literacy issues?
- How did politics influence people's beliefs in effective COVID-19 treatment?
- How do we know that treatments are effective?

3 Tell students they are going to explore vaccines, how they work in the body, and how they are created.

4 Now, have students do the first part of the *3-2-1 Bridge thinking routine* using the topic Vaccines.

- Students write down three thoughts or ideas, two questions, and come up with one metaphor or simile about vaccines.
- When done, have a few students share their examples.
- Students will complete Part 2 of the thinking routine at the end of class on Day 3.

Teacher Note > *Please keep in mind that some students and their families will have religious or health reasons for not vaccinating. Some students will not have experiences with vaccinations or the side effects. It is important to ensure a safe environment for students as they discuss vaccines and the science surrounding the use of vaccines to prevent disease.*

Slides 7–8

How vaccines are developed and enable disease immunity (30 minutes)

1 Have students turn to a partner and discuss side effects of vaccinations. Ask students to think about why these side effects occurred. Tell students that that they are going to discover why vaccines have side effects and why this may be positive.

Continues next page >

Day 1

Continued

Slides 7–9

2 Ask students to share out different companies that produce vaccines for various diseases. As students share out, place the companies under two categories written on the board:

a. mRNA Vaccines:

- Moderna
- Pfizer

b. Other Traditional Vaccines:

- Johnson and Johnson
- AstraZeneca
- Novavax

3 Tell students they are going to compare and contrast these two types of vaccines.

4 Have group members select vaccine types to study. Both vaccines should be represented in each group.

5 Pass out the *Traditional Vaccines vs. mRNA Vaccines* capture sheet.

6 Review the document and online resources with students. Tell students they will fill out Part 1 for their chosen vaccine type.

7 If more than one student in a group has the same vaccine type, they can work together to complete Part 1.

8 Give students 15 minutes to complete Part 1.

9 When ready, have students connect back with the rest of their group to complete Part 2. Give students 15 minutes to complete the Venn diagram in part 2.

Slides 9

Closing reflection (5 minutes)

1 Ask students to respond to the prompt:

- Based on what you know now, why can side effects be a positive consequence of receiving a vaccine?

Day 2

Slides 10–13

Slides 10–13

What do proteins do and how can they fight specific diseases? Research mRNA vaccines for COVID-19. (15 minutes)

1 Inform students they are going to investigate how vaccines are able to make the body immune to specific diseases.

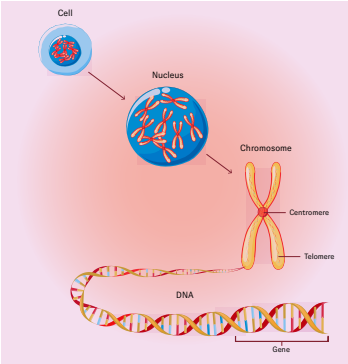
2 Split students into two large groups. Assign one group the *DNA and Genes* video and the other group *What are Proteins* video. Have students in each group split into smaller groups of two in order to create an AEIOU together.

3 Pass out a blank sheet of paper for students to create an *AEIOU* to summarize and clarify the information from their video.

Teacher Note > *Have each student record their group's AEIOU so they are able to share their group's information during the next paired activity. Explain the meaning of each vowel for the purposes of this strategy before students begin.*

- A = Adjective: List a word or two that describes something you saw or learned.
- E = Emotion: Describe how a particular part of the video made you feel.
- I = Interesting: Write something you found interesting about the content topic.
- O = Oh!: Describe something that caused you to say "Oh!"
- U = Um?: Write a question you have, or what you want to learn more about.

4 When groups are finished with their *AEIOU* charts, form new groups of two pairing a student who watched the *DNA and Genes* with a student who watched *What are Proteins*. Then, have students complete the questions in the *DNA, Genes, and Proteins* capture sheet.



The image shows gene to DNA and chromosome in cell structure, (illustration).

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Day 2

Continued

Slides 14

Slides 14

Through an inquiry process, students begin to learn about the first step of protein synthesis, transcription, to learn how vaccines can produce disease-specific antibody proteins. (35 minutes)

1. Now, tell students they are going to learn how vaccines cause the body to create specific antibody proteins that cause the body to be immune to specific diseases.

2. Using the *Transcription Investigation* capture sheet, have students record their observations of a picture of transcription that is projected for the whole class to see. Record a list of student observations on the board by using Train or Pass It On—in this activity, students call on one another to add observations of the text to the board. If a student is uncertain of what to add, they may "pass it on" to another student.

3. Have student pairs use the class observations to develop questions about the image of transcription.

4. Have students turn one closed-ended question into an open-ended question and vice versa.

5. Have students share one or two questions from their list to make a class list of questions about transcription.

6. Through the process of developing the class list of transcription questions, guide students to identify the two key questions for their research:

   a. What are the steps of transcription?

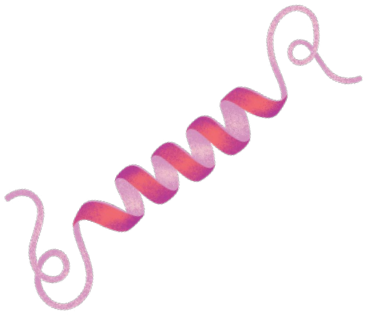
   b. How does the information in DNA get to the ribosomes?

7. Use these two questions to transition students into the research in Part two of the capture sheet.

8. Assign any unfinished work as homework so students can begin to investigate the second part of protein synthesis, translation, during the next class.

Day 3

Slides 15–19



Slides 15–19

Through an inquiry process, students begin to learn about the second step of protein synthesis, translation. (35 minutes)

1	Using the *Translation Investigation* capture sheet, have students record their observations of the picture of translation that is projected for the whole class to see. Record a list of student observations on the board by using Train or Pass It On—in this activity, students call on one another to add observations of the text to the board. If a student is uncertain of what to add, they may "pass it on" to another student.
2	Have students turn one closed-ended question into an open-ended question and vice versa, similar to Day 2's activity.
3	Have students turn one closed-ended question into an open-ended question and vice versa, similar to Day 2's activity.
4	Have students share one or two questions from their list to make a class list of questions about translation.
5	Through the same process of developing the class list of transcription questions, guide students to identify the two key questions for their research in Day 2: • What are the steps of translation? • What code is used to read the information in DNA to make proteins?
6	Use these two questions to transition into the research in Part 3 of the capture sheet.
7	When ready, review the *Tying It All Together* capture sheet questions with students in order to connect protein synthesis to infectious diseases and vaccines.
8	Use the final two questions in the *Tying It All Together* capture sheet to transition to the second part of the 3-2-1 bridge thinking routine about vaccines, described below.

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Day 3

Continued

Slides 20–21

Slides 20–21

Students complete the 3-2-1 bridge thinking routine about vaccines. (10 minutes)

1 Have students complete the second part of the 3-2-1 bridge thinking protocol using the following prompts:

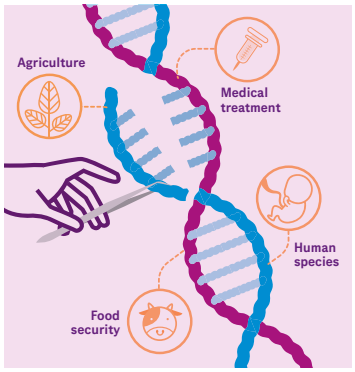
c. Tell students: what you learned about vaccines, write new responses:

- What are three new thoughts or ideas you have about vaccines?
- What are two new questions you have about vaccines?
- What is a new metaphor or simile you can make about vaccines?
- Now, create your bridge between your first response and today's response. Explain how your new responses connect to your initial response.

2 Have a few students share how their thoughts changed around their responses to vaccines in the 3-2-1 activity.

Day 4

Slides 22–28



Slides 22–28

Students learn about current treatments for diseases and look into future treatments using CRISPR. (20 minutes)

1	Tell students that they have already looked at one current preventative treatment for diseases with vaccines. Today they will look at current and future treatments for infectious diseases.
2	Have students look through the *Current Treatments for Infectious Disease* chart and have them answer the questions: • What was confirmed for you after reading through the document? • What may be challenging as we continue to use these medications?
3	Have a few students share their responses. Take the opportunity to point out issues related to the overuse of medications, and because of quick mutation rates, the ability for infections to become drug resistan.
4	Explain to students that there are new and innovative possibilities to treat many types of diseases with gene therapy through the use of CRISPR technology.
5	Ask students if they have heard about CRISPR and uncover any background knowledge they may have about CRISPR.
6	Have students watch this introductory video: *CRISPR Explained*.
7	Ask students to create an analogy for what CRISPR does for gene editing. This is a way to help them use what they know to understand something new (ie: CRISPR is to gene editing as Spell Check is to a Word Document). Have a few students explain their analogies.
8	Now, post the following quotes from a scientific article from the US National Library of Medicine, National Institute of Health. Students will try to encapsulate each quoted section using six word summaries. This will help to synthesize heavy content into an easy to understand synopsis.

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Day 4

Continued

Slides 22–29

9	Quote One—"Derived from an ancient microbial defense system, these so-called 'molecular scissors' enable precise gene editing with a low error rate. However, CRISPR systems can also be targeted against pathogenic DNA or RNA sequences. This potential is being combined with innovative delivery systems to develop new therapeutic approaches to infectious diseases."
10	Tell students: Looking at this first quote, use six words or less to describe the main idea of this section.
11	Quote Two—"CRISPR-based systems can be used to target viral genomes inside the host cell, rendering them incapable for transcription and replication. Thus, CRISPR gene editing offers the potential of a cure for these challenging chronic infections."
12	Ask students: How can CRISPR be used to treat chronic viral infections? Use six words or less.
13	Quote Three—"Although CRISPR systems evolved in bacteria, they can also be used to create anti-bacterial therapeutics that can be delivered through the cell wall using bacteriophages, which are viruses that infect bacteria. Unlike antibiotics, engineered bacteriophages should hypothetically have an extremely narrow spectrum of action, killing the bacteria of interest while sparing non-pathogenic commensal bacteria."
14	Ask students: How can CRISPR be used to treat bacterial infections? Use six words or less.
15	Reflect with students around the purpose of six word summaries.

Slides 29

Students predict what treatments could be used for eradicating their disease. (5 minutes)

1	Have groups summarize the various treatments available to use to fight diseases.
2	From their discussion, have students predict what treatments may work to help eliminate their disease specifically. Students should be able to justify why they believe it may work.

Teacher Note > *Let students know that they are getting their thinking out, and scientists often predict things that are wrong.*

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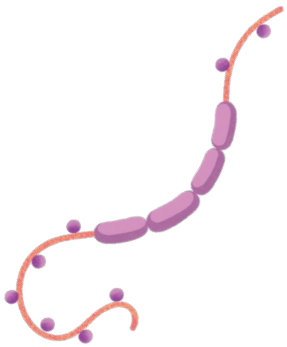
Day 4

Continued

Slide 30



Slides 30

Students research specific treatments used for people infected by their disease. (20 minutes)

1 Students will see if their predictions match with the latest research of treatments specific to their disease.

2 Pass out the *Treatments to Fight Disease Research* capture sheet to students.

3 Using the following links, have students discover what the latest treatments are for their disease, focusing on:

- What preventative measures can people do to stop themselves from becoming infected?
- What is the treatment called?
- What forms of the treatment are available?
- How long does the treatment take to work effectively in fighting the disease?
- Are there any potential issues with getting the treatment (side effects, availability, etc.)?
- How does the treatment work to stop the disease from spreading?
- Are there any possible new treatments in trials or being tested?

WHO	CDC
Rabies	*Rabies*
HIV/AIDS	*HIV/AIDS*
Influenza	*Influenza*
Cholera	*Cholera*
Tuberculosis	*Tuberculosis*
Malaria	*Malaria*
Dengue	*Dengue*
Zika	*Zika*

Continues next page >

Day 4

Continued

Slide 30–31

As students are researching, take note of collaboration and communication within each group. Listen for any misconceptions or questions that arise as students are researching. Address these misconceptions right away.

4 At the end of the research, have each student write what treatment they feel would work best for their specific community.

Slides 31

Students create a list of ideas for how the disease can be eradicated in their community. (15 minutes)

Students should:

- Describe the treatments they feel will help their community the most.
- Discuss equity and access of distribution (video from COVID).
- Discuss how to best communicate treatments and distribution in the community outreach campaign.

Day 5

Slide 32–33

Slides 32–33

Students further develop their **Disease Education Report**. (45 minutes)

1	Ask students to review the **Disease Education Report** and guess which section they can now fill in based on the information they have learned in this lesson.
2	Use student responses to make sure they know to complete the following section: • **Disease Treatment Recommendation**
3	To write their disease treatment recommendation, tell students they will need to explain: • Which type of vaccine is best suited for your specific disease? • How does this vaccine create disease-specific antibody proteins to fight the disease that impacts your community? • How was the vaccine tested and why is it safe to use? • Beside vaccines, what other treatments do you recommend? How will these treatments help?
4	Students should utilize vocabulary-rich writing in their report. To help them identify the language and terminology, have students individually write down all of the words they have been learning about on a piece of paper.
5	Next, students should identify the words they will incorporate as they respond to the questions and provide information in the **Disease Treatment** section of the **Disease Education Report**.

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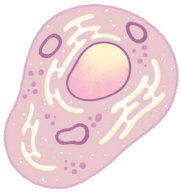
Day 5

Continued

Slide 32–33



6 As students share, circle the words they will need to use. Refer to this list of vocabulary words to make sure they are identified:

Types of Treatment Vocabulary	Transcription Vocabulary	Translation Vocabulary
Vaccines	Transcription	Transcription
Defense Proteins	Nucleotides (Thymine, Adenine, Cytosine, Guanine, Uracil)	Translation
mRNA	RNA Polymerase	Nucleotides (Thymine, Adenine, Cytosine, Guanine, Uracil)
Antibodies	DNA	Ribosome
Immune System	Promoter	RNA Polymerase
Antigens	Coding / Encode	DNA
Gene Therapy	Termination Sequence	Messenger RNA (mRNA)
CRISPR	Messenger RNA (mRNA)	Amino Acid
	Ribosome	Codon

7 Tell students they will need to include these vocabulary words in their writing.

8 Tell students to refer to their answers in the *Tying It All Together* capture sheet to help with this writing.

9 Finally, have students select two of the elements below to help communicate information when they write this section of the report:

- Charts & graphs
- Infographics
- Pictures & diagrams
- Glossary of terms

When ready, let students use the rest of class to finish the sections detailed above.

Day 6

Slides 34–37

Slides 34–35

Students review the different posts they can create for their community outreach campaign. (5 minutes)

1. Using the knowledge they have built in previous lessons, students begin to develop a way to communicate specific treatments.
2. Provide time for students to revisit the **Community Communication Toolkit**.
3. Have students switch their group roles and update it on the group copy of the **Community Communication Toolkit**. Provide time for students to review their new roles.
4. Remind students that they should reference **Our Group Collaborative Contract** and the **Common Group Challenges While Working on a Collaborative Project** as they work in their groups.

Slides 36–37

Students are assigned roles and work in a group to create their post. (40 minutes)

1. Now that students have reviewed their job roles, groups will work on their fourth post. The group manager facilitates this section. Walk around the room to provide support to groups.
2. Encourage students to think about what they've learned about infectious diseases and community communication. Remind groups of the feedback they received in the previous posts to improve their work. They may want to revisit their previous posts. Each post should build off of each other.
3. Each group manager should address his or her group:
   - **a.** Our focus for this post is, as a group, to communicate specific treatments for our infectious disease.
   - **b.** Let's review the different social media posts or communication in the group copy of the **Community Communication Toolkit**.
   - **c.** As a group, we will determine the format for our next post.

Continues next page >

Day 6

Continued

Slides 36–37

d. As we develop our community communication or posts, we need to keep in mind our community and target audience. We can refer back to our **Community Outreach Campaign Community Identification** capture sheet from Lesson 1.

e. We will use the information from our **Disease Education Report** to help us create our community education.

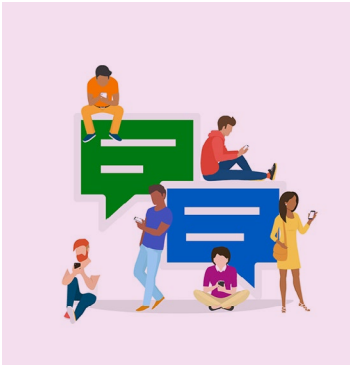
f. We will have (insert amount of minutes) to work on our sections of the posts. Our posts should go on slide (insert slide number) of the class copy of the **Disease Education Communication Posts**.

- group members work on their sections of the community communication on the class copy of the **Disease Education Community Post**.

4 Students' fourth post should be completed on the class copy of the **Disease Education Communication Posts** for the Gallery Walk in the next lesson.

Day 7

Slides 38–40



Slides 38–40

Gallery Walk Feedback of Community Communication (45 minutes)

Teacher Note > *Students will once again participate in a gallery walk. In this gallery walk, students will be using the Six Thinking Hats protocol to provide feedback,*

1 **Prepare in Advance** to display posts on the wall: copies of posts, chart paper (three sections labeled: Reactions, Feedback, Likes), markers, 6 Thinking Hats protocol (project, post, print cards, or make copies for student reference).

A gallery walk is a critique protocol where students get and give feedback to their peers to improve their work. Prior to the gallery walk, students should understand how to give and receive feedback. You may want to model this process through role-plays, providing sentence starters, or building in additional learning experiences to reinforce a positive culture.

2 Students should display the content they created. These posts communication can be taped to the wall or displayed on a computer screen.

3 Students will be participating in a gallery walk to view student-created content. Let students know they will be posting and giving feedback as if they were commenting on social media.

a. Tell students, they can provide reaction to posts for the information presented and can "like" a group's post.

b. Tell students they will be using the *Six Thinking Hats* protocol. This protocol is useful for tuning ideas and planning next steps because it allows a group to use several different lenses as they consider giving feedback.

c. In their groups, have each student select different-colored thinking hat. Tell students that the hat is the lens through which they will provide feedback to a group's community communication.

- Remind students of the three rules when giving feedback: Be kind, be specific, and be helpful.

4 With students' help, tape the posts to the walls.

- Provide time for groups to visit other groups' posts.
- On the chart paper, students can write feedback, provide reactions, and "like" a group's post by drawing a heart.

Continues next page >

Day 7

Continued

Slides 38–40

5	For posts displayed on a computer screen: • Groups can access the **Disease Education Community Posts** presentation. • Students can give feedback in the notes section of the slide. • Using the infinite heart, drag and they can drop a heart on the slide to "like" a post. • Students can provide reactions to a group's post.
6	In their groups, students should review and discuss the feedback from their peers.
7	Students have a choice in how they use the feedback. Groups may revise their posts using the feedback they received.
8	Exit ticket: On a sticky note, have students reflect on the *Six Thinking Hats* protocol. Which hat really pushed your thinking when providing feedback to a group's post? Why?

National Standards

Next Generation Science Standards

Science and Engineering Practices (SEP)

Practice 6
Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Practice 1
Asking Questions and Defining Problems

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Disciplinary Core Ideas (DCI)

LS1.A
Structure and Function

Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells

ETS1.C
Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Crosscutting Concepts (CC)

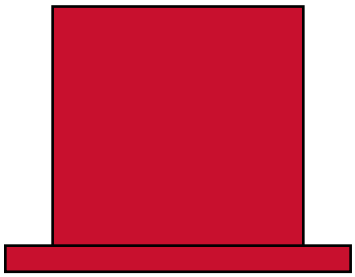
Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Educator Resources

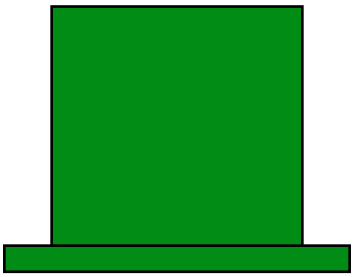
Six Thinking Hats Protocol

This protocol is useful for tuning ideas and planning next steps because it allows a group to use several different lenses as they consider the matter at hand.



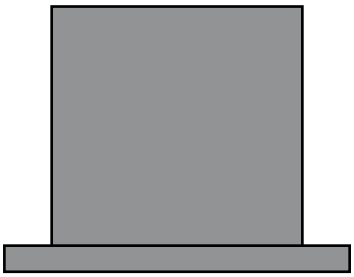
WOW | Feelings

The red hat signifies feelings and hunches. When using this hat you can express emotions and feelings. You should consider how the ideas will make others feel.



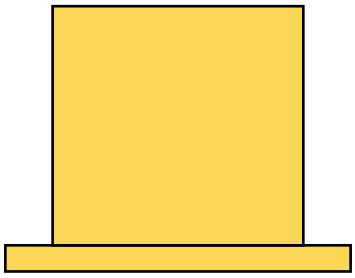
NEW | Creative

The green hat represents creativity. Consider all the alternative solutions and different approaches, including ones that seem tangential.



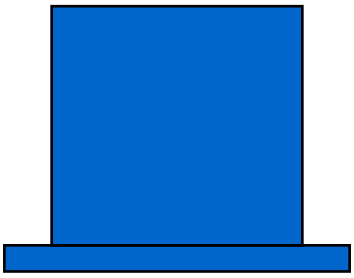
NO | Critical

The black hat is for identifying all the possible pitfalls of the idea. Look for the places that it could fail or be ineffective.



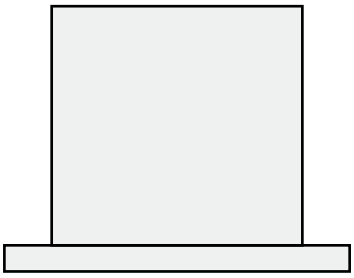
YES | Benefits

The yellow hat is about optimism. If this idea is widely successful, what will happen?



THINK | Reflective

The blue had is to identify where thinking can be expanded or revisited.



FACTS | Information

The white hat is to identify what additional information and research.

Educator Resources

Traditional Vaccines vs. mRNA Vaccines

HHS Article
Types of Vaccines

CDC Article
How Vaccines Work

Harvard Article
How traditional vaccines work and why mRNA vaccines are so exciting

Vaccine Infographic
Vaccine Development and Clearance Process

Johns Hopkins Video
How do mRNA Vaccines Work?

Harvard Video
How mRNA vaccines work

Yale School of Medicine Video
COVID-19 Vaccine an Illustrated Summary of Development

Yale School of Medicine Video
How vaccines work

Yale School of Medicine Video
How mRNA Vaccines Work

Educator Resources

Transcription Investigation, Part 3

Article
Steps of Transcription

Audio
Transcription Described

Video
Narrated Transcription Description
(w/ subtitles)

Video
Transcription Explained (basic)

Video
Transcription Explained (advanced)

Video
Triplet Code

Educator Resources

Translation Investigation, Part 3

Article
Steps of Translation

Article
About Translation

Image
Codon Table

Audio
Translation Described

Video
Translation Explained (basic)

Video
Translation Explained (advanced)

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Traditional Vaccines vs. mRNA Vaccines, Part 1

Types of Vaccine Notes

Directions

Use the articles and videos in the Online Resources to take notes about the different types of vaccines. Collect the following information about each vaccine type:

- *What are different types of vaccines and what diseases do they treat?*
- *How is the vaccine developed?*
- *How does the vaccine create an immune response in the body?*
- *How are vaccines tested to know they are safe to use?*

Online Resources

Traditional Vaccine Notes	mRNA Vaccine Notes

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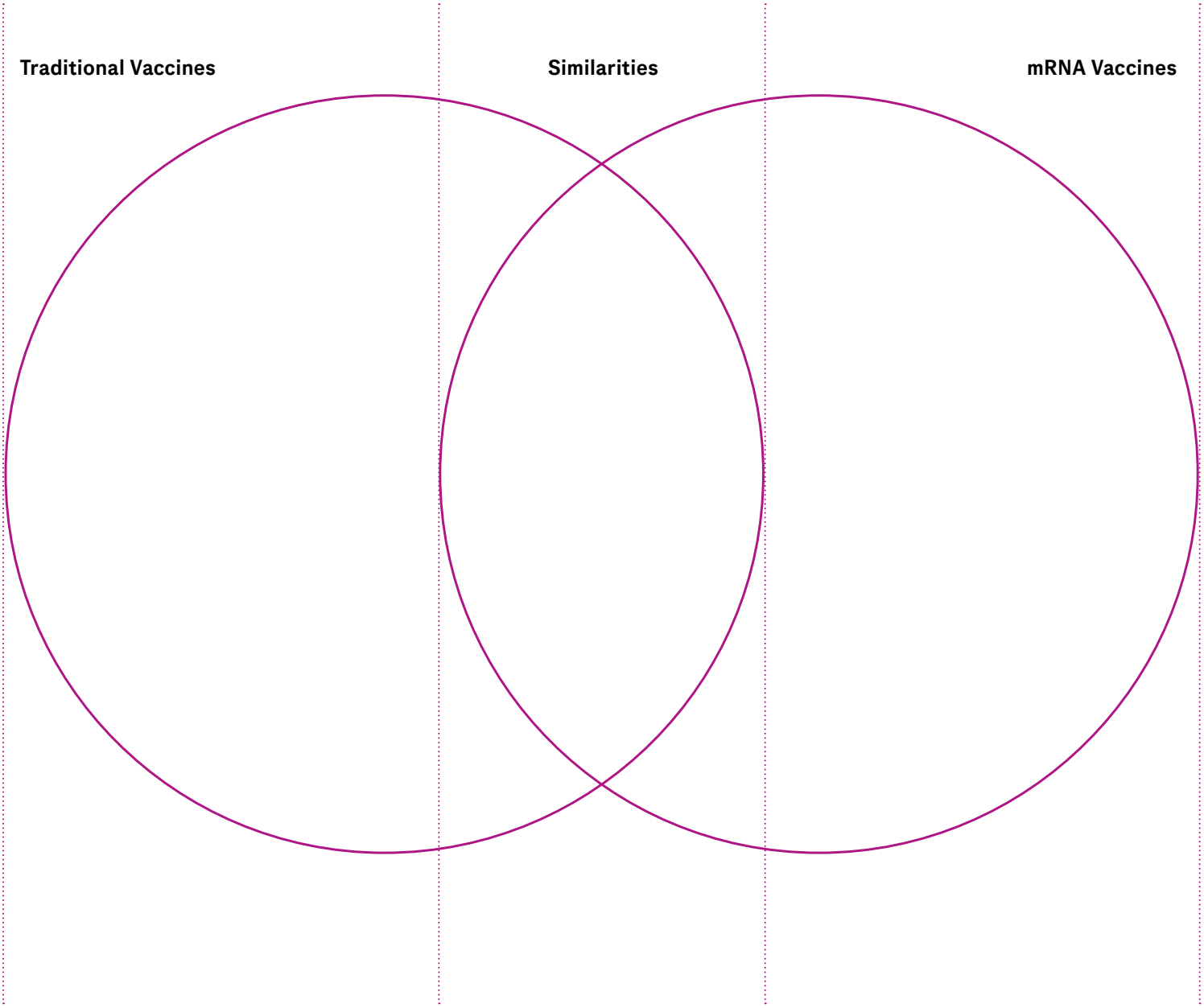
Traditional Vaccines vs. mRNA Vaccines, Part 2

Venn Diagram Compare and Contrast

Directions

Use your notes to compare and contrast traditional vaccines and mRNA vaccines in the Venn diagram.



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DNA, Genes, and Proteins, Part 1

Directions
In your group, share the information you learn while you watch the videos and make connections by answering the questions below.

What are Proteins

DNA and Genes

1. What are the parts of DNA and how are they structured?

2. How are genes connected to proteins?

Continues next page >

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DNA, Genes, and Proteins, Part 2

Directions
Open the resource Learn Genetics: Types of Protein?

Learn Genetics: Types of Protein?

1. What do you see, think, and wonder as you explore the types of proteins?

	See What do you see in the video and images?	**Think** What do you think about the content?	**Wonder** What questions do you have?
A			
B			
C			
D			

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DNA, Genes, and Proteins, Part 2

Continued

2. What types of proteins help the body fight disease?

3. Based on the video, how are antibodies like pieces of a puzzle when they help the body fight different types of diseases?

4. Think about what you know now about the immune system and antibodies. Why do you think COVID-19 infected so many people?

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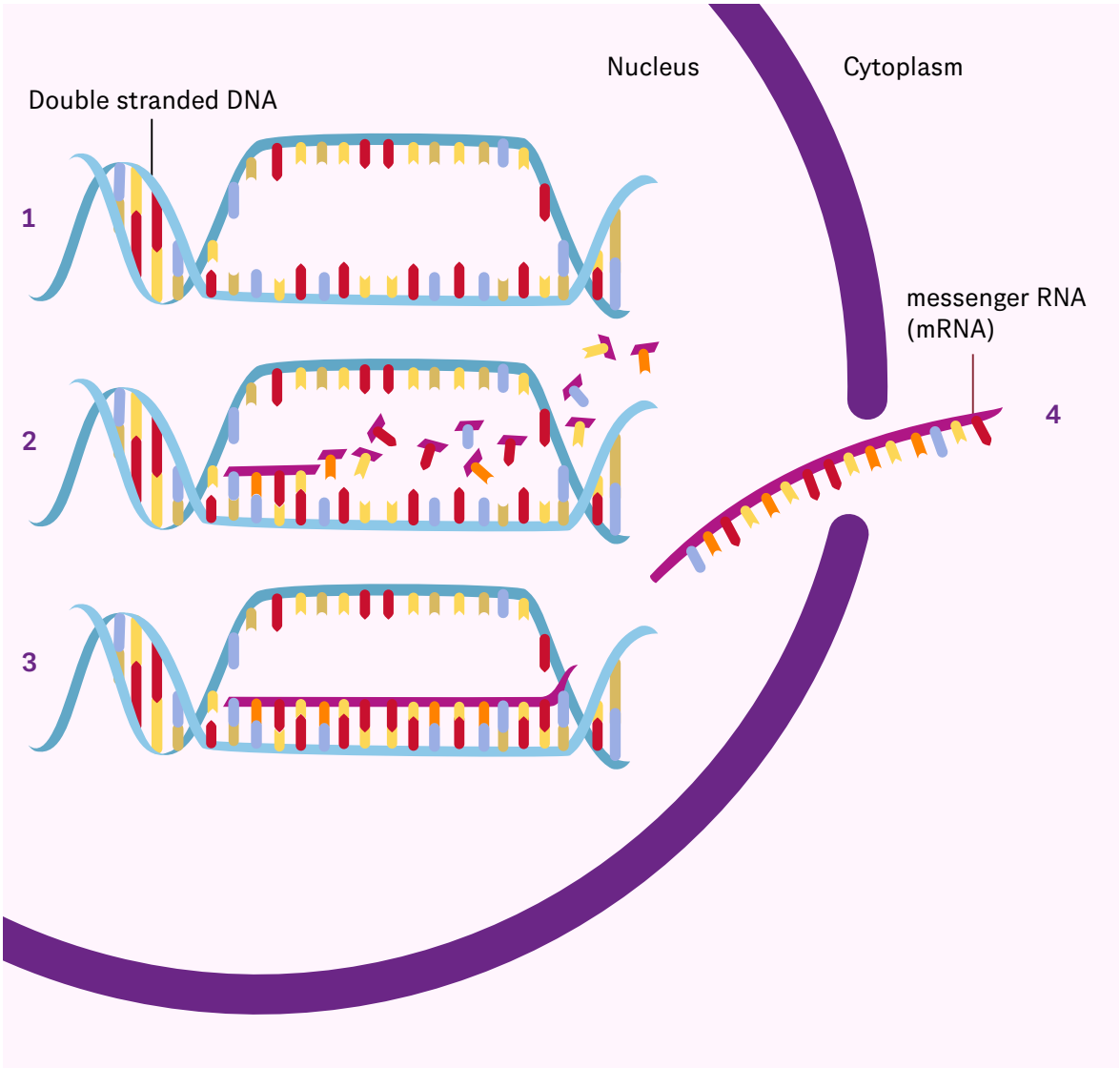
Transcription Investigation, Part 1

My Transcription Observations

Directions

Write down your observations of this diagram depicting transcription.

DNA Transcription



1. DNA is separated into two strands of the DNA helix.
2. RNA polymerase adds RNA nucleotides.
3. New synthesized RNA strand is formed.
4. The RNA exits to the cytoplasm through the nuclear pore.

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Transcription Investigation, Part 1

My Transcription Observations

Continued

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

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Transcription Investigation, Part 2

My Transcription Questions

Directions

a. *Write down as many questions about the picture as you can. How many questions can you come up with?*

b. *Identify which questions are open-ended and which are closed-ended.*

c. *Turn one closed-ended question into an open-ended question and vice versa.*

d. *Select three questions to share aloud to create the Class Transcription Questions list.*

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

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Transcription Investigation, Part 3

My Transcription Research

Directions

Describe the steps of transcription in detail using the resources to help.

Transcription Resources

Step	Name	Description
1		
2		
3		

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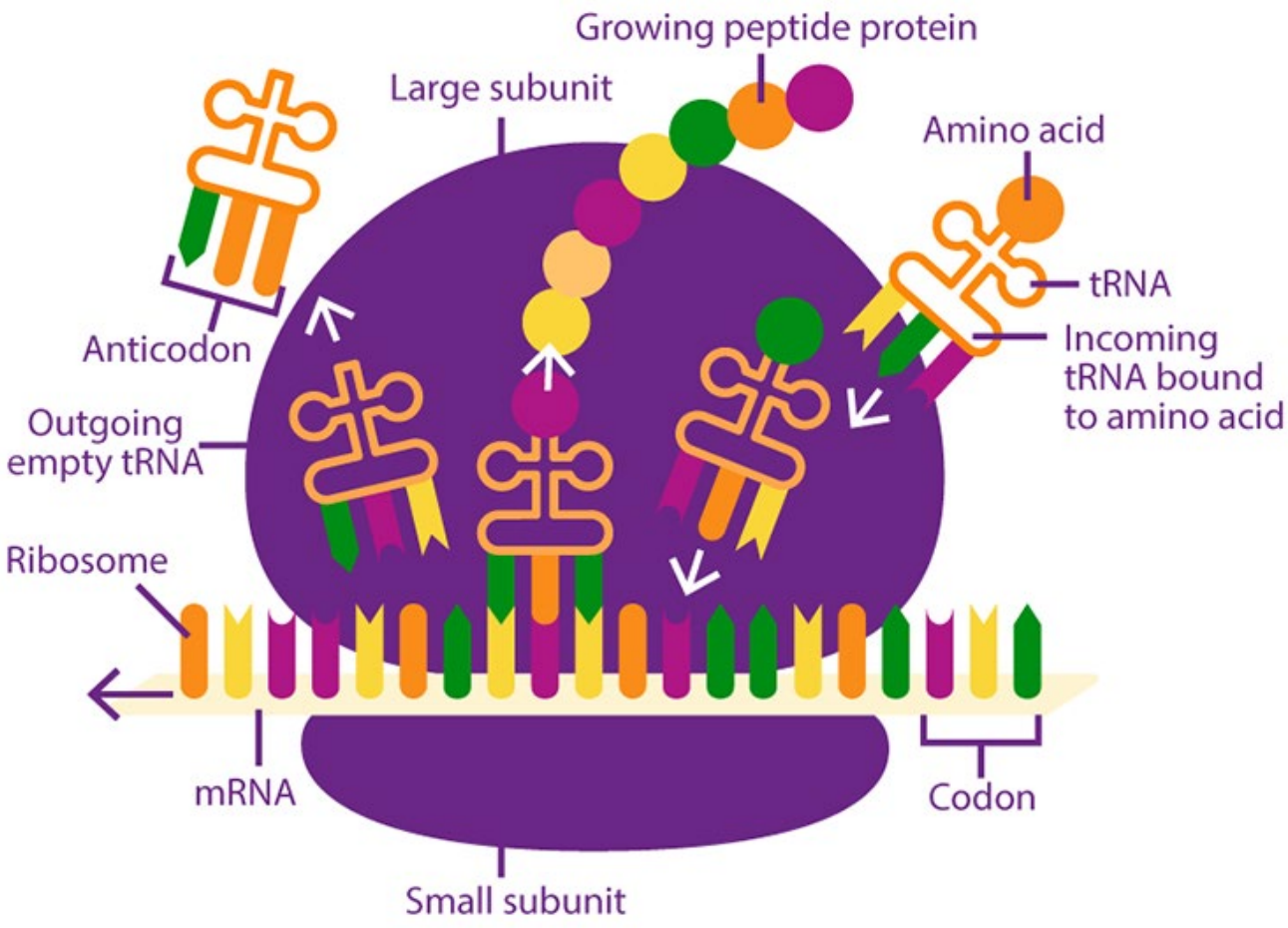
Translation Investigation, Part 1

My Translation Observations

Directions

Write down your observations of this diagram depicting translation.

Peptide Synthesis



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Translation Investigation, Part 1

My Translation Observations

Continued

1.

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10.

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Translation Investigation, Part 2

My Translation Questions

Directions

a. *Write down as many questions about the picture as you can. How many questions can you come up with?*

b. *Identify which questions are open-ended and which are closed-ended.*

c. *Turn one closed-ended question into an open-ended question and vice versa.*

d. *Select three questions to share aloud to create the Class Translation Questions list.*

1.

2.

3.

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10.

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Translation Investigation, Part 3

My Translation Research

Directions

Describe the steps of translation in detail using the resources to help.

Translation Resources

Step	Name	Description
1		
2		
3		

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Tying It All Together

Protein Synthesis and Fighting Disease

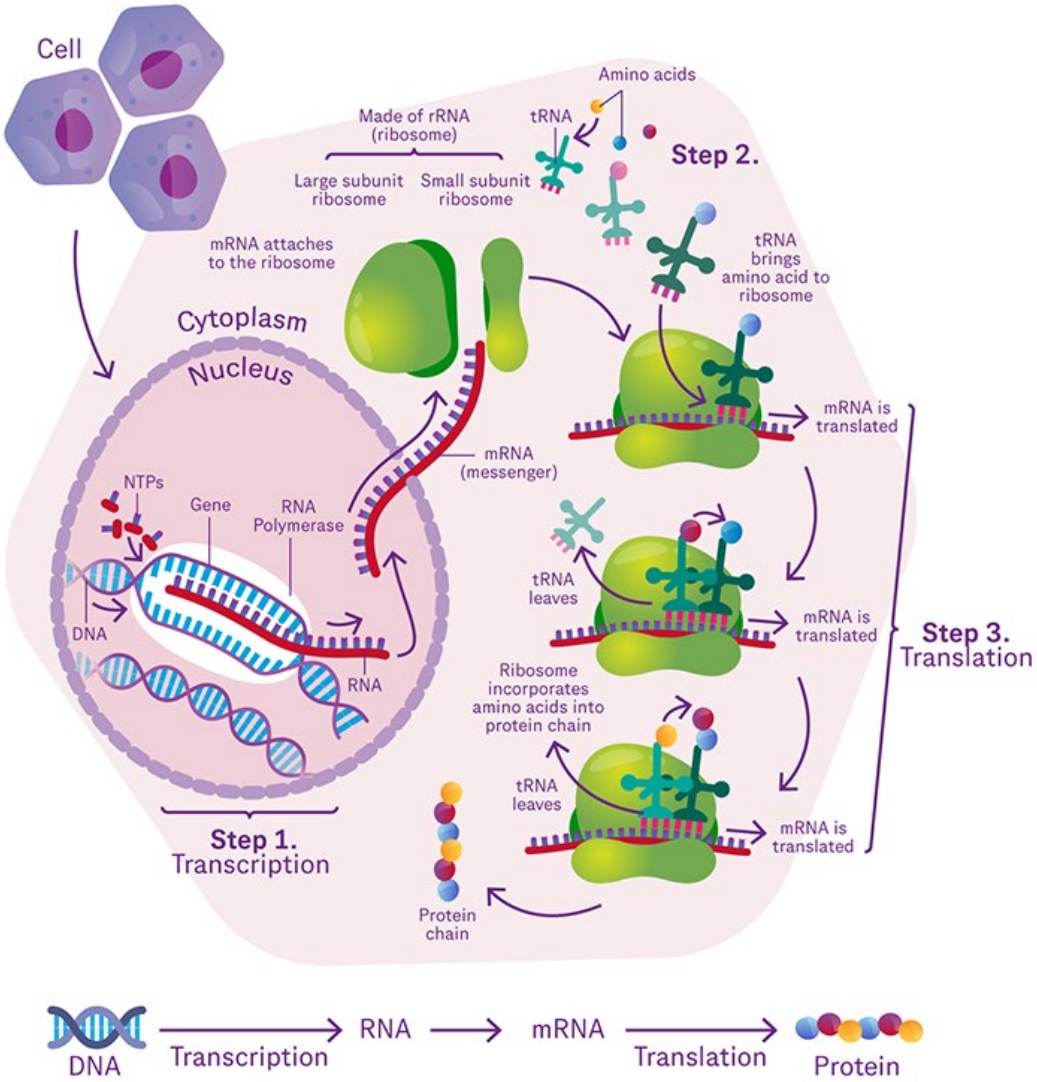
Directions

Using the resources provided, apply what you have learned about antibody proteins and protein synthesis to answer the questions on the next page.

Transcribe and Translate a Gene

DNA to RNA to Protein

Protein Synthesis



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Put It All Together

Protein Synthesis and Fighting Disease

Continued

Question	Answer
People say that our DNA contains our "genetic code." Now that you learned about protein synthesis, what is the genetic code? What is the information in the code used for?	
Our DNA is contained in the nucleus of every cell in our body where it stays protected. DNA never leaves the nucleus of our cells. However, ribosomes, where proteins are made, are located outside of the nucleus. How is the information in DNA to make proteins able to reach the ribosomes outside of the nucleus?	
How does the body respond when an infectious disease-causing agent invades the body?	
Consider the mRNA vaccines that were used to fight COVID-19 and what you know now about mRNA from learning about protein synthesis. How do you think the mRNA vaccine for COVID-19 worked to help fight the disease?	

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Current Treatments for Infectious Disease

Drug Types	How it Works	Examples
Antiviral	Inhibits virus' ability to reproduce or it strengthens the person's immune response More narrow in scope, specific antivirals work for certain class of viruses	Oseltamivir— flu Abacavir—HIV Zanamivir
Antibiotic	Fights bacteria by either killing it or stopping it from reproducing, allowing body's immune system to eliminate disease Broad scope, one antibacterial medicine can fight several different types of bacteria	Penicillin Amoxicillin Azithromycin
Antiparasitic	Eliminates parasite by either killing it, or inhibiting its growth Medicine is specific to work for a particular class of parasite	Nitazoxanide Mebendazole Pyrantel

Prevention and Treatment—What You Need to Know About Infectious Disease—NCBI Bookshelf Cell

What You Should Know about Flu Antiviral Drugs

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Treatments to Fight Disease Research

Directions

Using the World Health Organization (WHO) and the Center for Disease Control (CDC) websites, discover what the latest treatments are for your selected disease. Respond to the guiding questions and note where you found the information in the chart below.

Guiding Questions

- What preventative measures can people do to stop themselves from becoming infected?
- What type of treatments are available? Is there a preventative treatment?
- What is the treatment called?
- What forms of the treatment are available?
- How long does the treatment take to work effectively in combating or preventing the disease?
- Are there any potential issues with getting the treatment (side effects, availability, etc.)?
- How does the treatment work to stop the disease from spreading?
- Are there any possible new treatments in trials or being tested?

What treatments are available to treat your disease?

Sources