# DNA Structure

## SCIENCE NSPIRED



## Science Objectives

Students will

- Learn about the structure of DNA, including base pairing.
- Be able to predict paired sequences of DNA.
- Understand how the structure of DNA affects its function.

## Vocabulary

- nucleotide
- phosphate backbone
- adenine
- cytosine
- ribose
- base pair
- double helix
- thymine
- guanine
- deoxyribonucleic acid

## About the Lesson

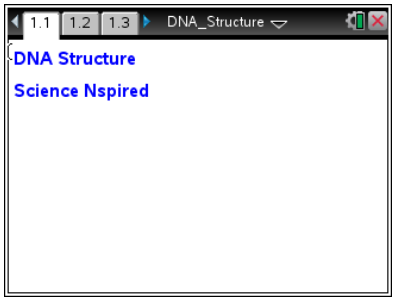
- Using a variety of simulations, students will interact with the structure of DNA to explore the building blocks and double helical structure of DNA. Assessments are embedded in the activity to engage discussion and gauge learning.
- As a result, students will:
  - Learn to recognize the general structure of DNA and its nucleotides: a nitrogen base, a deoxyribose sugar, and a phosphate.
  - Learn to apply Chargaff's rules for base pairing, including predicting the sequence of paired DNA strands.

## TI-Nspire™ Navigator™

- Send out the *DNA_Structure*.tns file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

## Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software




**Tech Tips:**

- This activity includes class captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologiesbesides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

**Lesson Files:**

*Student Activity*

- DNA_Structure_Student.doc
- DNA_Structure_Student.pdf

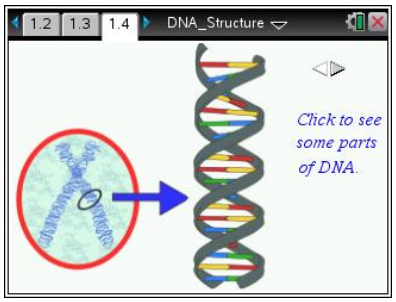
*TI-Nspire document*

- DNA_Structure.tns

## Discussion Points and Possible Answers

Have students read the background information on the student activity sheet.

**Part 1: Introduction**




**Move to pages 1.2 – 1.4.**

1. Students should read the background information on pages 1.2 and 1.3, and then look at the figure on page 1.4. Following those pages, there are several questions that assess the students' general knowledge of DNA structure.

**Move to pages 1.5 – 1.6.**

Have students answer questions 1 – 2 on the device, the activity sheet, or both.

Q1. How many separate strands of DNA are in the double helix?

**Answer:** C. 2

Q2. The phosphate backbone is covalently bonded to a _____ .

**Answer:** A. nucleotide base

Each single strand of DNA is a single molecule, and the pair of DNA strands are held together by hydrogen bonds, as you'll see later.

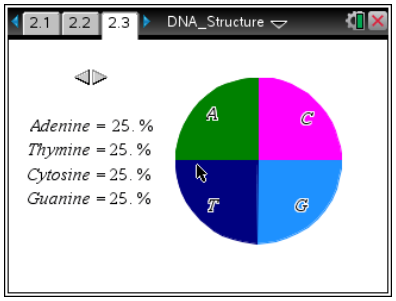
**Part 2: Chargaff's Rules**

**Move to pages 2.1 – 2.2.**

2. Students will get a brief introduction to Chargaff's rules as they read these pages. Before the structure of DNA was determined to be a double helix, Chargaff's rules indicated that A pairs with T, and G pairs with C. Students will learn about this from the text and the simulation.

**Move to page 2.3.**

3. Have students change the relative quantities of each base in a hypothetical DNA sample to see how it affects the other three nucleotides. They should try several different combinations before moving on the questions.




**Tech Tip:** Select the arrows to change the values of the chart.

**Move to pages 2.4 – 2.6.**

Have students answer questions 3 – 5 on the device, the activity sheet, or both.

Q3. Based on Chargaff's rules, which are the correct base pairs? (Select all that apply).

**Answer:** A. Adenine and Thymine and C. Cytosine and Guanine

Q4. If a DNA molecule is 29% Guanine, what percent will be Thymine?

**Answer:** A. 21%; 29% G will require 29% C, for a total of 58%. The remaining 42% will be half T and half A, 21% each.

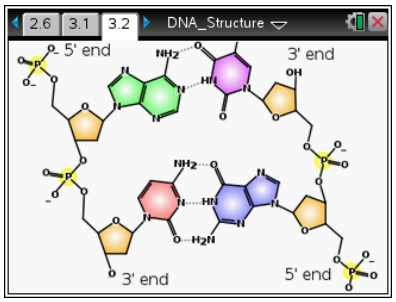
Q5. Are there limits to the amount of any base pair in DNA? For example, can you have DNA that is 52% A? Explain.

**Suggested Answer:** Yes, there are limits to the relative amounts of each base pair. A percentage equal to 52% of any nucleotide is not possible because each base requires a pair to satisfy Chargaff's rules.

**Part 3: DNA Structure**

**Move to pages 3.1 – 3.2.**

4. Students will receive a brief introduction to the next simulation on page 3.2. Have students read the directions in the pop-up box. They can select ☒ to close the directions and view the simulation.



**Tech Tip:** Press menu if you need to view the directions again.

**Tech Tip:** Select **Tools > Directions** to view the directions again.

This interactive page will allow students to select different parts of the molecular structure of DNA to learn about each component. Students should explore this simulation thoroughly before moving on to answer the questions on the following pages.

**Move to pages 3.3 – 3.5.**

Have students answer questions 6 – 8 on the device, the activity sheet, or both.

Q6. Does DNA have an overall charge? Explain.

**Suggested Answer**: Yes, DNA has a negative charge which comes from the phosphates in the backbone. The longer the DNA strand, the greater the total charge.

Q7. Which structure(s) is/are found in the backbone of DNA? (Select all that apply).

**Answer**: A. Deoxyibose, D. Phosphates

**Teacher Tip:** This question is a bit tricky. Have students try to visualize the structures that give the DNA ladder length, in contrast to the rungs, which are the bases.

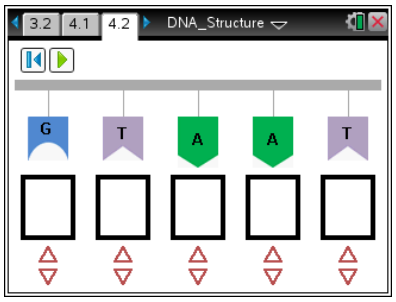
Q8. Is the base pair A-T bound more tightly than the base pair G-C? Explain.

**Suggested Answer**: No. G-C pairs have three hydrogen bonds which are stronger than the two hydrogen bonds of A-T base pairs.

**Part 4: Base Pairing**

**Move to page 4.1 – 4.2.**

5. Students will get instructions for the final simulation. This demonstration helps to check their base pair rules as they match a DNA sequence. On page 4.2, students should use the up and down arrows to select a nucleotide, and the play button to check their answer. Finally, they can use the reset button on the slide to create a new sequence to match.



**TI-Nspire™ Navigator™ Opportunities**

This would be a good activity to use the Class Capture and Presenter tools to have students work together on the same sequence, as sequences will be randomly generated.

**Move to pages 4.3 – 4.4.**

Have students answer questions 9 – 10 on the device, the activity sheet, or both.

Q9. Both strands have the same sequence of DNA.

**Answer**: False

Q10. One strand of DNA can be used to solve the sequence of its pair.

**Answer**: True

**TI-Nspire™ Navigator™ Opportunities**

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

## 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.