

ACTIVITY SHEET

Physical Properties Effecting DNA Denaturation

A 20 Minute Lesson for Undergraduate Biology Students



What Physical Properties of DNA Impact How it Denatures?

READ

DNA denaturation is the reversible process of splitting the hydrogen bonds between the base pairs of a DNA molecule, turning it from a double strand to a single strand (Chen, 2023). DNA denaturation is observed using spectroscopy, where the ultraviolet absorption at 260 nm is measured to track the progress of denaturation (Blanco & Blanco, 2022). The process of DNA denaturation starts with normal double-stranded DNA, which absorbs less UV light than the last step in the process: DNA that has been split into single strands (Blanco & Blanco, 2022). Using the spectroscopy data, a denaturation curve can be made to look at the UV absorption and determine the melting point. The melting point is at the midpoint of the denaturation curve; it pinpoints the moment that approximately half of the DNA is double-stranded, and half is single-stranded (Blanco & Blanco, 2022). The melting point of DNA can be affected by the physical properties of each section of individual DNA being denatured (Blanco & Blanco, 2022). The more hydrogen bonds that have to be broken in order to split the double helix DNA into single strands, the higher the melting point (Blanco & Blanco, 2022). So why is knowing the melting point of a section of DNA important? Knowing the temperature at which a section of DNA denatures and when the DNA section is completely denatured is important for a process called a Polymerase Chain Reaction (PCR) (Khehra, 2025). PCR is used in biomolecular research and to identify viral infections, making it an essential tool in science and medicine (Khehra et al., 2025).

PREDICT

Now, knowing that the number of hydrogen bonds needing to be broken in a section of DNA affects the melting point, predict the following:

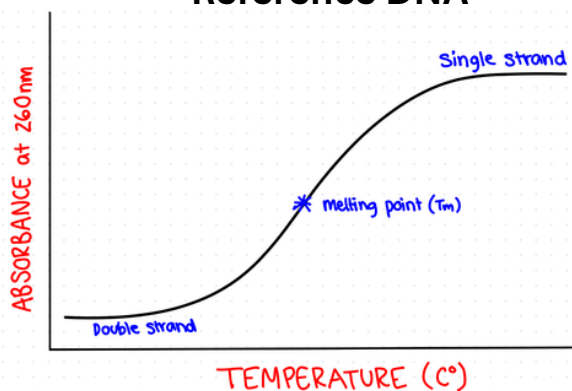
1. Will a section of DNA with a high amount of Guanine and Cytosine base pairs have a higher or lower melting point than a section of DNA of the same length with a higher amount of Thymine and Adenine base pairs? (Hint: focus on how many hydrogen bonds are between the nitrogenous bases)
2. One section of DNA, "Section A," is two times longer than another section of DNA, "Section B". Which one will have the lower melting point? Remember to focus on the hydrogen bonds that hold the DNA double helix together.

EVIDENCE

Examine the DNA denaturation curves on the next page and answer the questions for each graph. Then review your predictions: were they accurate or inaccurate?

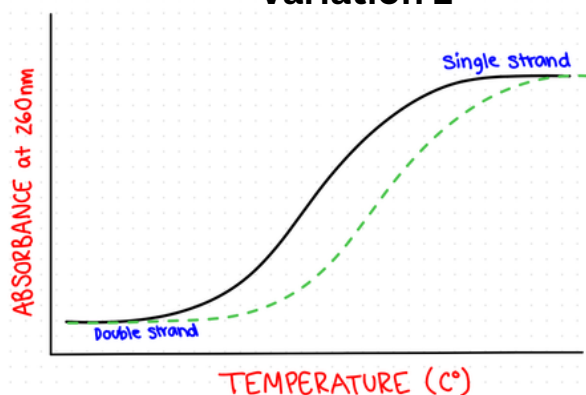
ACTIVITY SHEET

Reference DNA



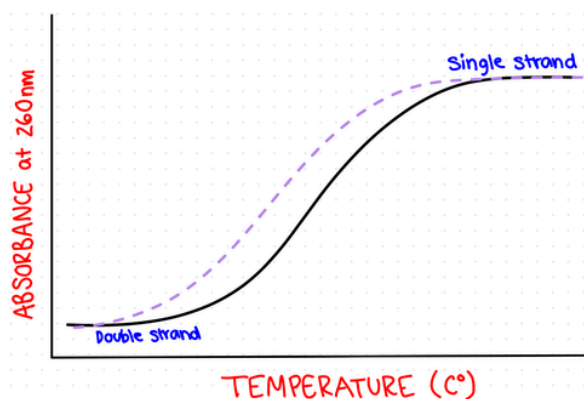
Reference denaturation curve: An average-sized piece of DNA with equal amounts of Guanine-Cytosine to Adenine-Thymine base pairs.

Variation 1



The dashed line corresponds to a denaturation curve for DNA with a high amount of Guanine and Cytosine base pairs compared to the reference DNA.

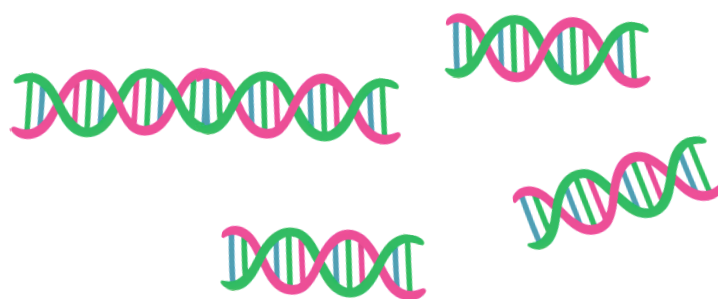
Variation 2



The dashed line corresponds to a denaturation curve for a section of DNA that is really short compared to the reference DNA.

QUESTIONS

1. Mark where you would expect the approximate melting point to be on the variation 1 and 2 curves.
2. Beside each variation curve, write whether the melting temperature would be **higher** or **lower** than the reference DNA curve.



DISCUSS & EXPLAIN

- With your class, discuss and explain how the curves above showed you which physical properties of DNA impacted how it denatures.
- Discuss why these physical properties impact the melting point of each section of DNA.
- Brainstorm what other properties of DNA might affect how it is denatured.

TEACHER GUIDE

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PURPOSE

The purpose of this lesson is to get learners to learn:

1. How to use graphical evidence to make conclusions.
2. How DNA denatures.
3. What physical qualities of DNA will change the melting point of DNA during DNA denaturation, and why it changes.

MATERIALS → A printed learner-facing activity sheet and writing utensils for each learner.

FACILITATION NOTES

Introduce this idea to students before they learn about PCR and after they learn about the structure of DNA, to act as a segue between the topics. This lesson can also be used to help learners practice concluding information from graphs. Before starting, go over the parts of a denaturation curve and how it works. To guide learners through the lesson, place them in small groups and have them complete the activity before gathering them back together and discussing the explanation/discussion topics together.

EXPECTED ANSWERS/RESPONSES

On each of the variation curves, students should have marked the melting point (prompt from question 1) in approximately the middle of the dashed curve, similar to the melting point location on the reference DNA curve.

The variation 1 curve, where the DNA has a higher amount of guanine-cytosine base pairs, is the curve with the higher melting point than the reference curve. The variation 2 curve, where the DNA section is short compared to the reference DNA curve, should be labelled as having a lower melting point than the reference DNA curve.

Students should be able to conclude that the amount of guanine-cytosine base pairs and the length of the DNA section impact the melting point due to the higher number of hydrogen bonds that need to be broken to turn double-helix DNA into single-stranded denatured DNA

SAFETY AND ACCESSIBILITY NOTES

To ensure each student can easily participate in this activity, provide large-print copies of the DNA denaturation curves in the evidence section when needed.

REFERENCES

Shen, C.H. (2023). Chapter 1—Nucleic acids: DNA and RNA. In Diagnostic Molecular Biology (Second Edition) (pp. 1–26). Academic Press. <https://doi.org/10.1016/B978-0-323-91788-9.00005-3>

Blanco, A., & Blanco, G. (2022). Chapter 6—Nucleic acids. In Medical Biochemistry (Second Edition) (pp. 131–152). Academic Press. <https://doi.org/10.1016/B978-0-323-91599-1.00022-5>

Khehra, N., Padda, I. S., & Zubair, M. (2025). Polymerase Chain Reaction (PCR). In StatPearls. StatPearls Publishing. <http://www.ncbi.nlm.nih.gov/books/NBK589663/>

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SDG 4 STATEMENT

This toolkit supports SDG 4: Quality education by supporting scientific literacy. In science, the ability to understand and draw conclusions from data is important. In this toolkit, learners will practice obtaining data from a graph and using it to draw conclusions on the topic of DNA denaturation and melting point. This toolkit allows learners to incorporate the evidence provided in the activity into their reasoning process, promoting understanding instead of memorization.