DNA / RNA card games

A series of activities are suggested, for use as either initial teaching or as reinforcement & revision. Students will understand:

- the principle of hydrogen bonding to make base-pairs to create the structure of DNA,
- how the pairing works to permit replication, transcription & translation,
- that DNA has a double-stranded structure while mRNA is single-stranded, and
- that RNA contains Uracil, not Thymine.

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Printing

You will need 1 set of cards for each student.

There are 4 pages in a full set: 2 pages for DNA & 2 for RNA.

Cut each along the fine lines to make 8 individual cards per page.

Printing all 4 pages on 1 sheet makes mini cards.

Cards are available in **colour** or **B&W** versions. It might be helpful to ask the students to add colour coding if you choose the B&W option. This is especially useful to distinguish between the DNA & RNA sets.

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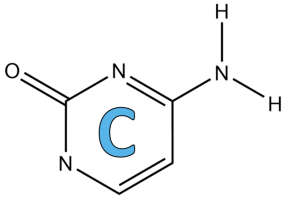
DNA structure part 1

solo activity

Shuffle the DNA cards then set out 8 in a row (2 of each, in any order)

Arrange the corresponding strand by matching the H-bonds to make pairs: A-T & C-G.

Students should ideally work along in the direction of the arrows shown, not at random.



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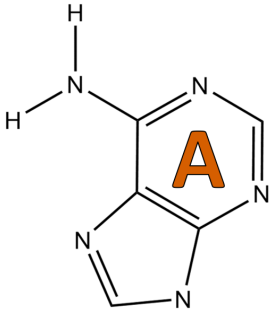
DNA structure part 2

paired activity

Student 1 sets out their DNA cards in any order to make a strand, following the arrows.

Student 2 creates the corresponding strand as quickly as they can, following the arrows.

(If working online, have the camera on the cards and make the corresponding strand separately.)



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Replication

Ideally work as a pair, or use 2 sets of cards

As a pair, make a double DNA strand from 1 set of cards.

Carefully slide the two strands apart.

Using the 2nd set of cards, match the base-pairs to make two separate molecules.

They should be identical!

Add or remove a base- pair from one molecule to illustrate mutations.

Transcription

Ideally work as a pair, or use 2 sets of cards to make long molecules

Make a double strand DNA molecule.

Slide the cards apart to separate the strands.

Starting at one end, using the RNA cards, work in the direction of the arrows, matching the base-pairs.

Slide away the mRNA strand.

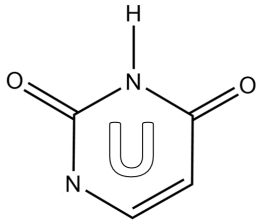
Reclose together the strands of the DNA molecule.

Translation

Ideally as a pair or group

Set out a long mRNA molecule.

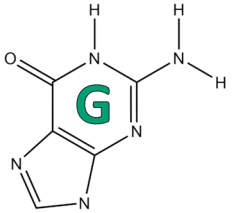
Make the corresponding anti-codons that would be on the tRNA.



Bonus if you look up & correctly use Start and Stop codons!

Chargaff Snap!

Pair



Shuffle each set of DNA cards and set them in separate stacks, face down.

Turn over the top cards at the same time & set them down as a pair.

If there's an AT or CG pair, call "Chargaff" to win the cards.

This works remotely: just hold up your card to the camera.

PS—Why is this called 'Chargaff' snap?

mRNA & vaccines

mRNA hit the news in 2020 because it was the first time that this molecule was used as the basis of a successful vaccine. The outline of the story is told here:

https://cen.acs.org/pharmaceuticals/vaccines/Periodic-Graphics-RNA-vaccines-made/99/i1 (3 free articles per month allowed)

'Oxford' vaccine explained here: https://practio.co.uk/coronavirus/articles/oxford-covid-19-vaccine

Lovely tale of how research builds on previous research: https://www.thetimes.co.uk/article/professor-gets-dose-of-his-own-covid-medicine-with-first-injection-2vklrlfbt (find someone with a subscription)

These links all worked in January 2021. If they stop working, go to http://ScienceAtHomeWithLisa.com & use 'Contact Me' to let me know!

Find out more

How do we know that these structures are correct? How did scientists work out the code for the new virus so quickly? What methods do they use? What's the day-to-day work like? How fast are new mutations emerging?

https://www.compoundchem.com/2021/01/11/chemvscovid-geneticsequence/

https://www.bbc.com/future/article/20210127-covid-19-variants-how-mutations-are-changing-the-pandemic

https://www.cam.ac.uk/stories/sequencingcovid

https://www.goodreads.com/book/show/43811262-unravelling-the-double-helix

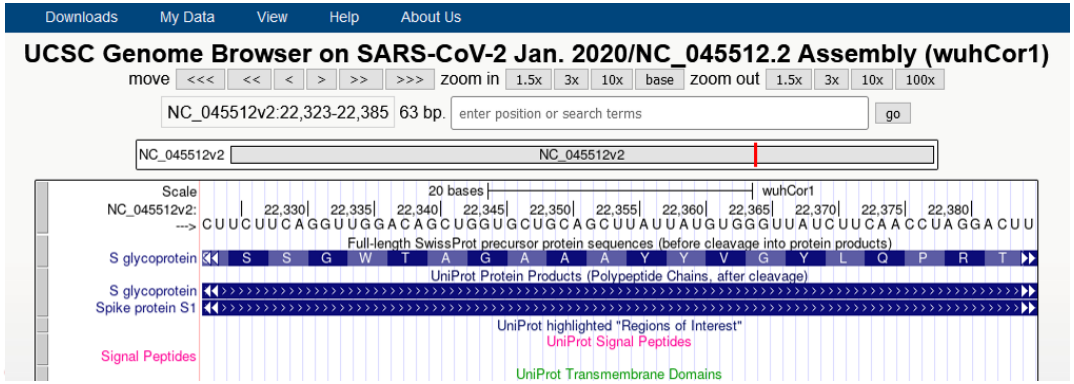
https://www.goodreads.com/book/show/15802325-brilliant-blunders

Use the real code

The entire genome is published here: https://genome.ucsc.edu/index.html

Use the 'genomes' dropdown in the top left to select SARS-CoV-2.

Use shift+click+drag, or the zoom buttons, until the top row of the chart shows the AUCG letters, above the Amino Acids that they code for. You can now make a bit of the code for the virus that causes Covid-19!



Take it further

Can you devise more things to do with the cards?

How would you explain the structures to a younger student?

More DNA activities for all ages: https://www.yourgenome.org/

If you're thinking of studying these topics at Uni, have a look at the **Oxford Biology Primers** series of books https://global.oup.com/ukhe/scienceresources/obp/?cc=gb&lang=en&

Also these **free genomics lectures**: https://publicengagement.wellcomegenomecampus.org/genome-lates-a-special-human-genome-project-anniversary-season