



In the Tube Where it Happens: Using Models to Support Understanding in Biotechnology

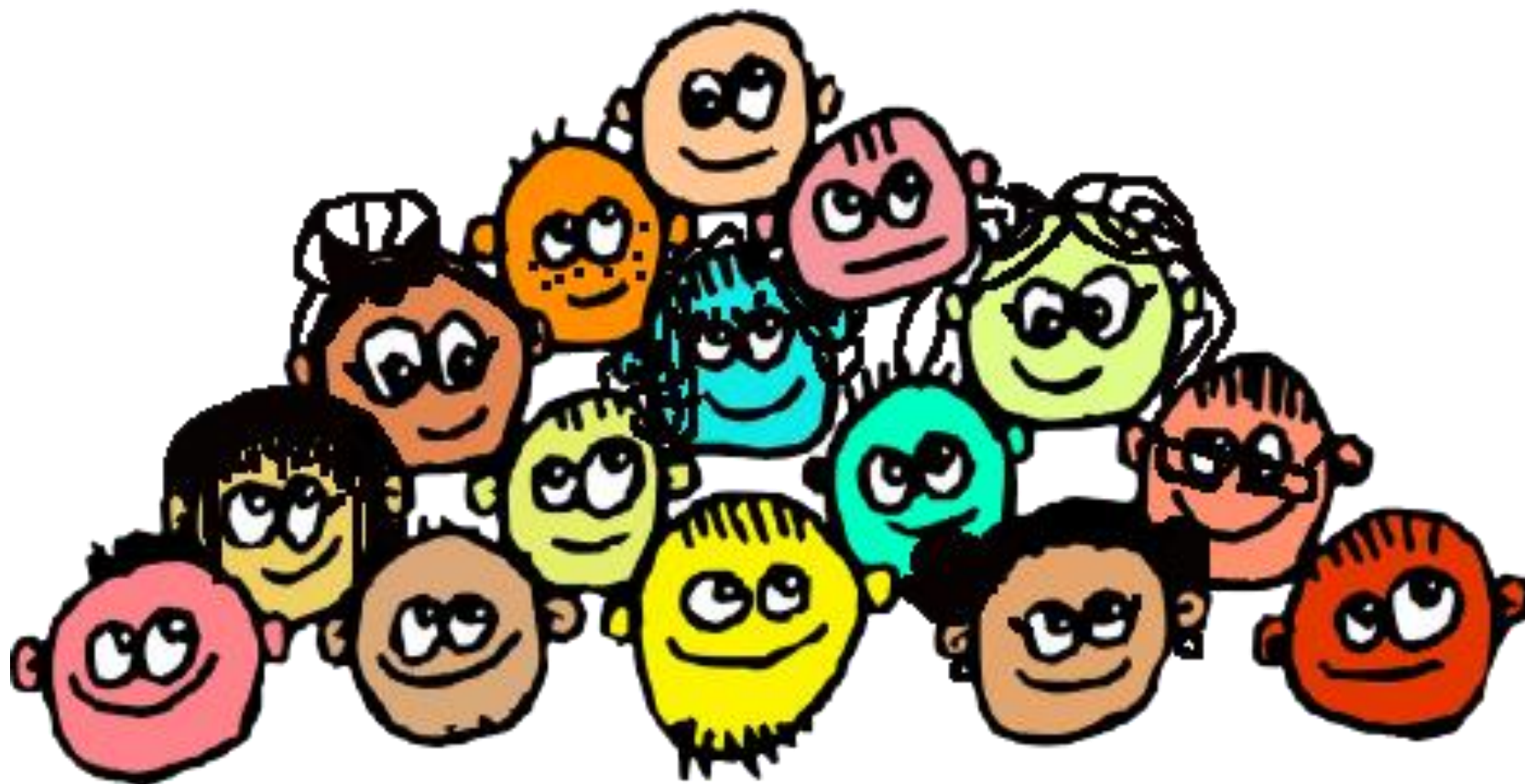
Keri Shingleton, Ph.D.
Holland Hall School
Tulsa, Oklahoma



Who am I?



Who are you?



Today we will...

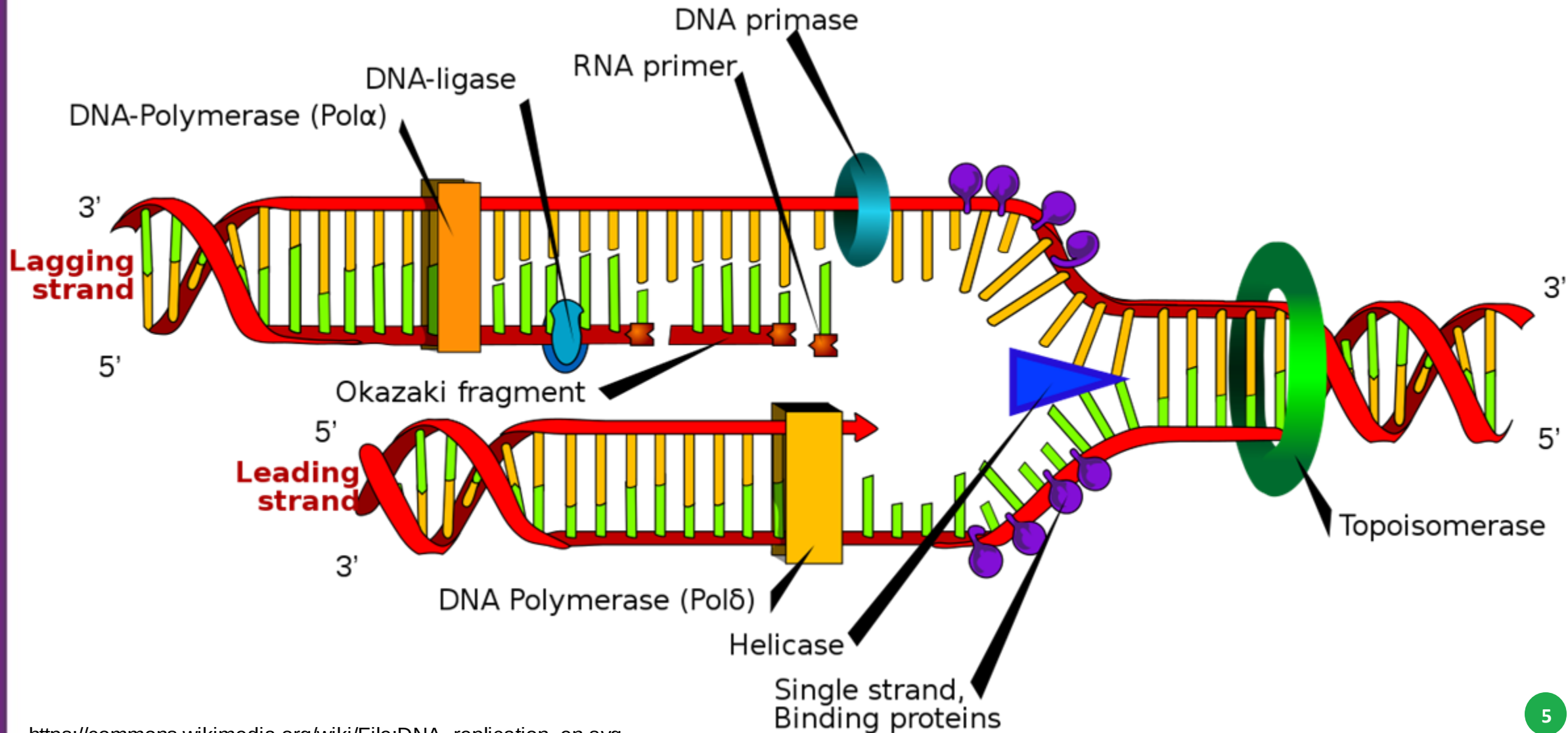
Experience the authentic learning we (and our students) will encounter while modeling the processes of:

- PCR (Polymerase Chain Reaction)
- Restriction digestion
- Electrophoresis

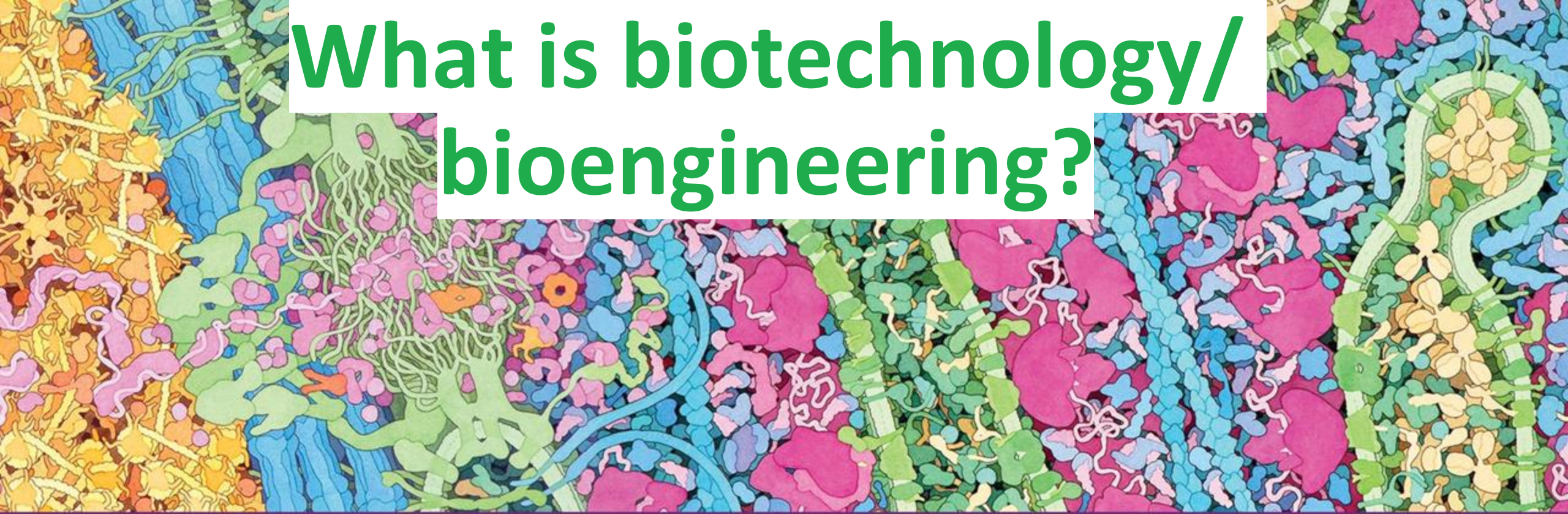
Identify pedagogies that can be used with modeling to help

- Increase deep engagement
- Make student thinking visible
- Formative assessments

“Enzymes” in DNA replication... ENZYMES ARE EXPENSIVE!



What is biotechnology/ bioengineering?



Let's learn about DNA replication!



Steps in DNA Replication in your cells...

DNA Replication	
Steps	Required Enzymes
Unwind the DNA	Helicase
Prime the DNA	Primase
Extend the DNA	DNA polymerase III
Remove the RNA Primers/ replace with DNA	DNA polymerase I
Ligate Okazaki Fragments	Ligase



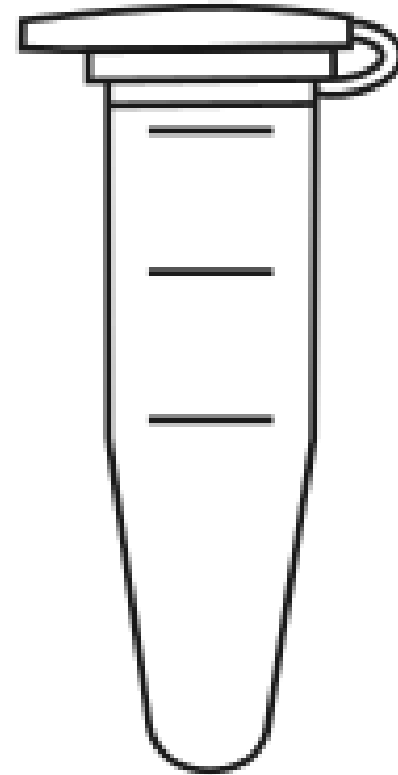
DNA Replication		Polymerase Chain Reaction
Steps	Required Enzymes	
Unwind the DNA	Helicase	HEAT
Prime the DNA	Primase	primers
Extend the DNA	DNA polymerase III	Taq polymerase
Remove the RNA Primers/ replace with DNA	DNA polymerase I	Not necessary
Ligate Okazaki Fragments	Ligase	Not necessary

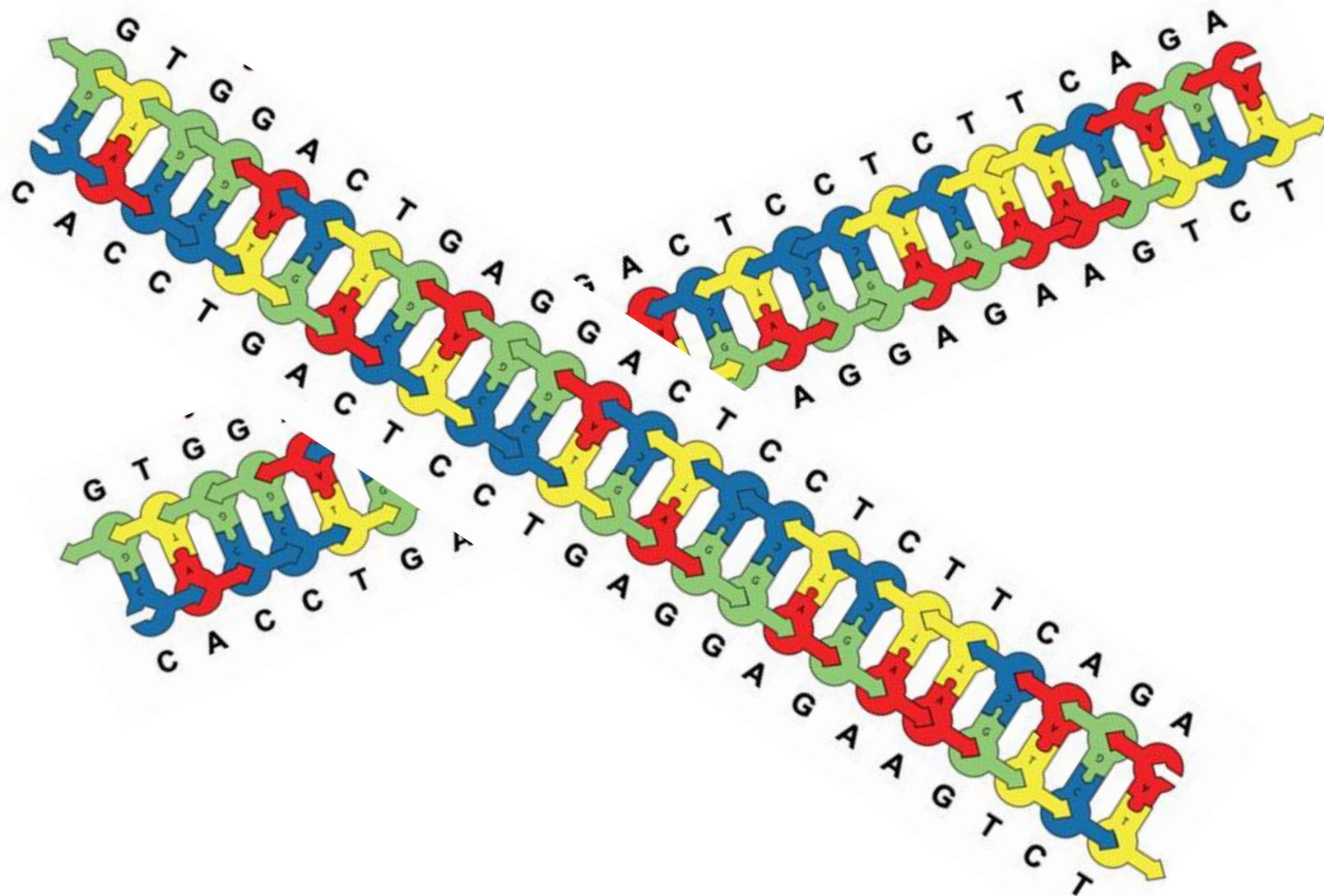


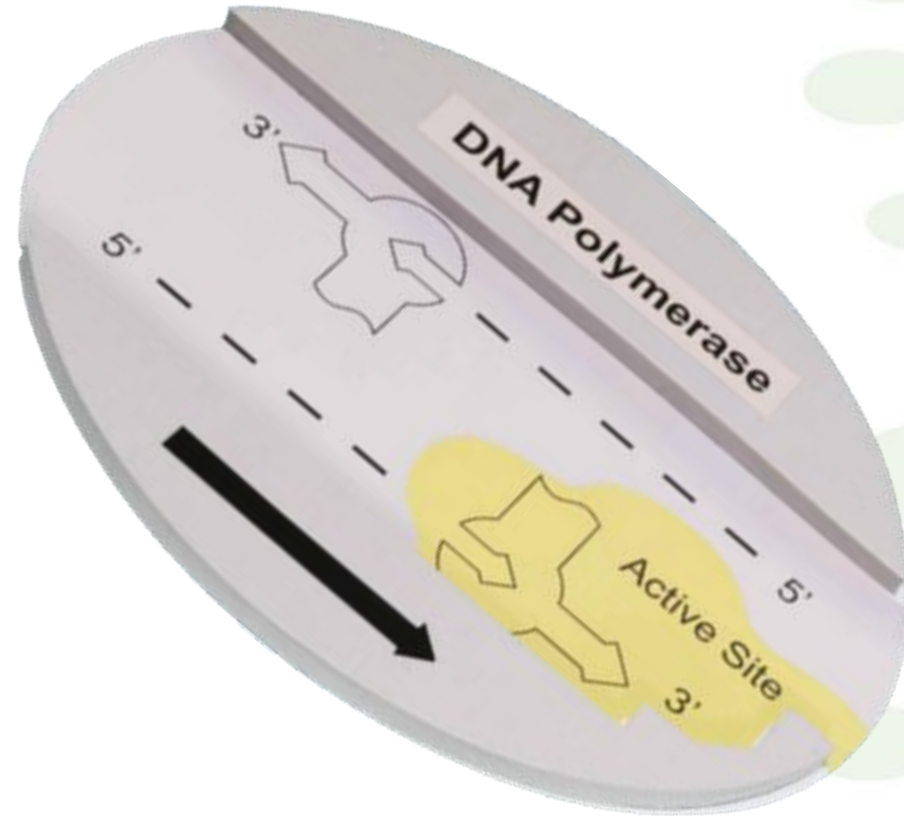
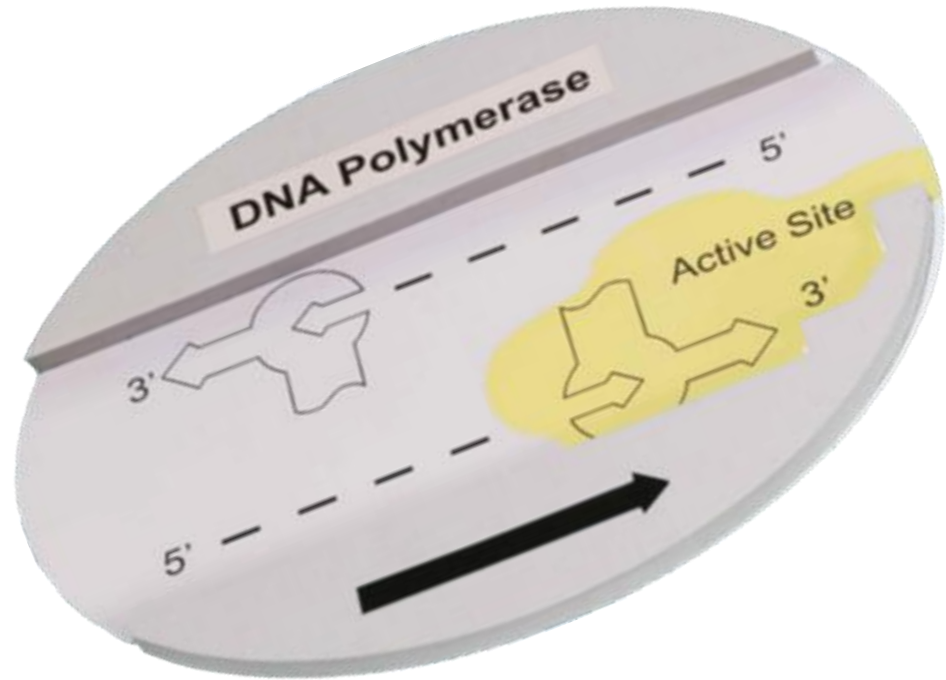
**KEEP
CALM
AND
CLEAR YOUR
TABLE**

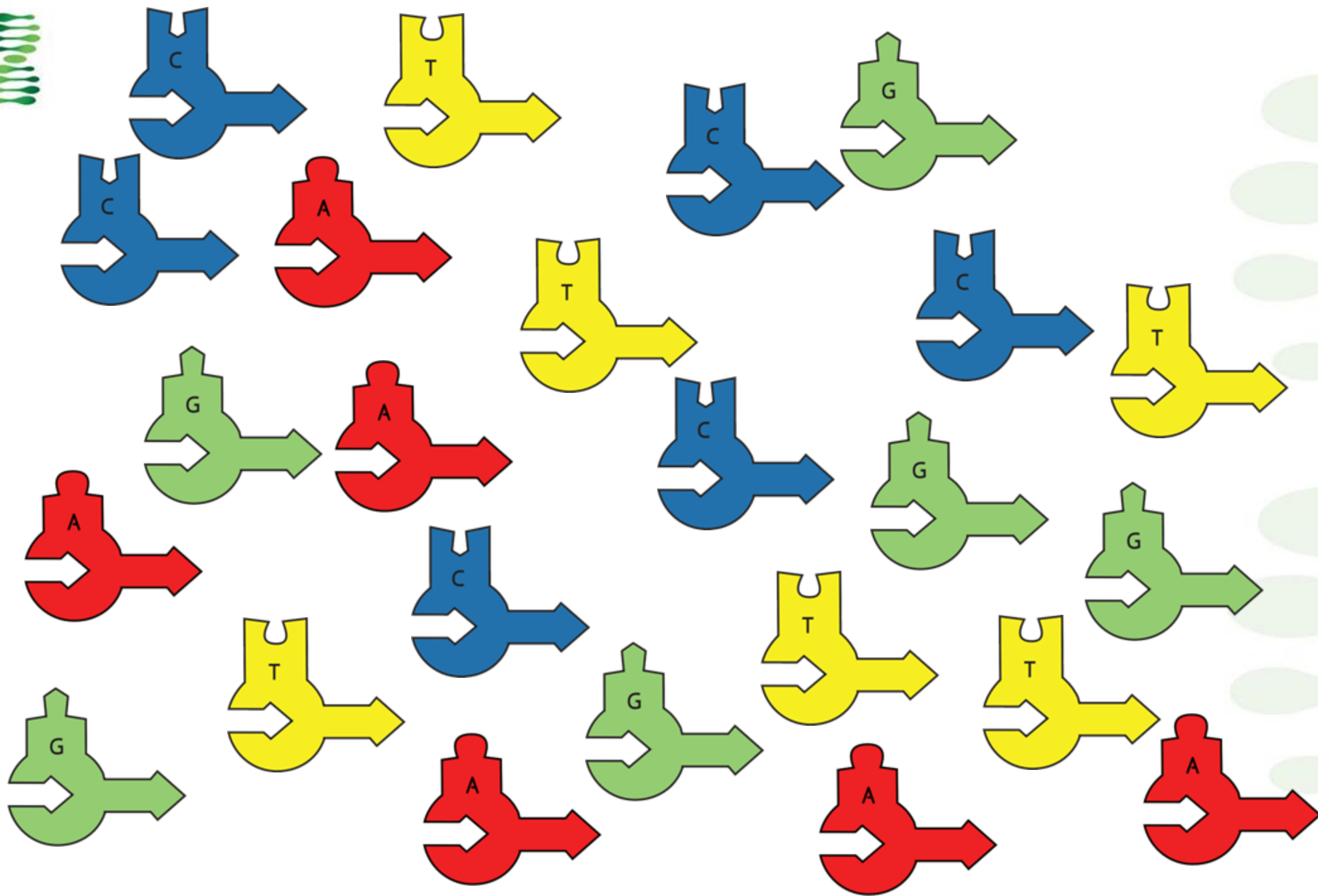


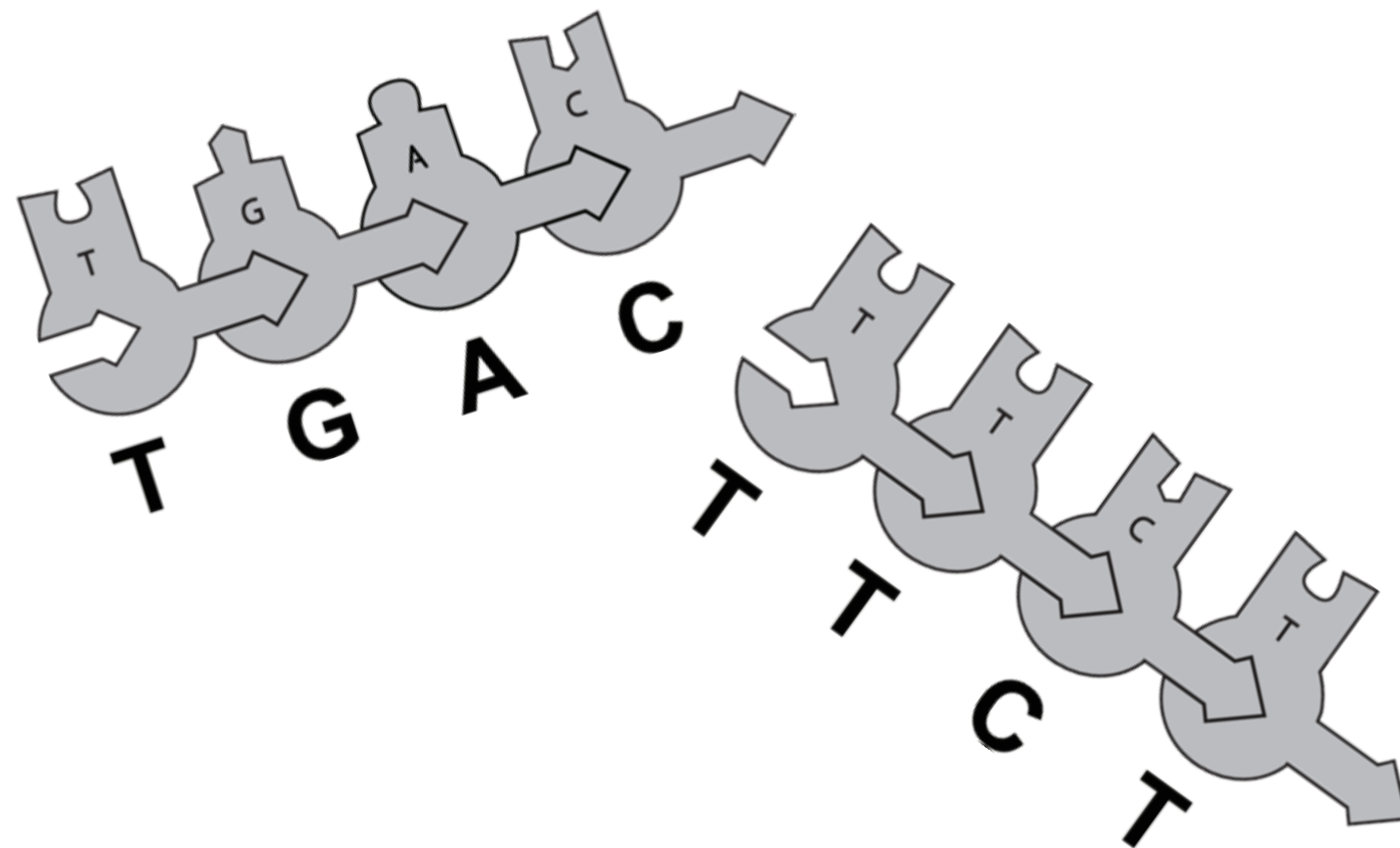
Your table is now a...





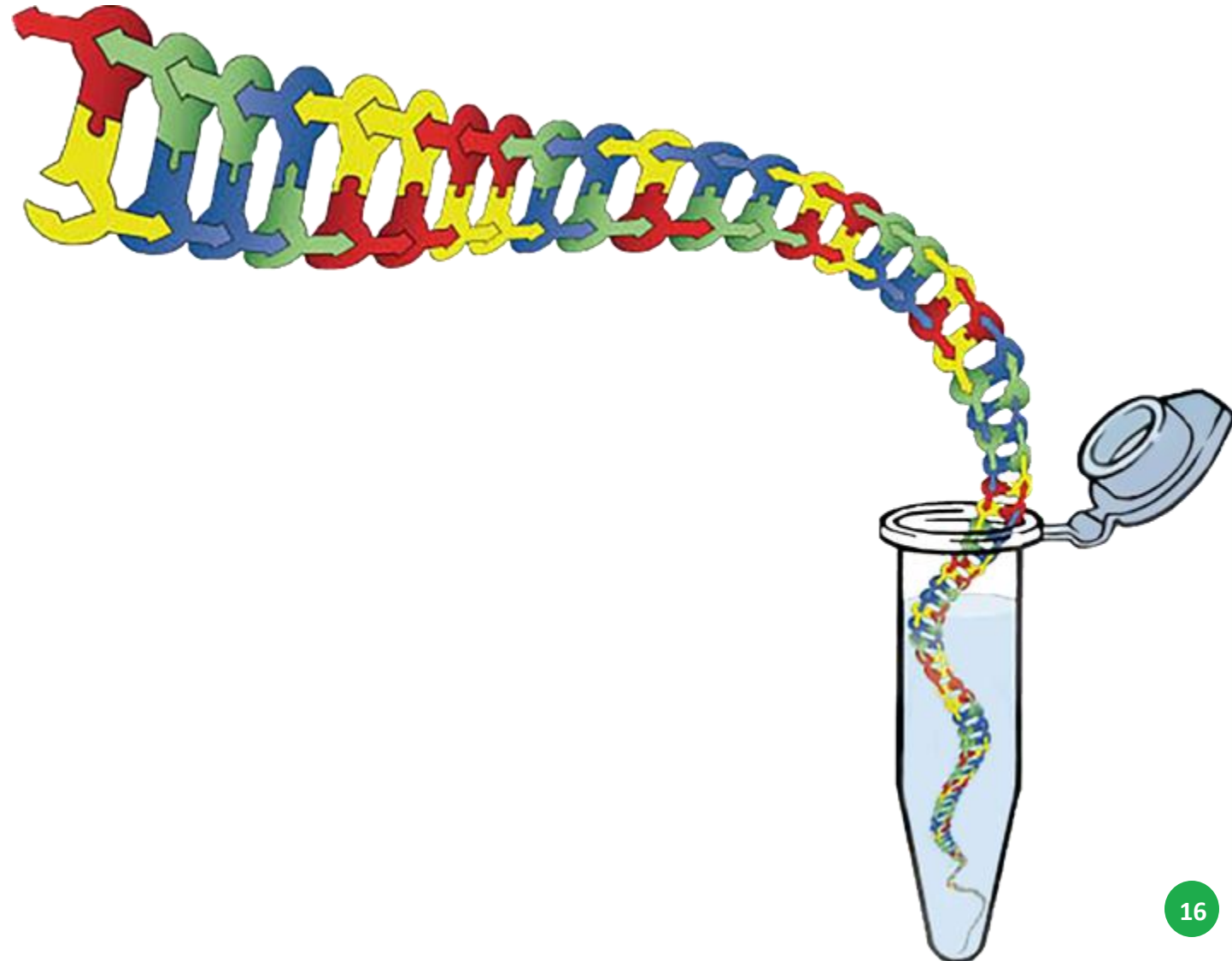




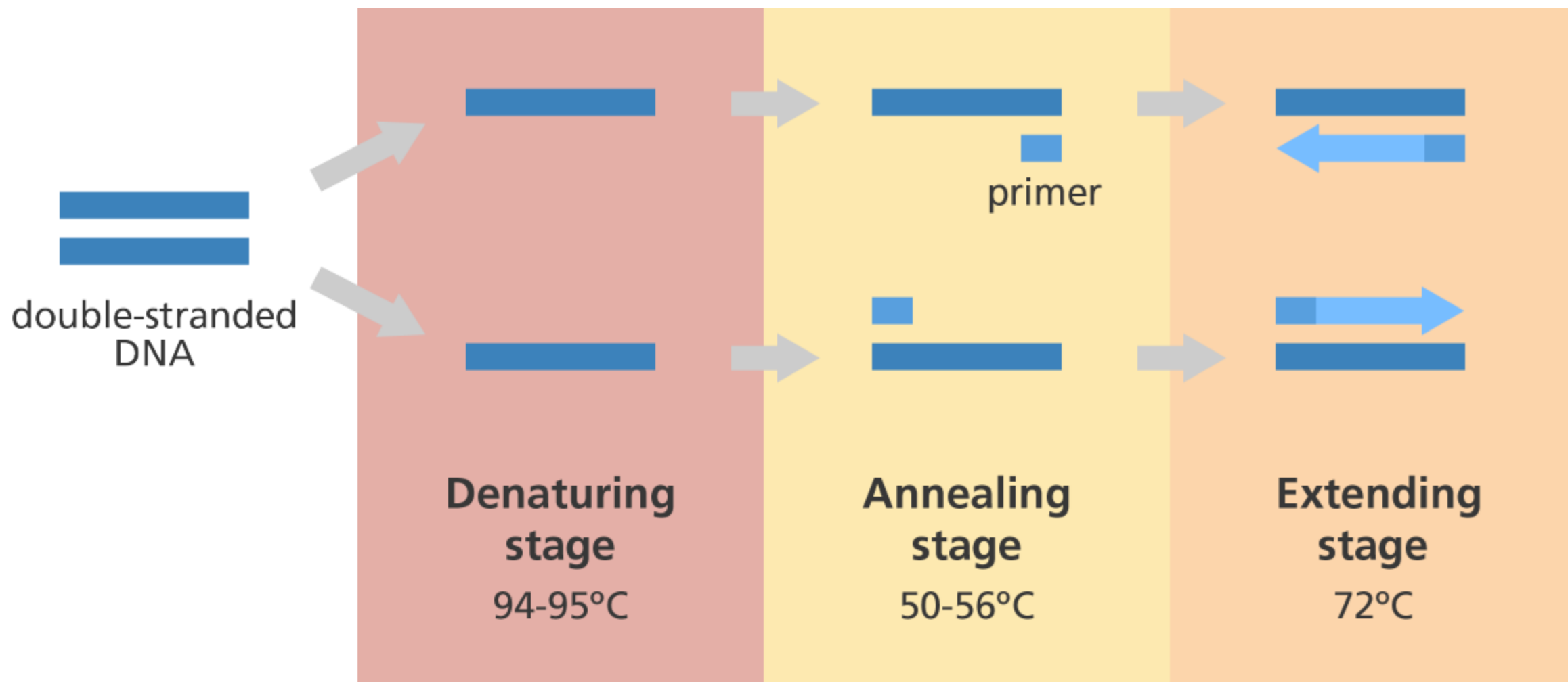


Remember these ingredients are
all in a tube...

Not on a table.

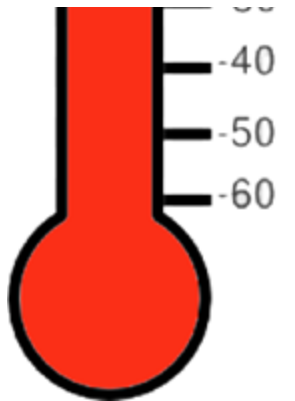
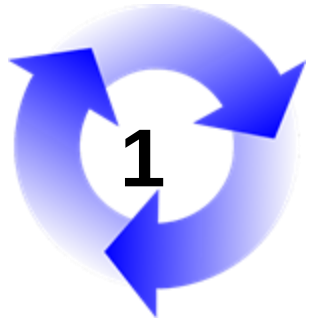
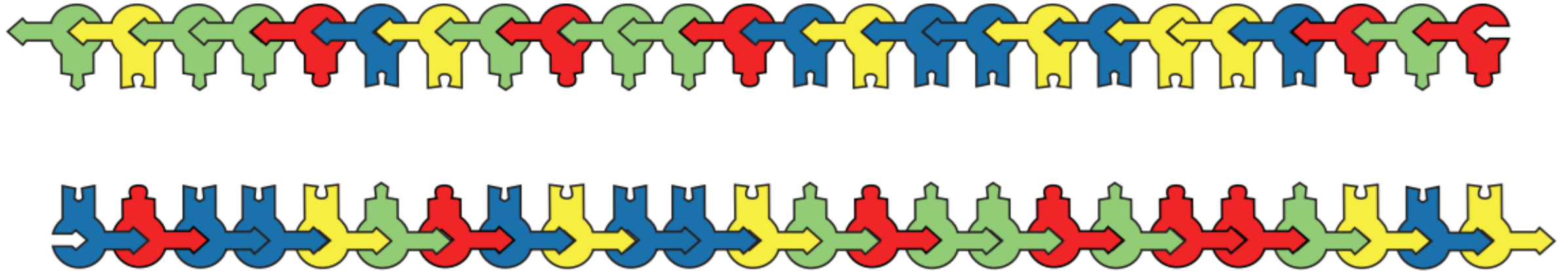
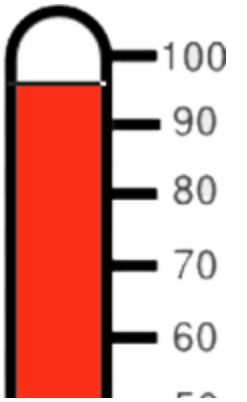




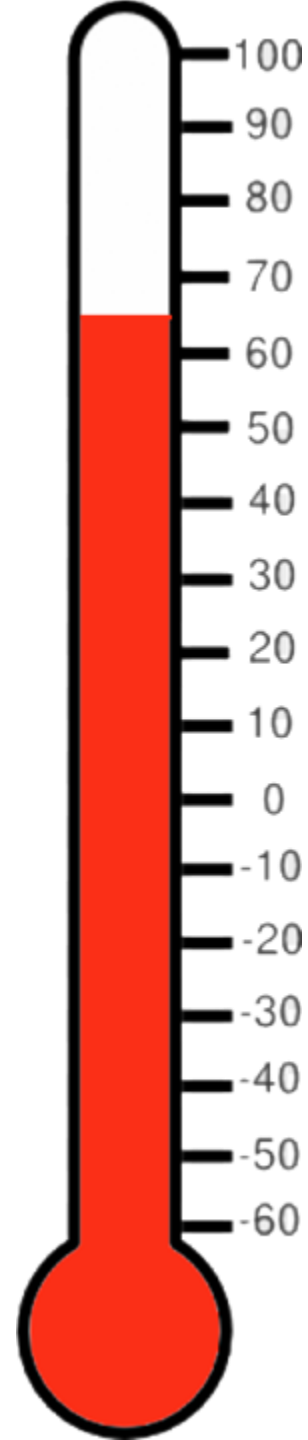
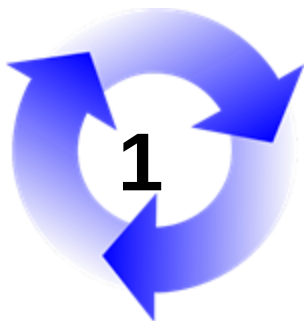
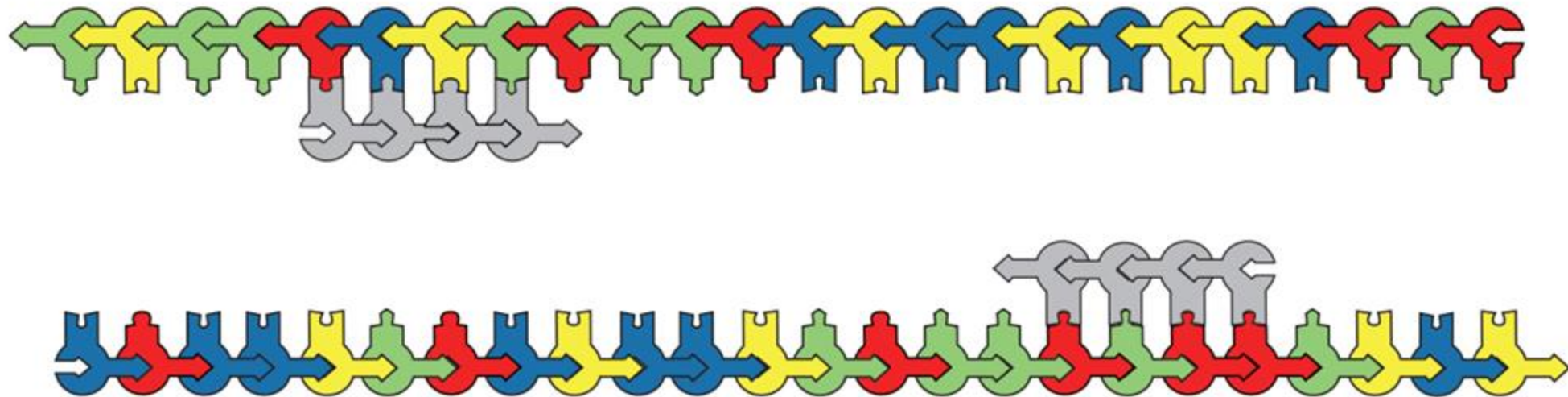


First step....

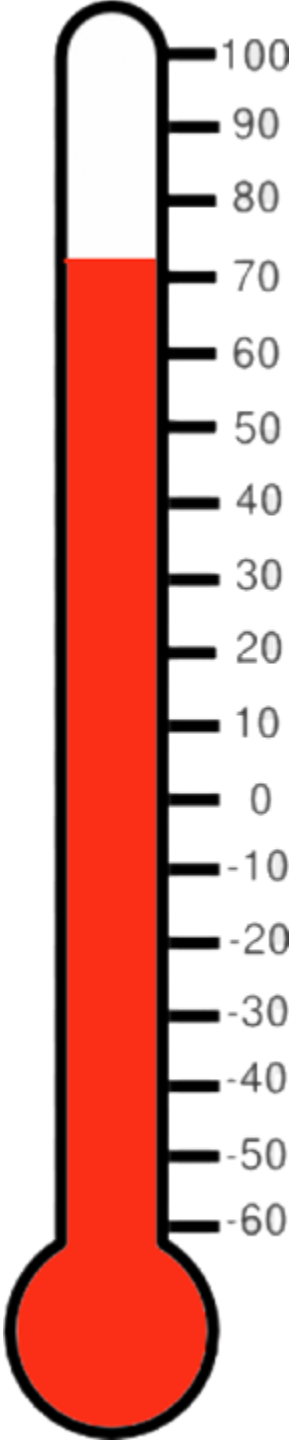
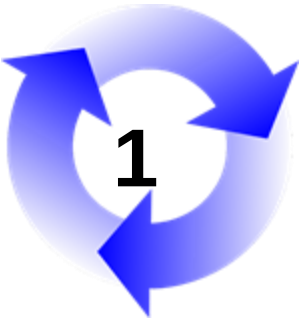
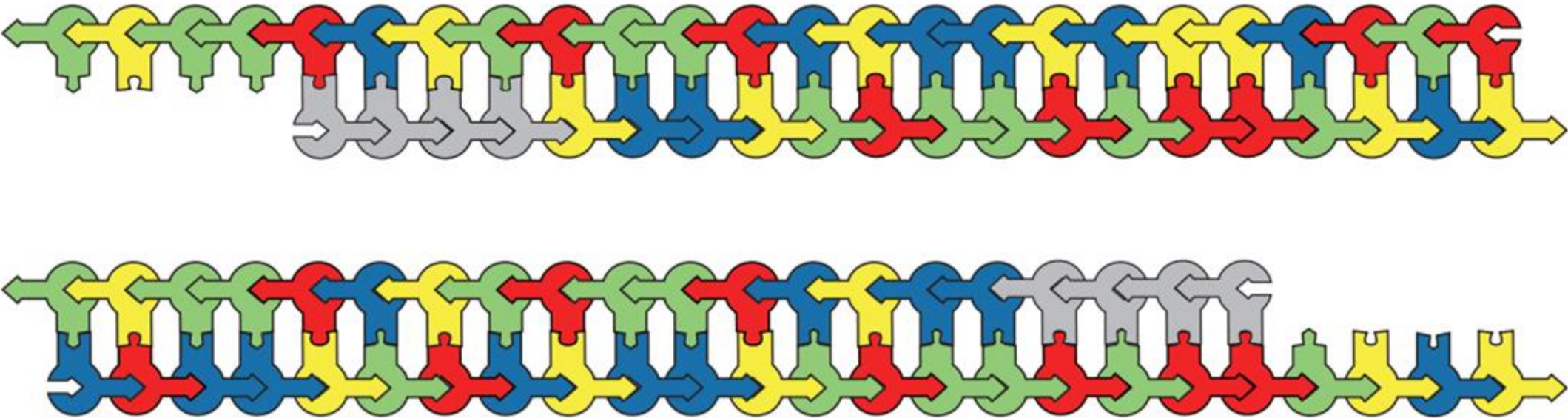
Denature for 11 minutes at 95°C

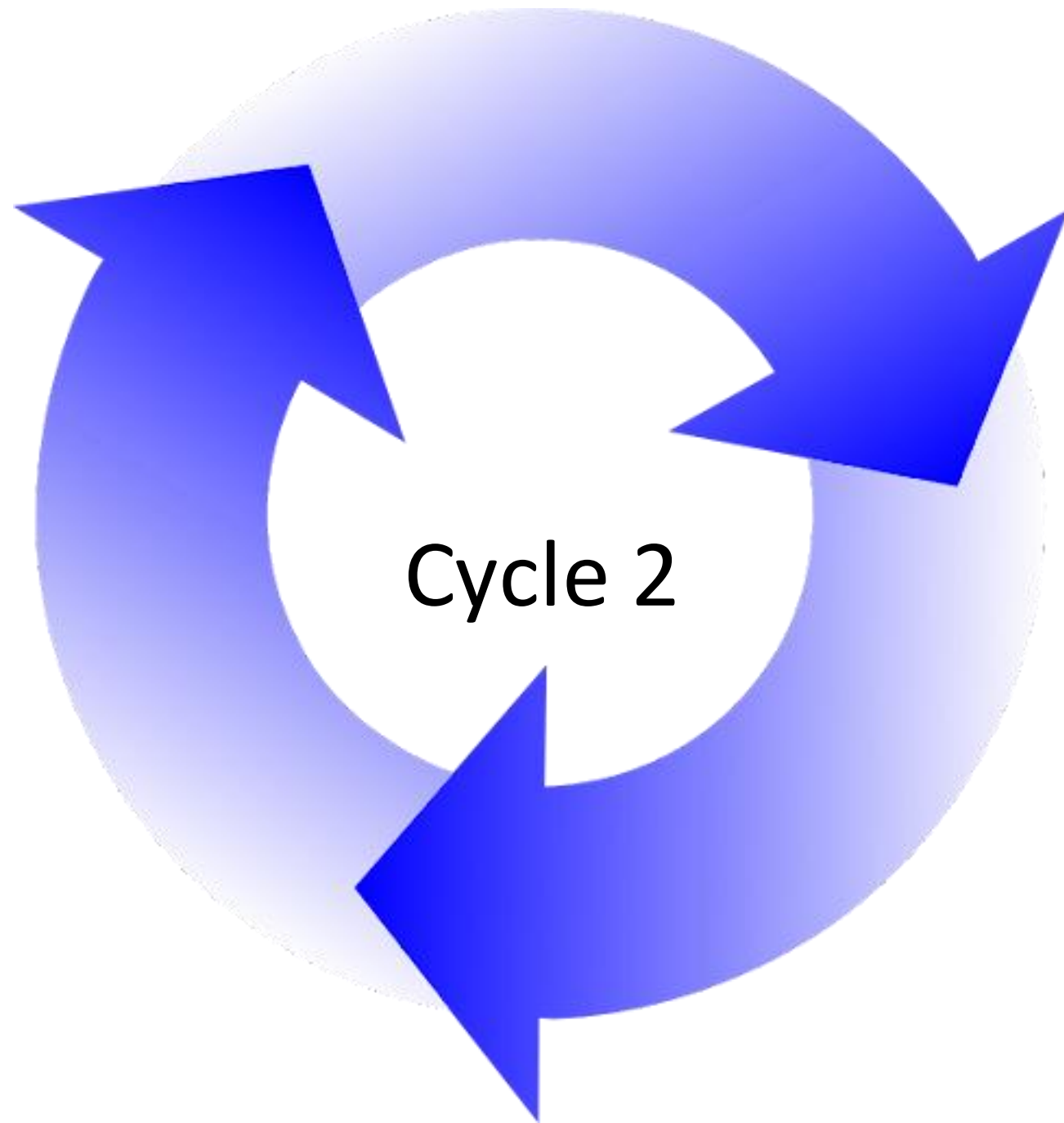


Anneal

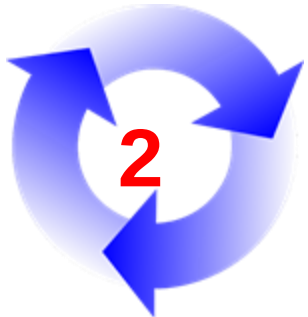
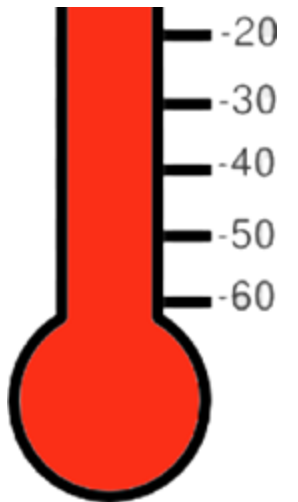
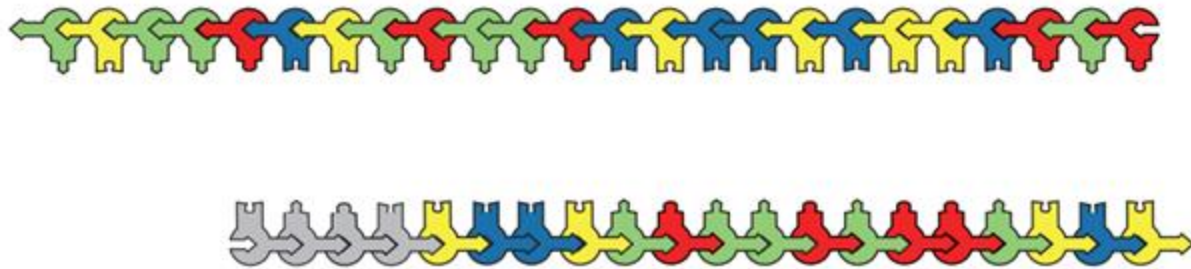
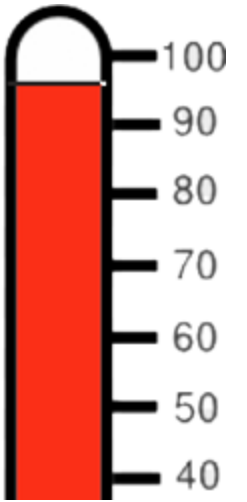


Extend

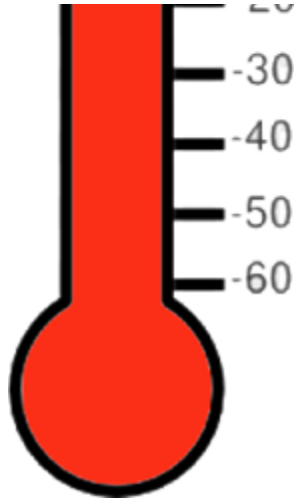
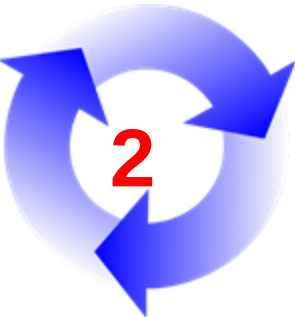
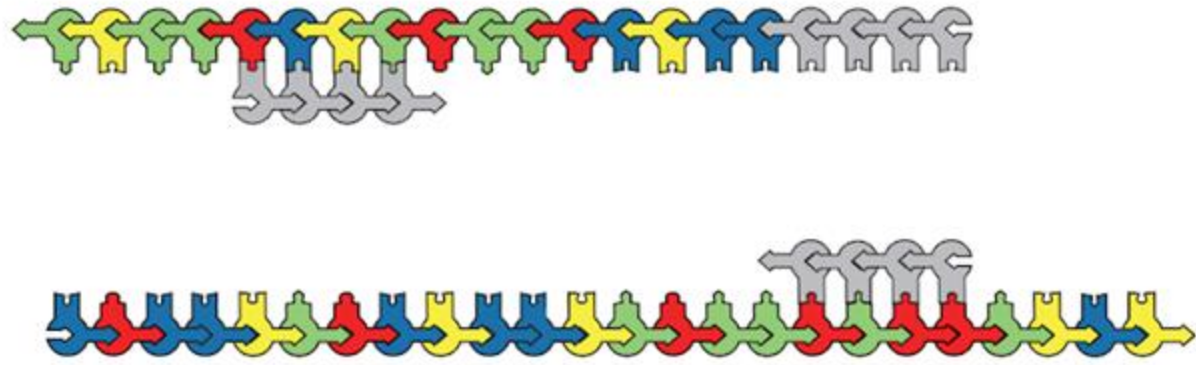
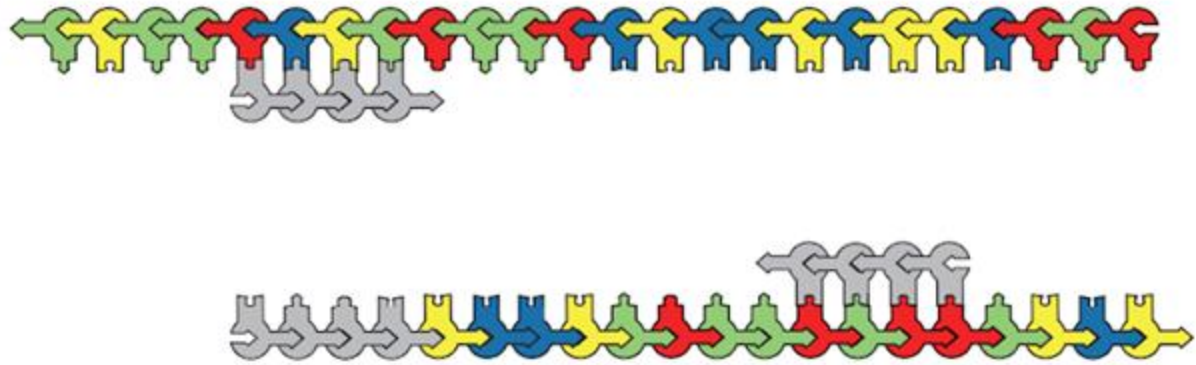
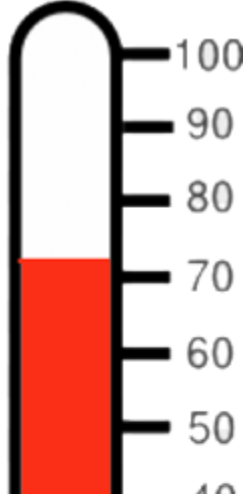




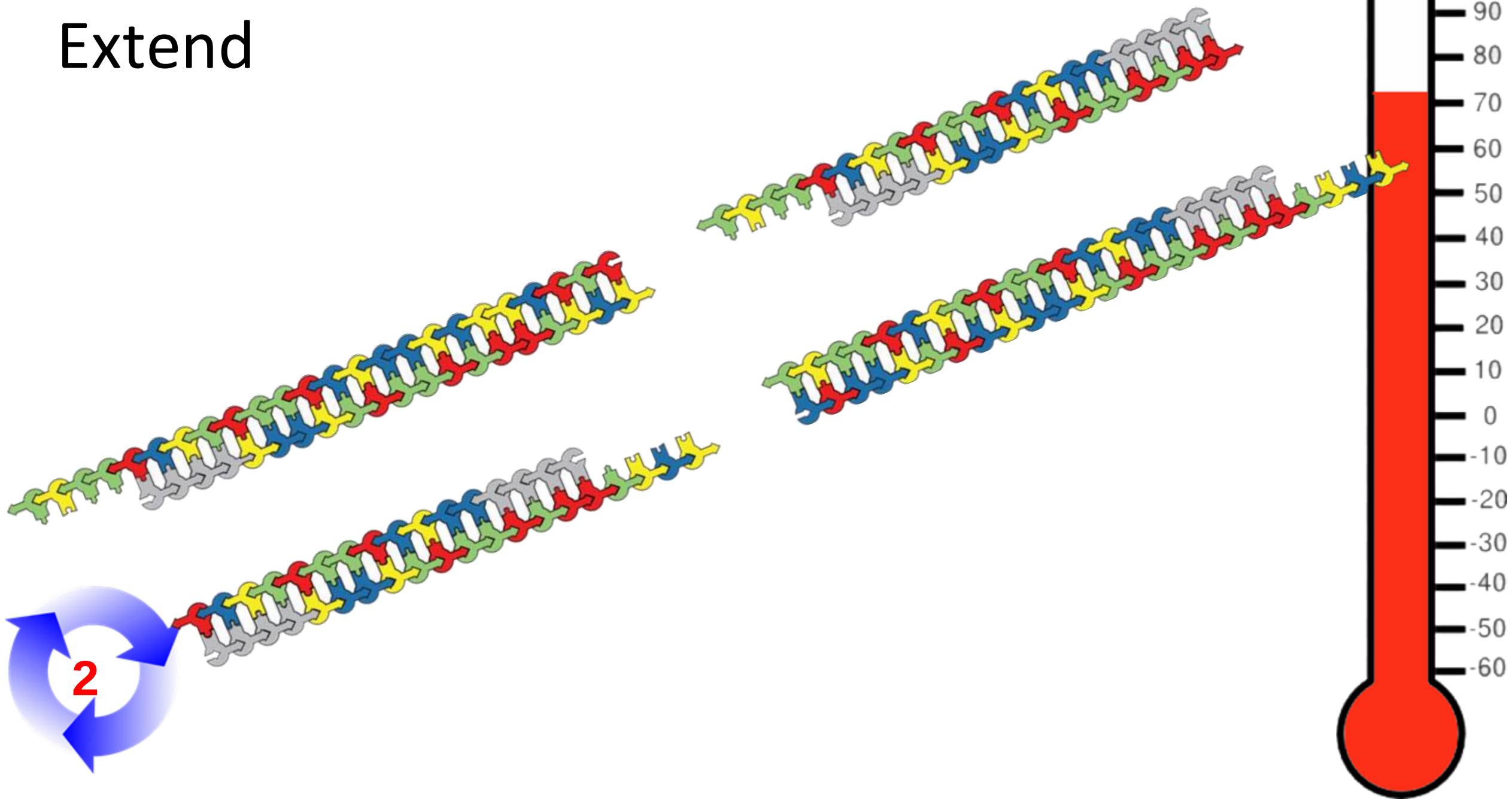
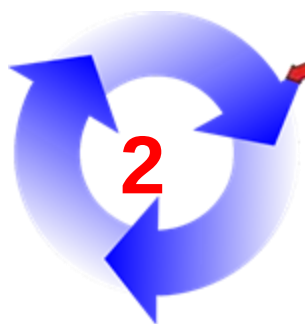
1 minute at 95°C. Why shorter this time?

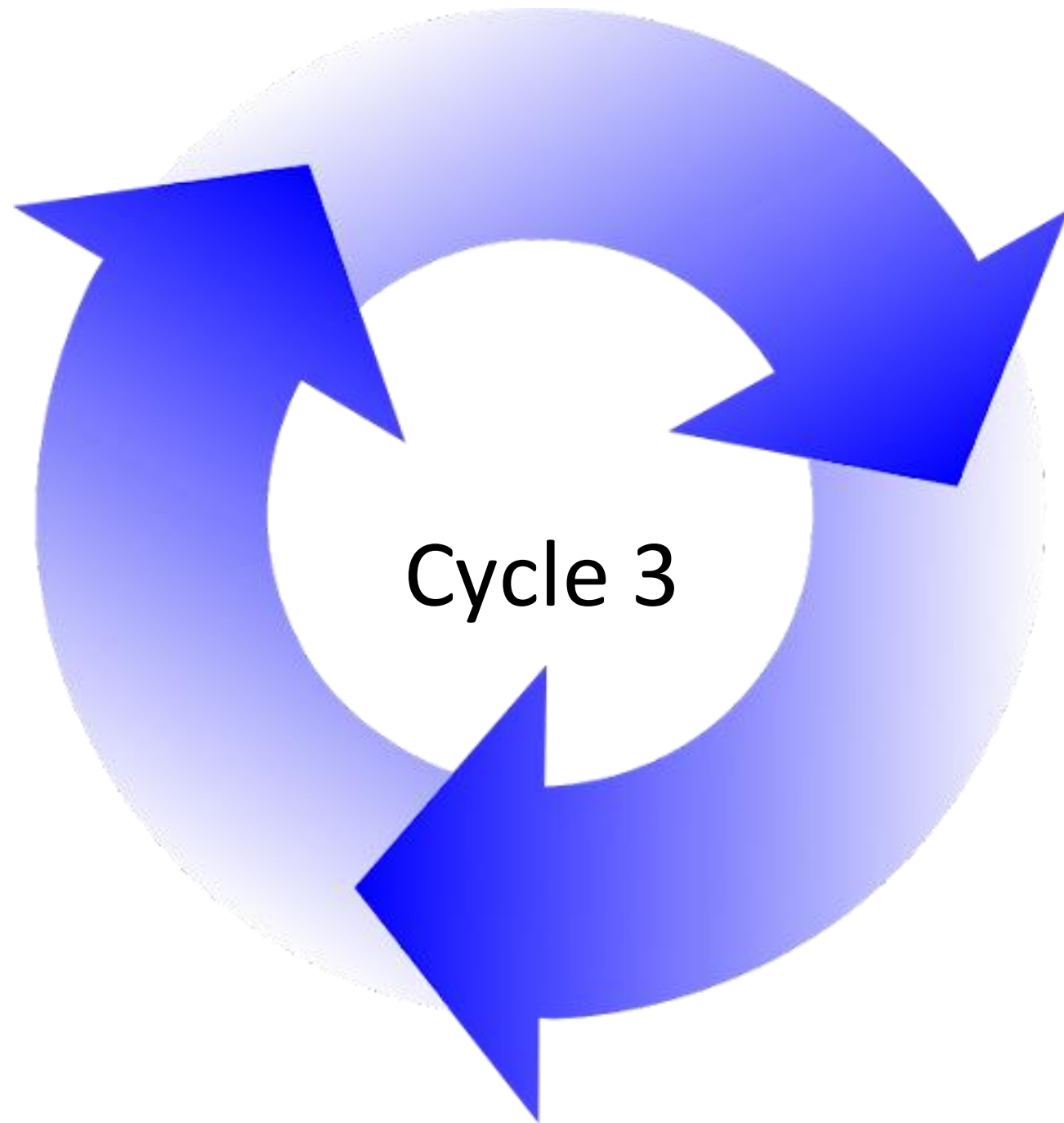


Extend

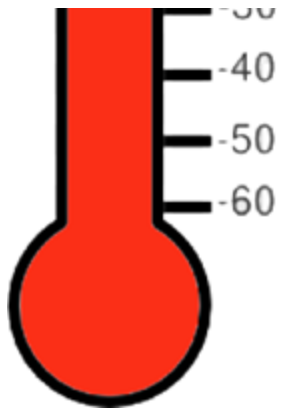
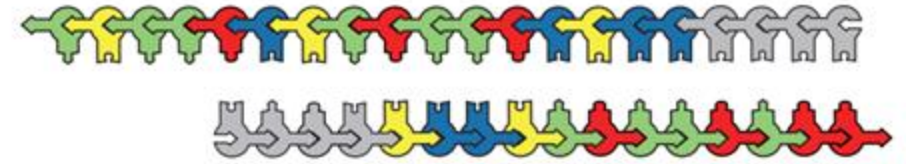
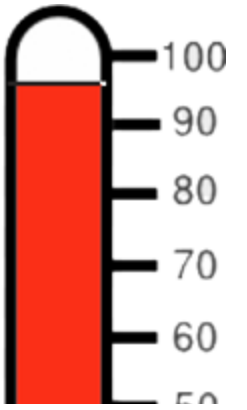


Extend

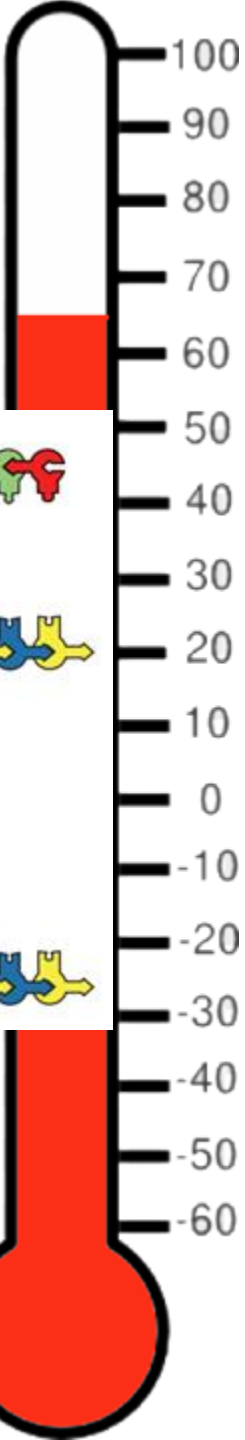
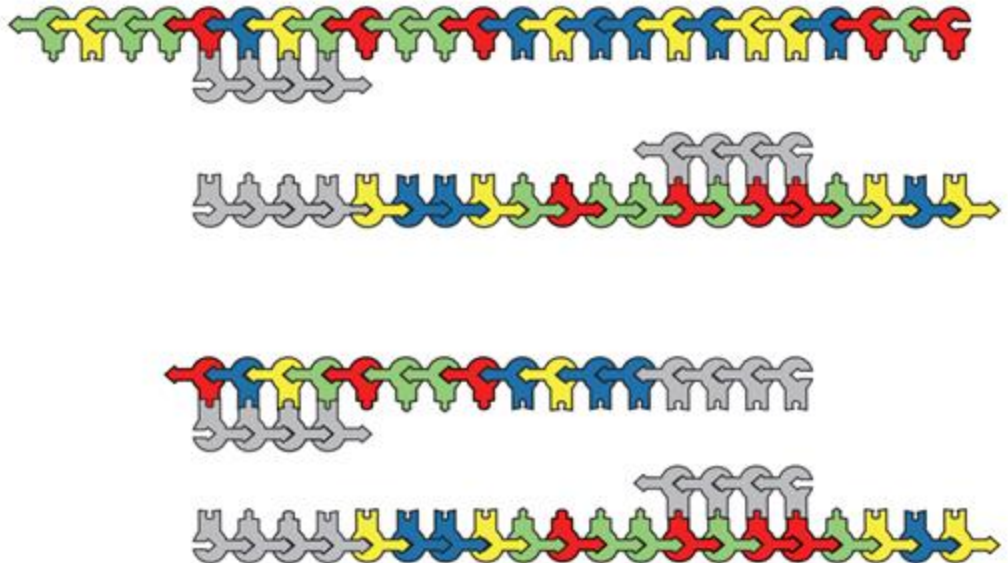
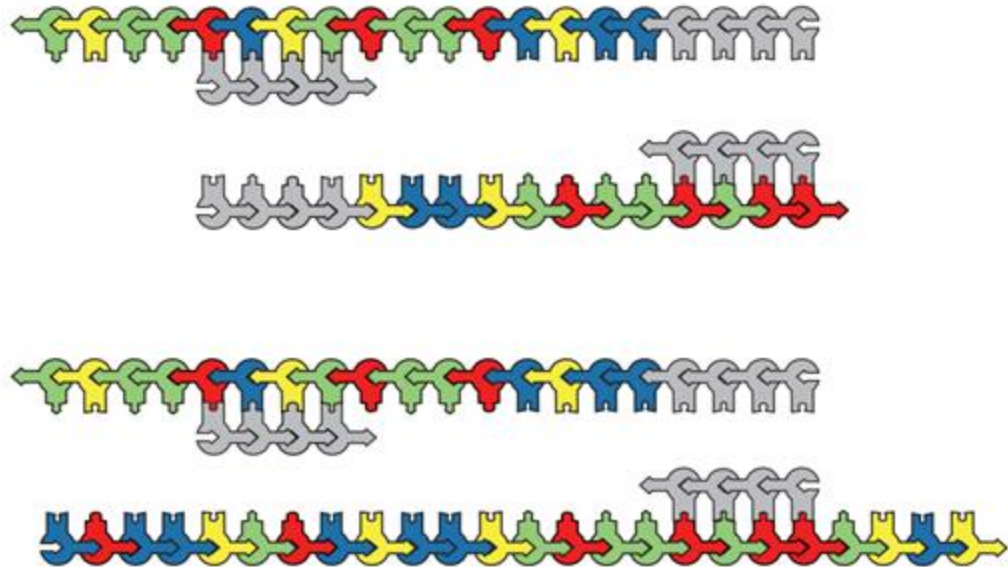




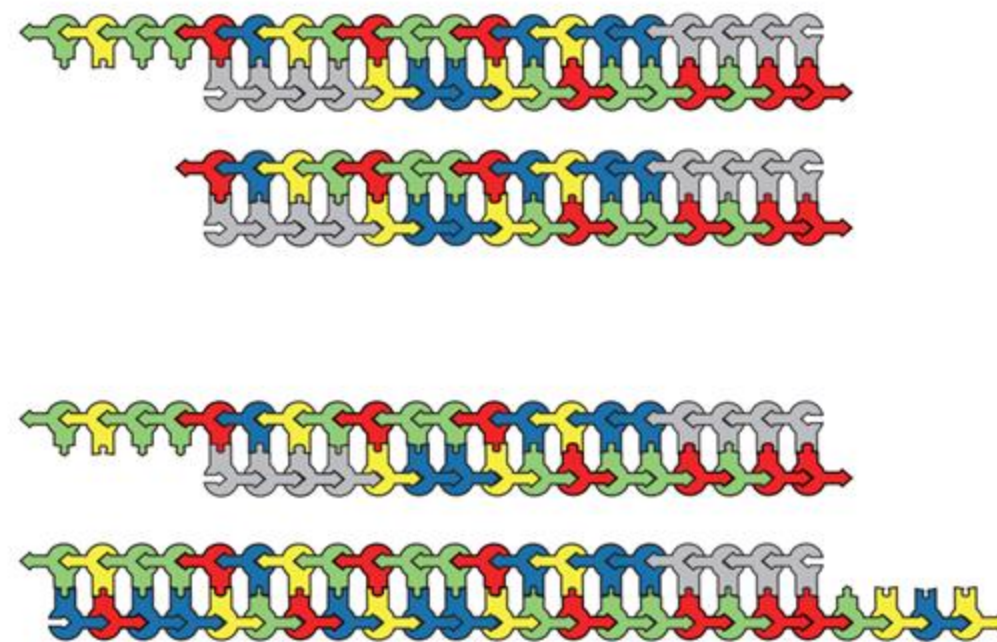
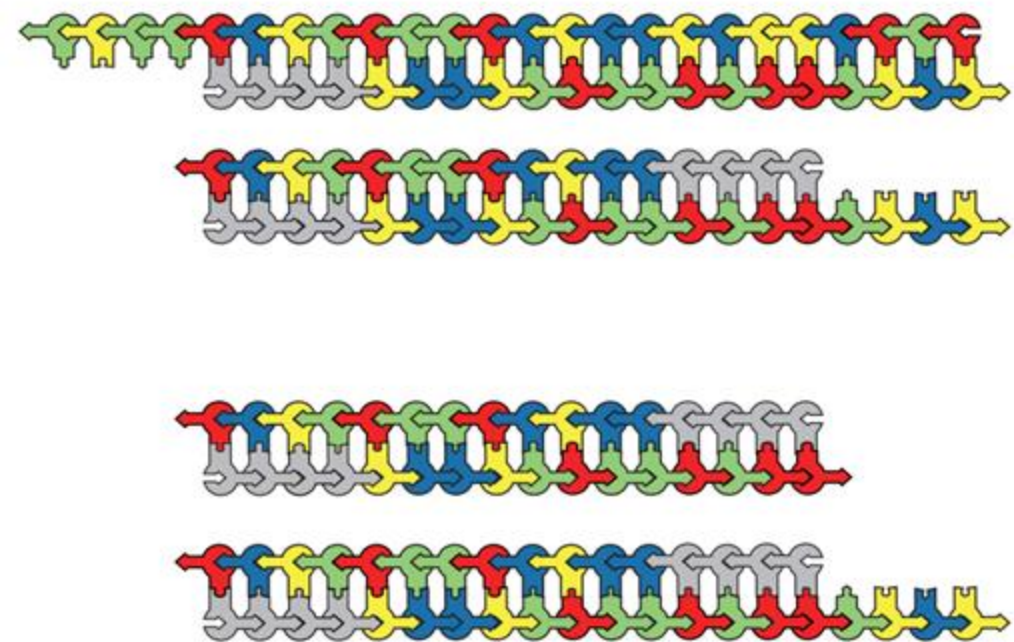
Denature: 95°C.



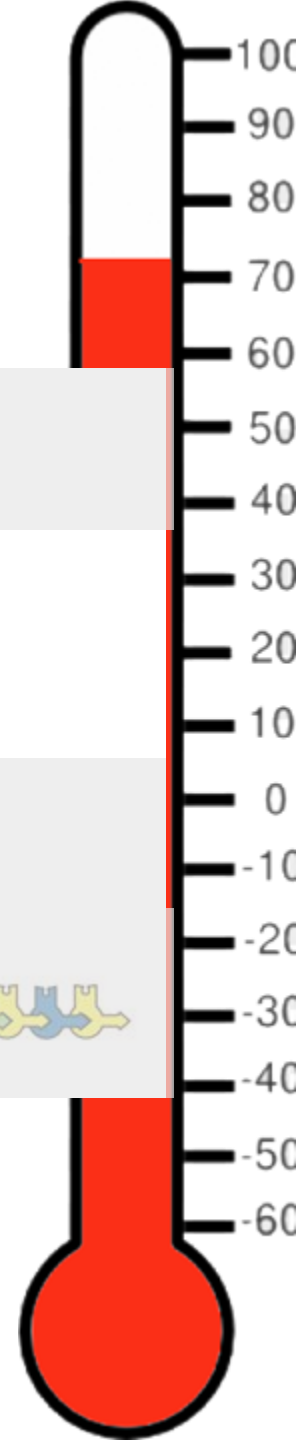
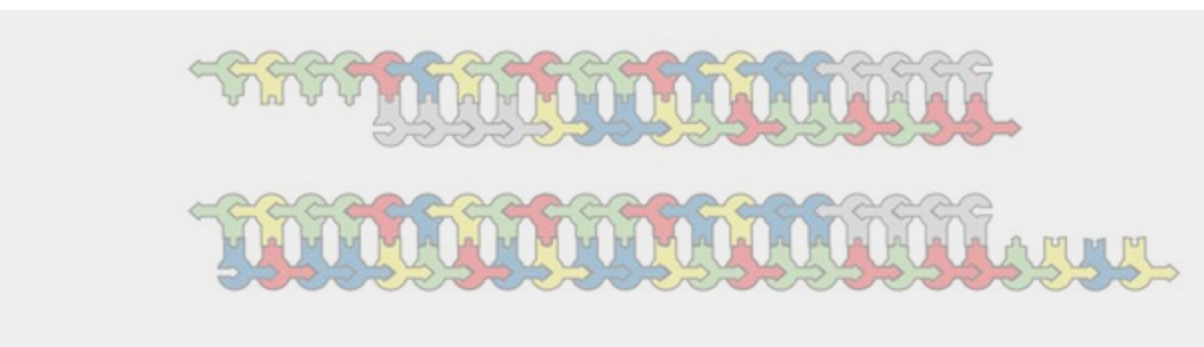
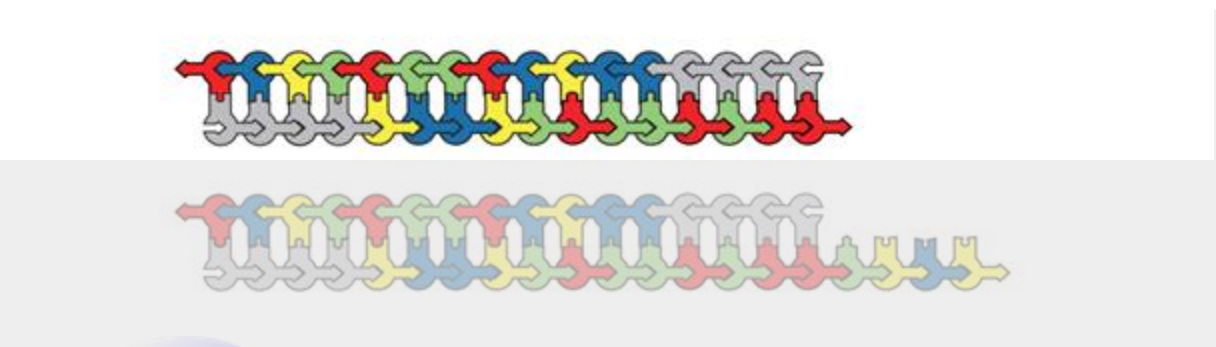
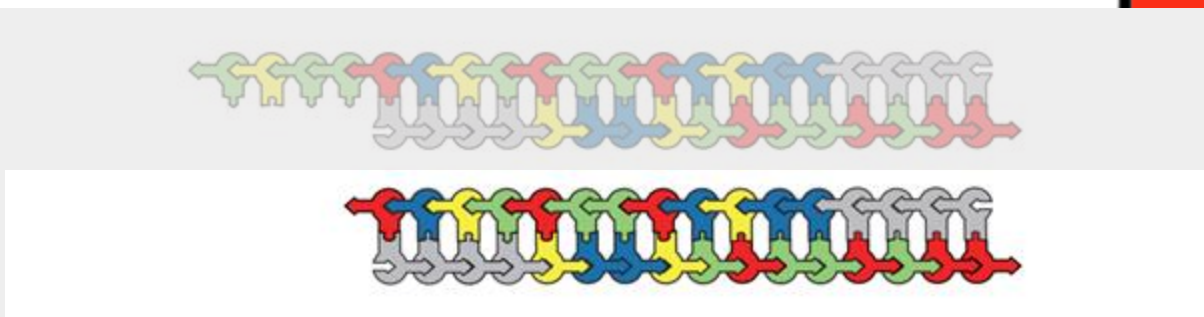
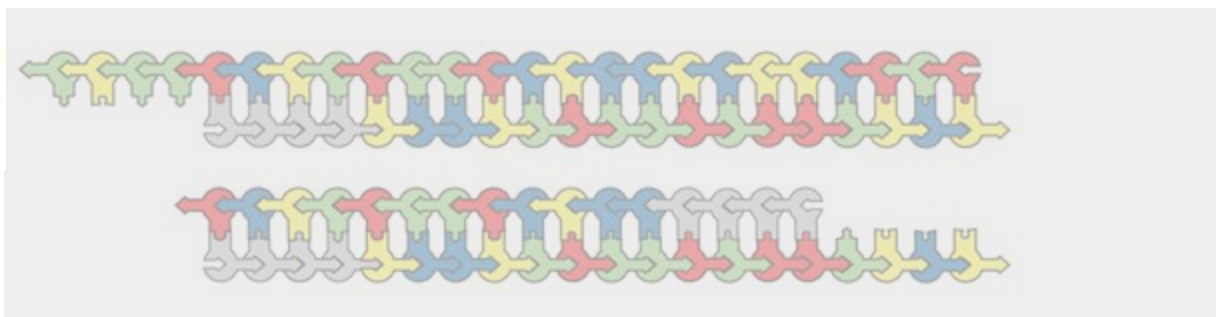
Anneal

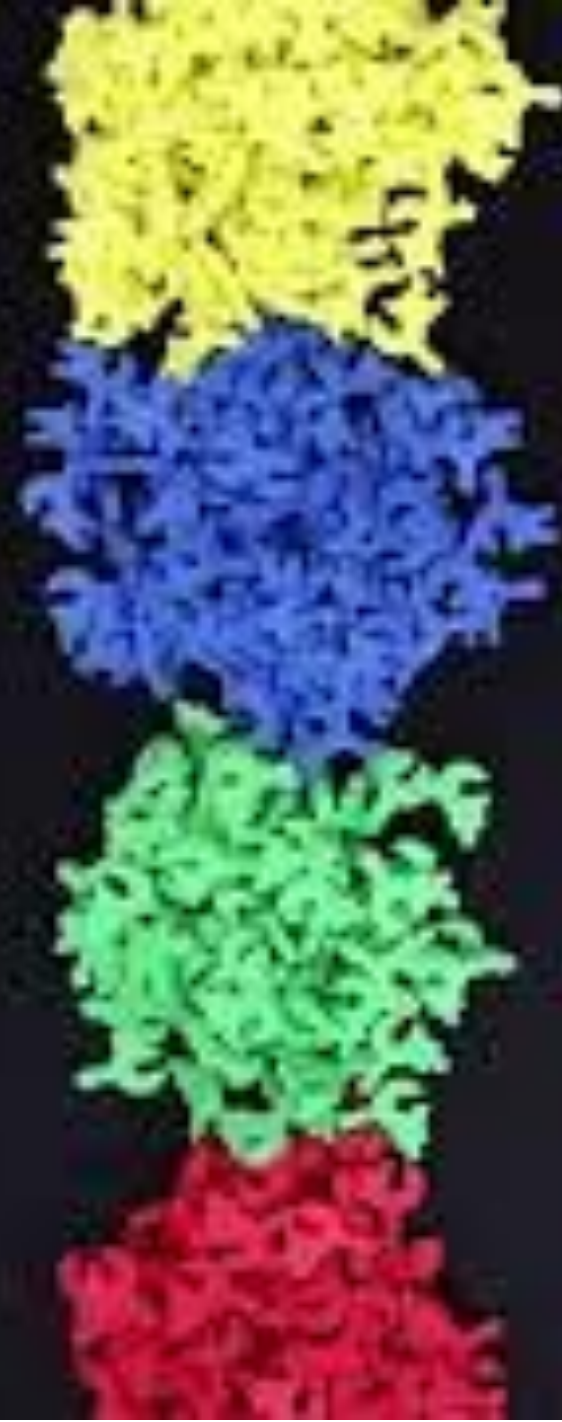


Extend



Extend



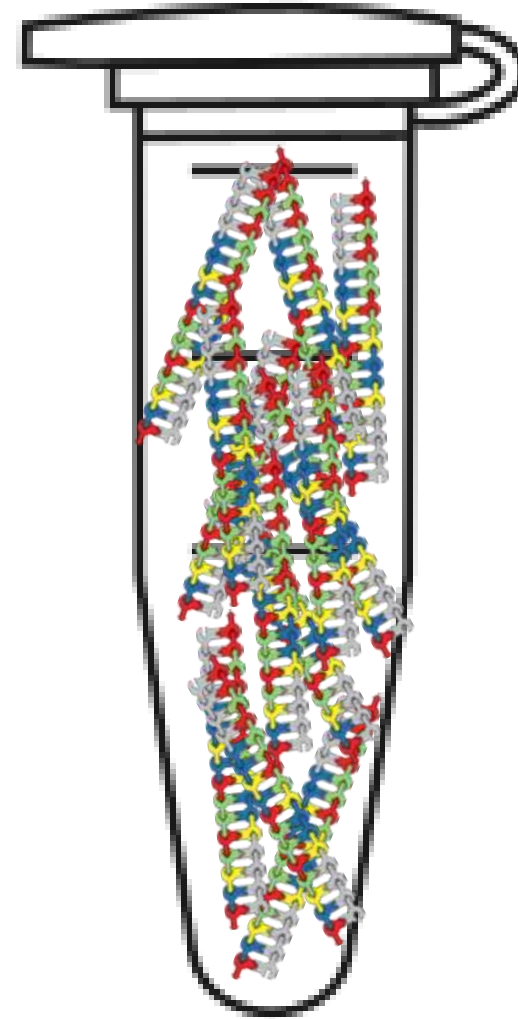


35 cycles, done!





Remember, your table is a PCR tube...



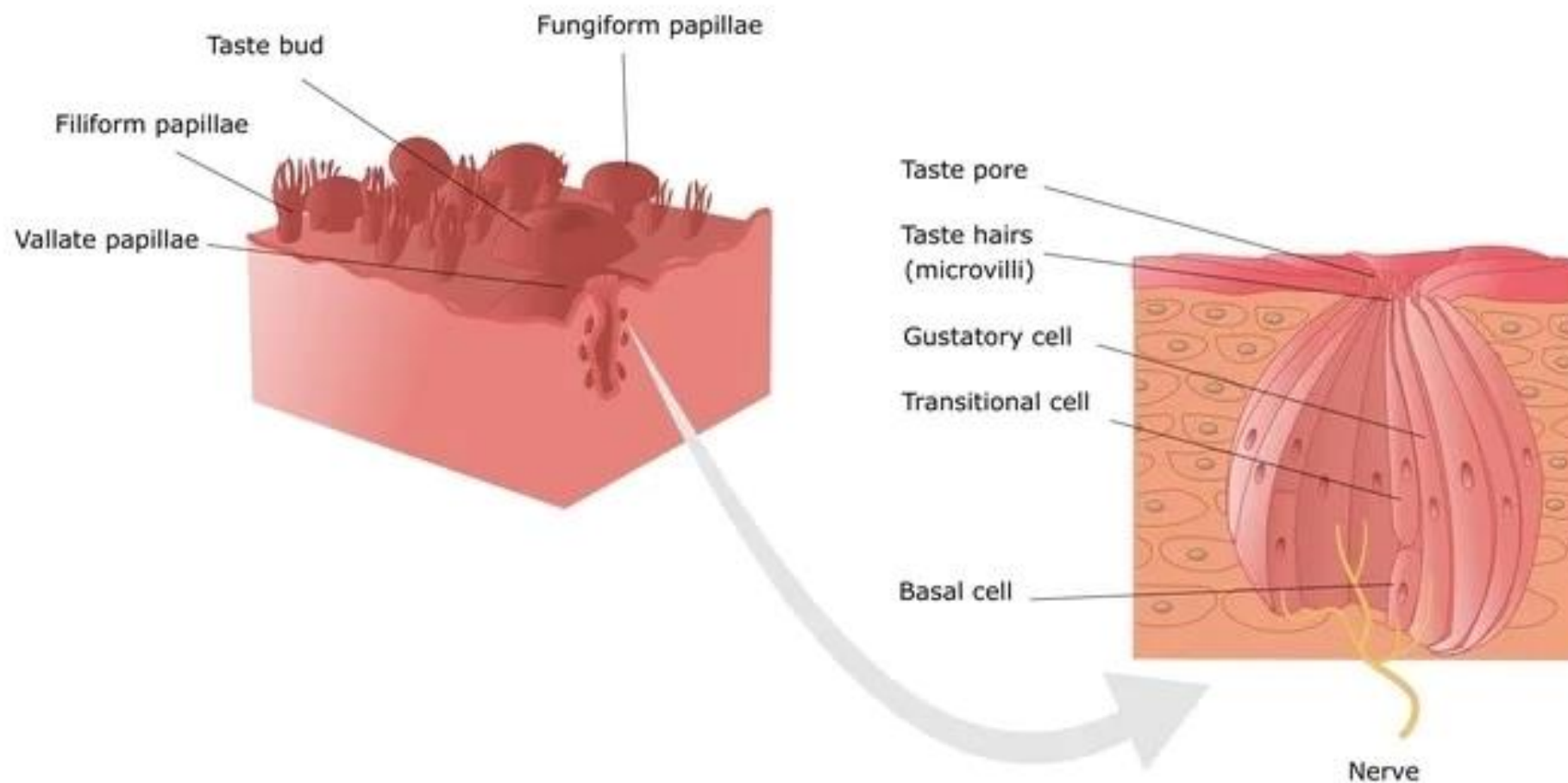
Context? Let's zoom out!



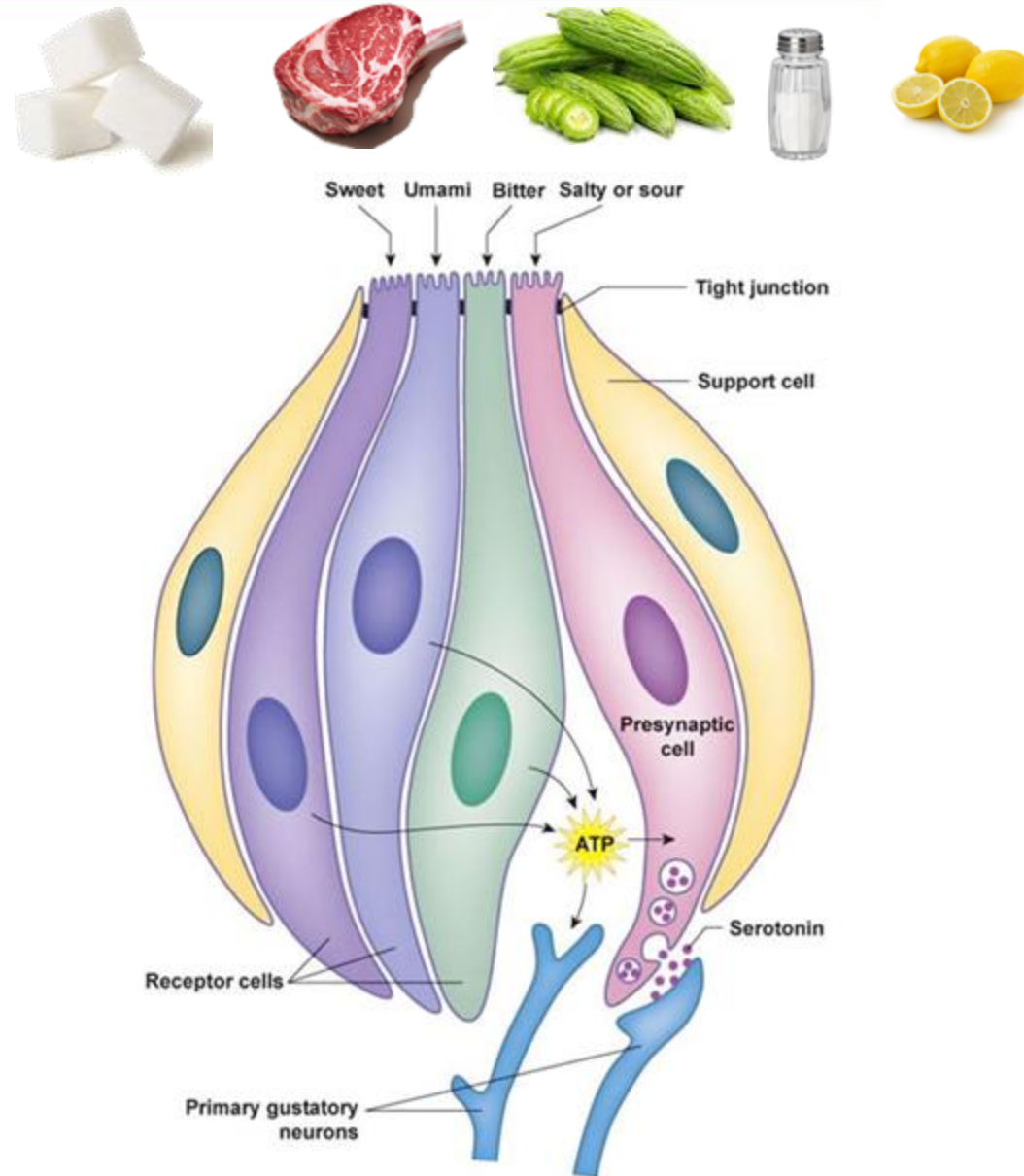
The Science of Bitter Taste

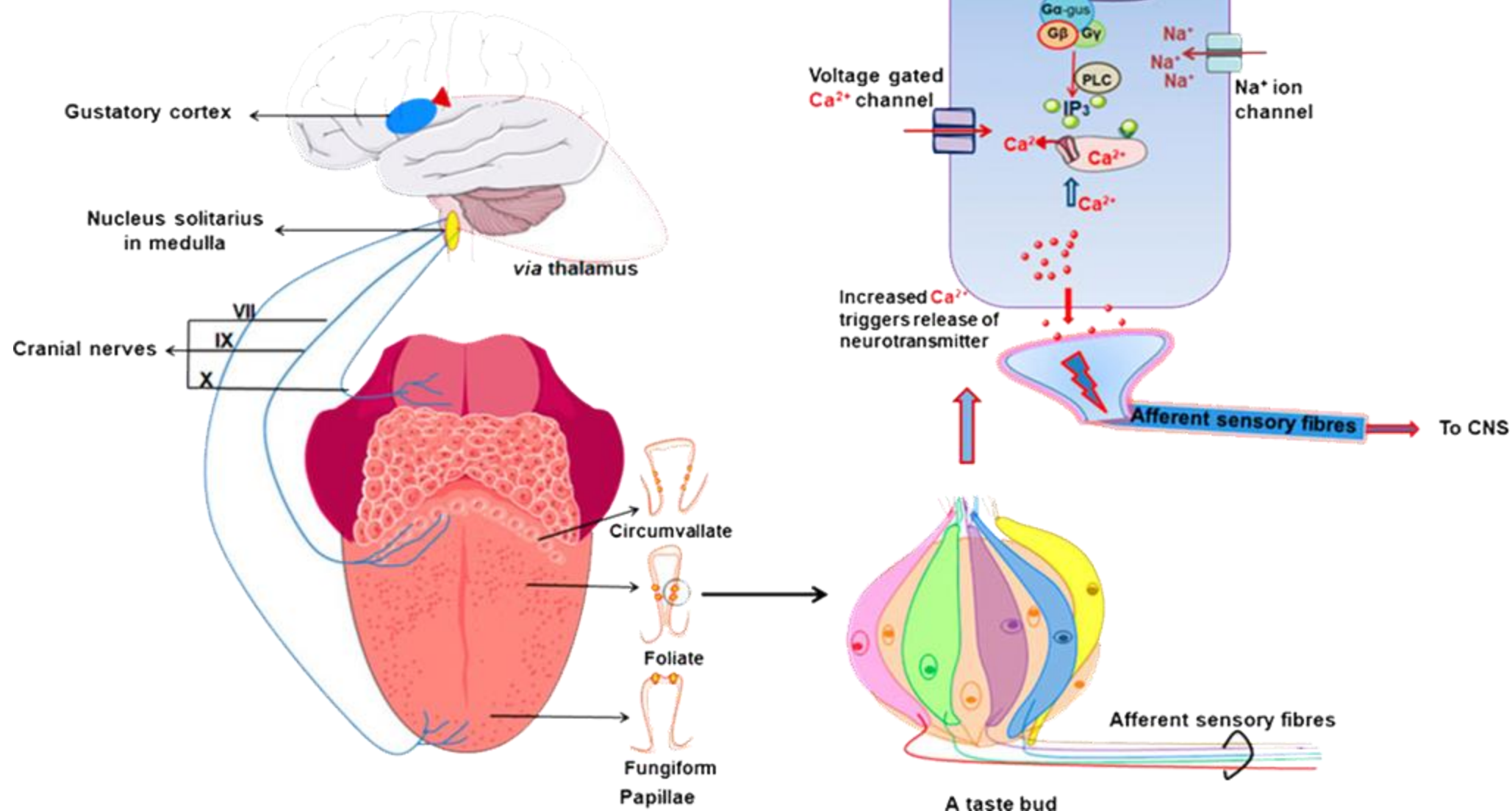


Taste Bud? Or Taste Pore?



<https://www.news-medical.net/health/Genetics-of-Taste.aspx>

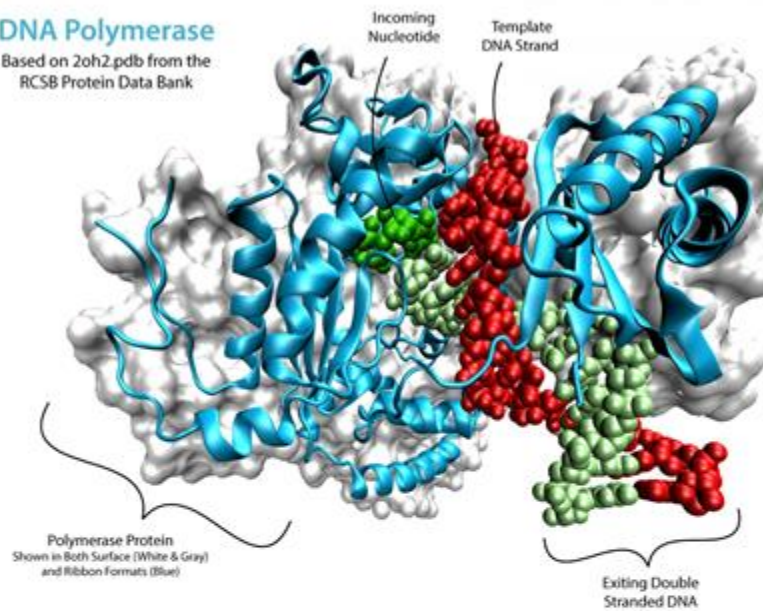




But how?

DNA Polymerase

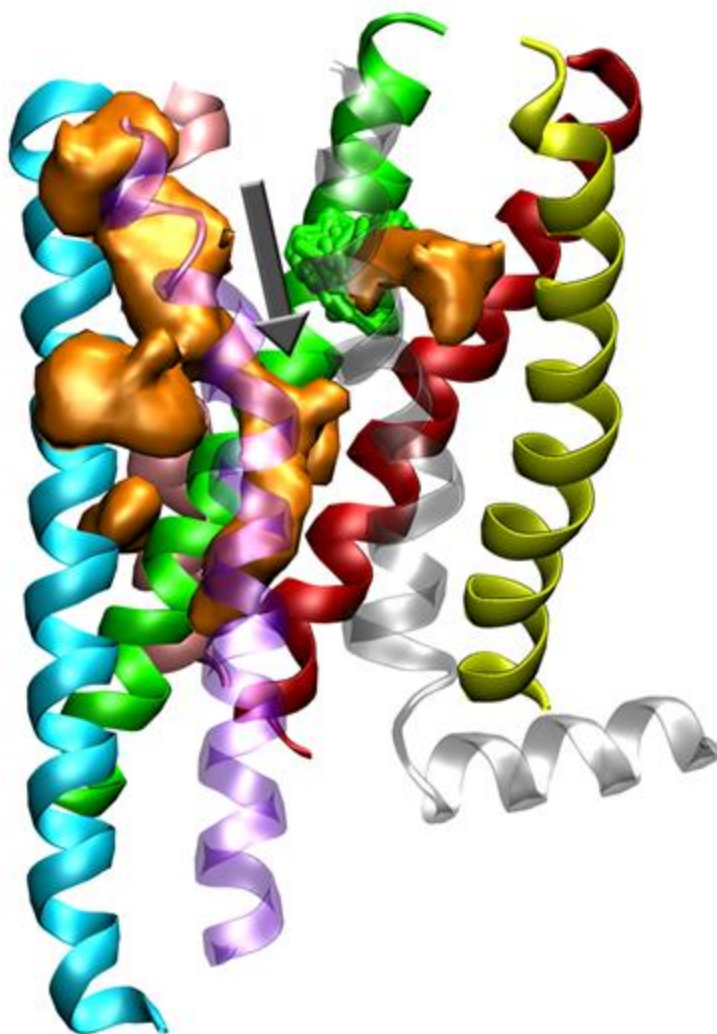
Based on 2oh2.pdb from the
RCSB Protein Data Bank



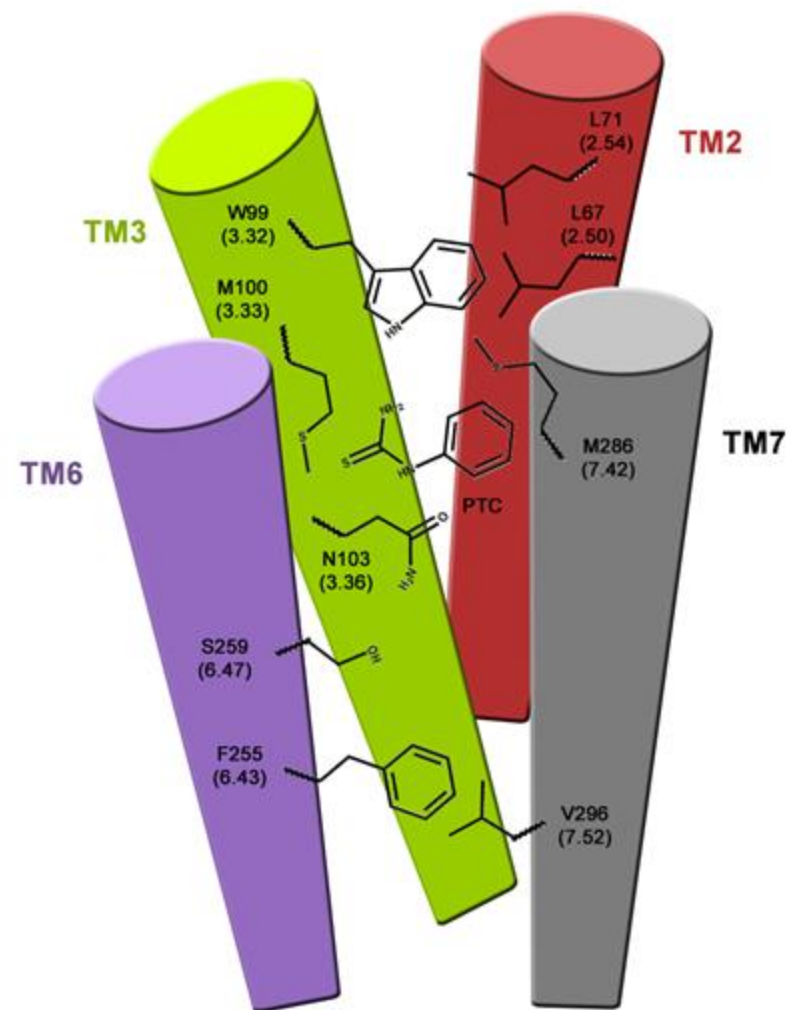
*Life is
Complicated*
Let's deal with it. . .

TAS2R38 bitter taste receptor protein

A



B



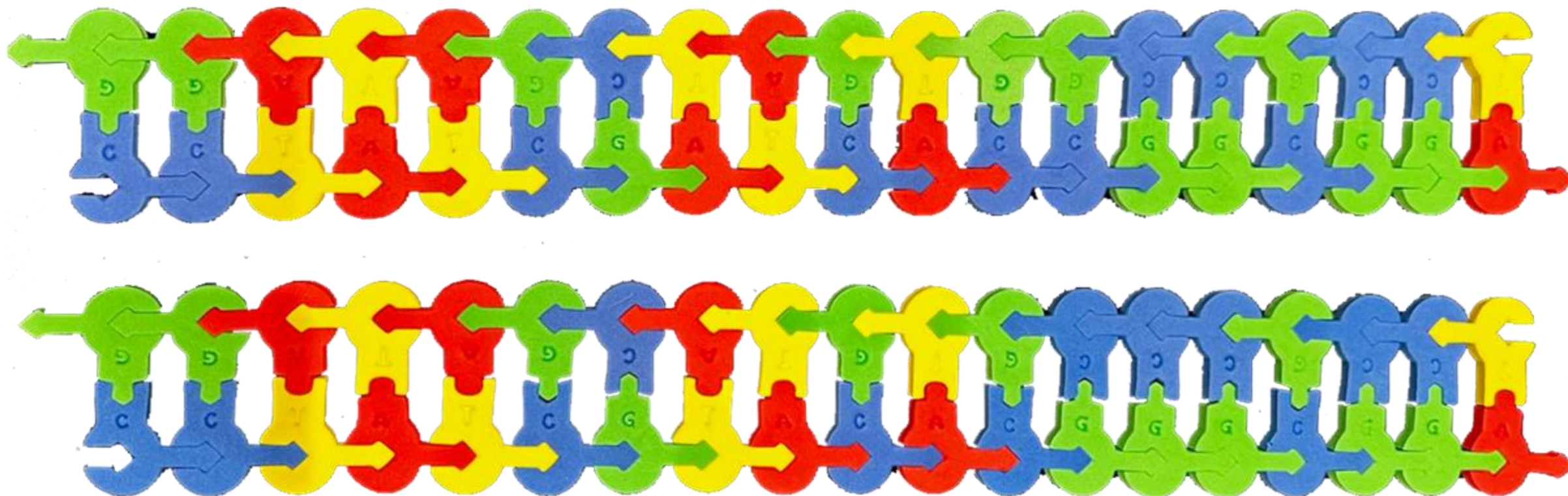


<https://www.genecards.org/cgi-bin/carddisp.pl?gene=TAS2R38>

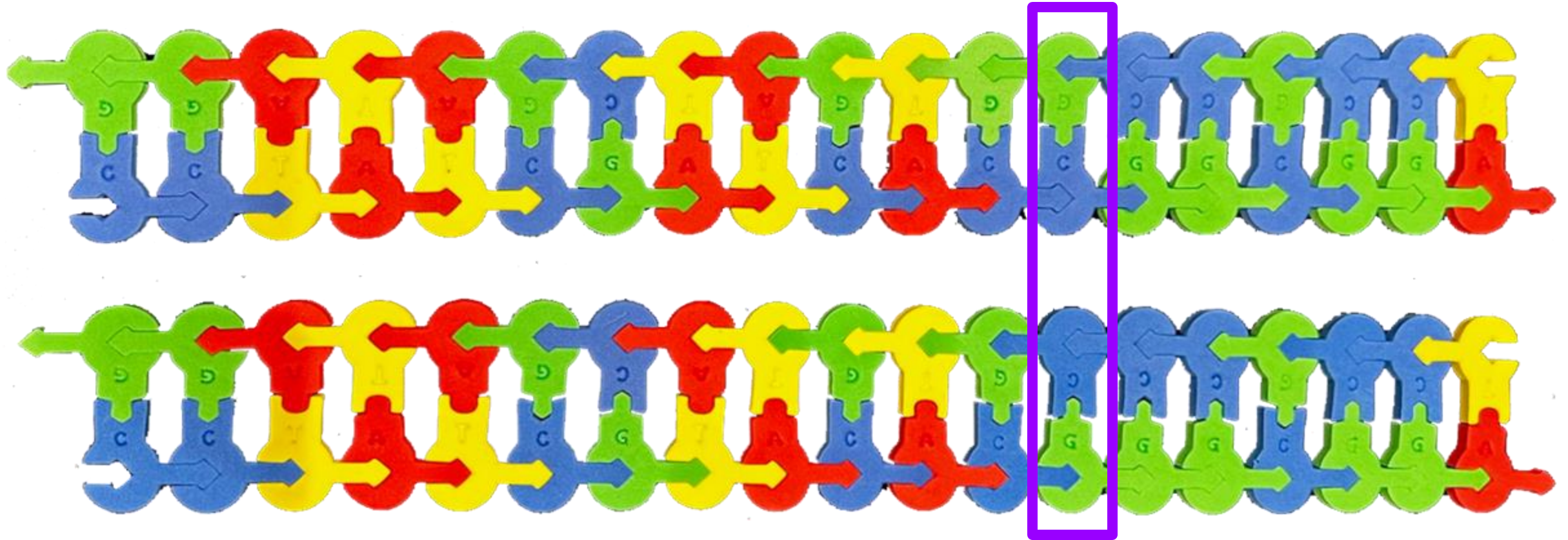
TAS2R38 bitter taste receptor gene...



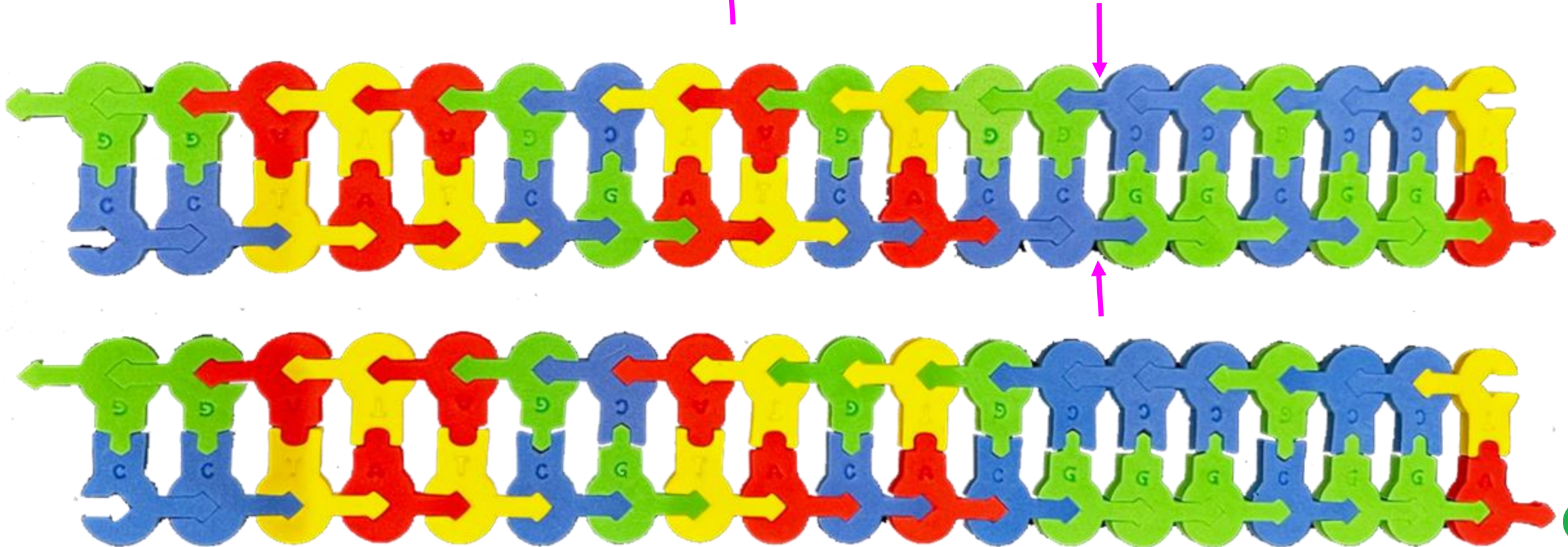
Can you find the SNP?



TAS2R38 bitter taste receptor gene...



HAE Cut site: GGCC
CCGG



TAS2R38 bitter taste receptor gene...

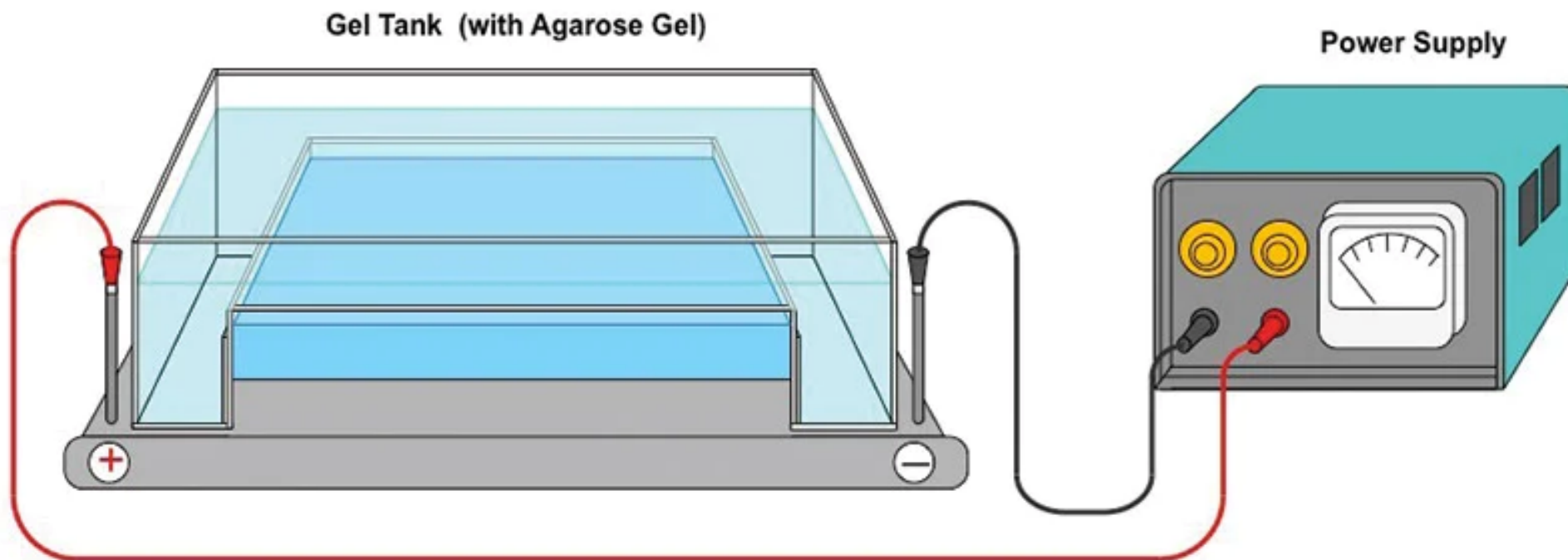
HAE Cut site: GGCC
CCGG





Electrophoresis!

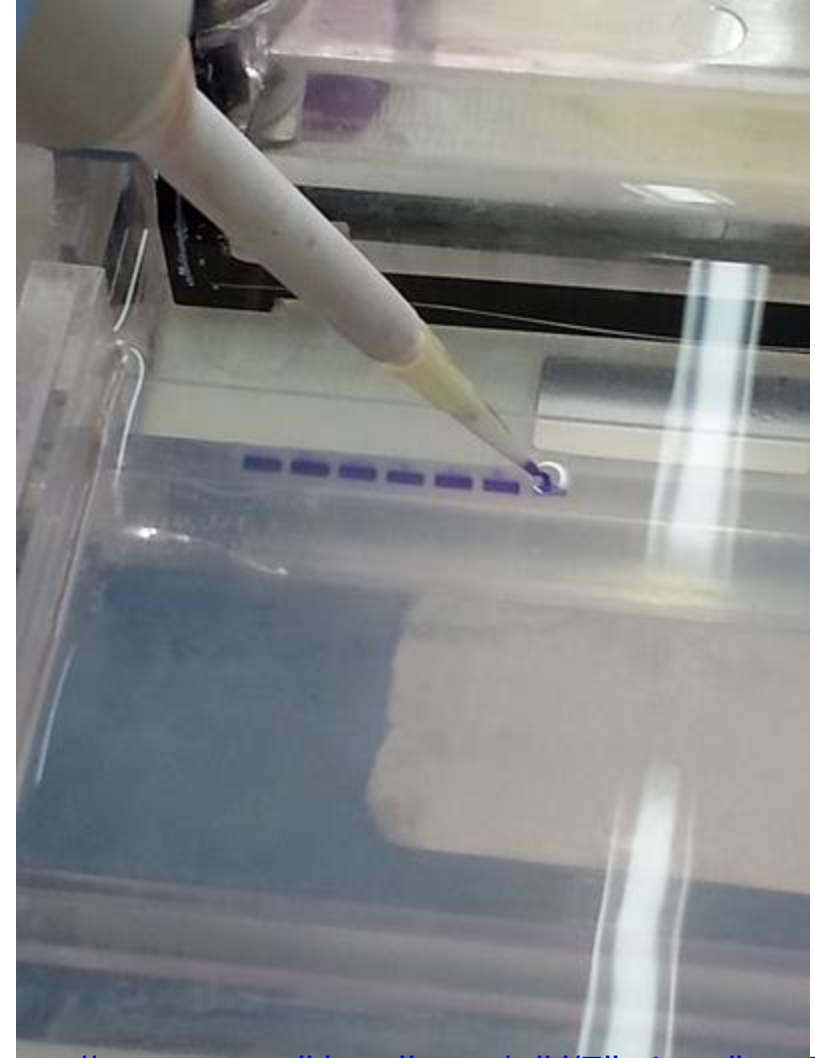
Agarose Gel Electrophoresis



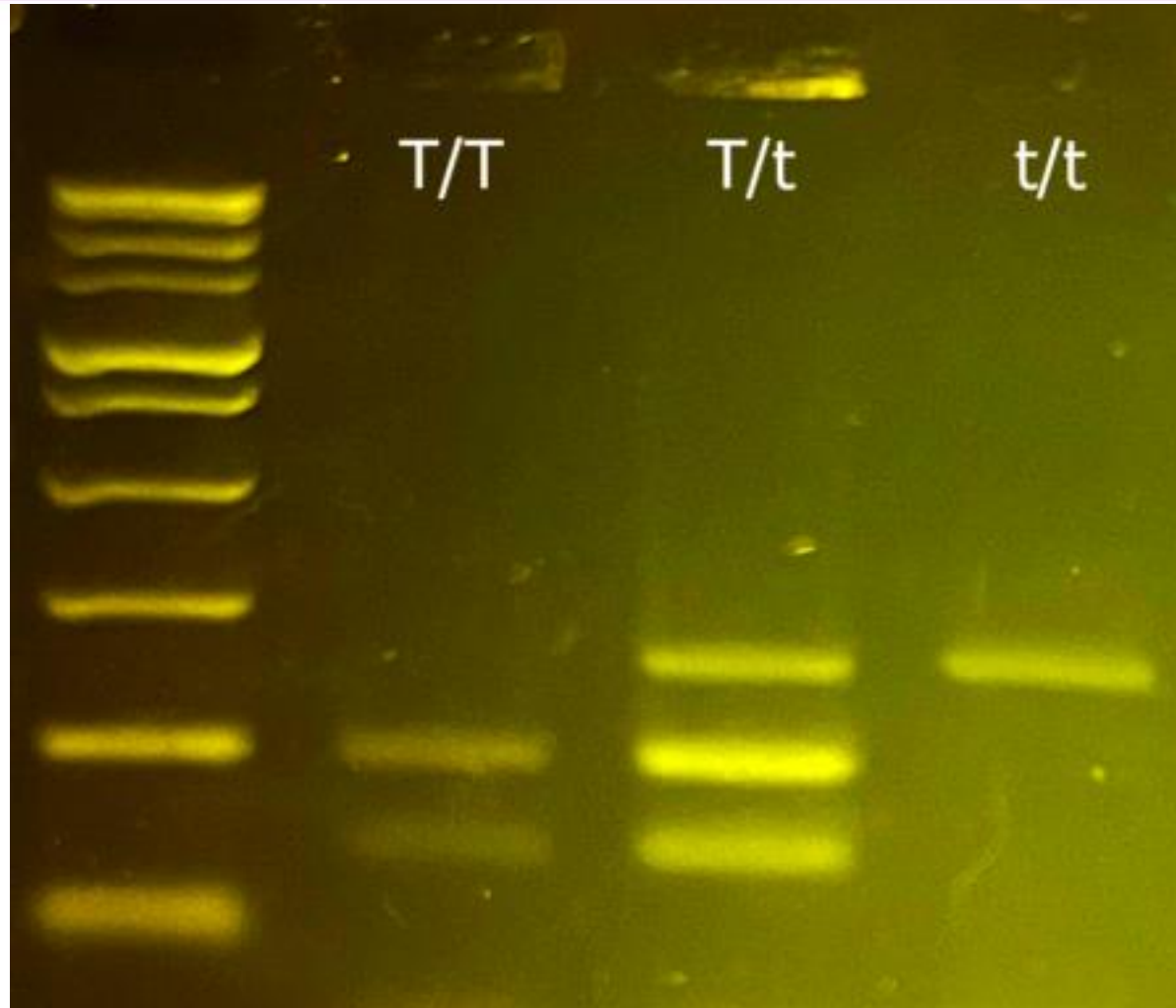
<https://microbenotes.com/agarose-gel-electrophoresis/>



Remember, your table is an electrophoresis apparatus!

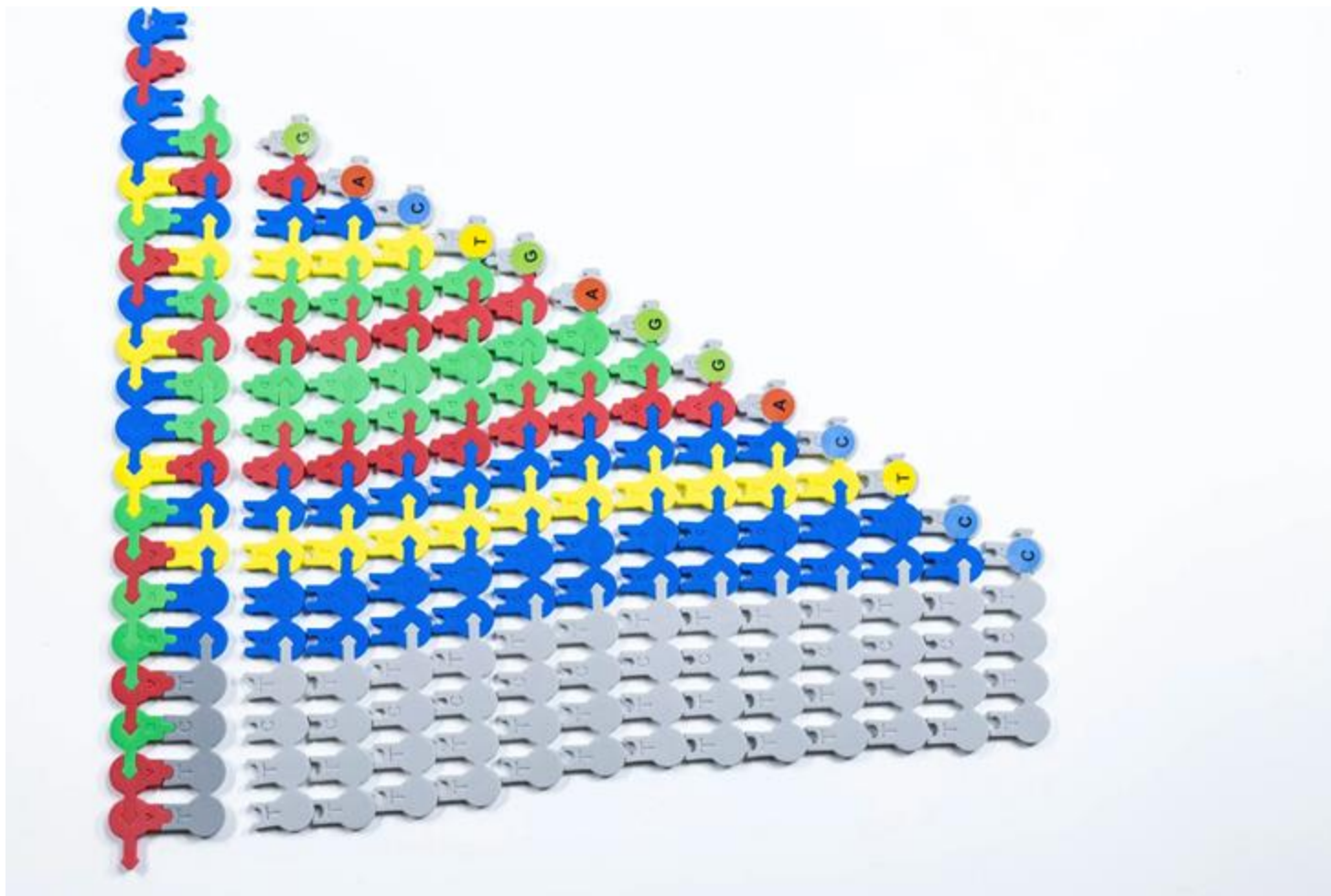


https://commons.wikimedia.org/wiki/File:Loading_DNA_sample_into_to_agarose_gel_electrophoresis.jpg

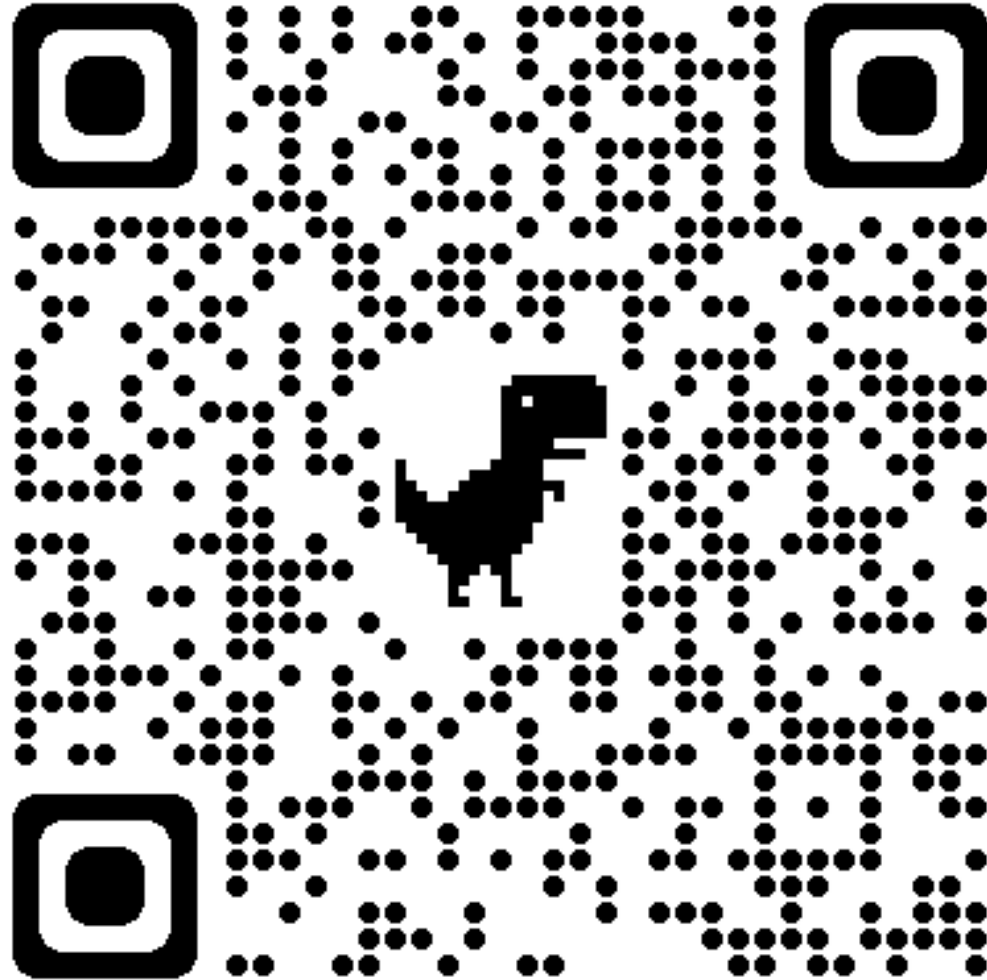


<https://www.minipcr.com/product/minipcr-genotype-to-phenotype-ptc-taster-lab/>

Sanger Sequencing



Summer Courses!

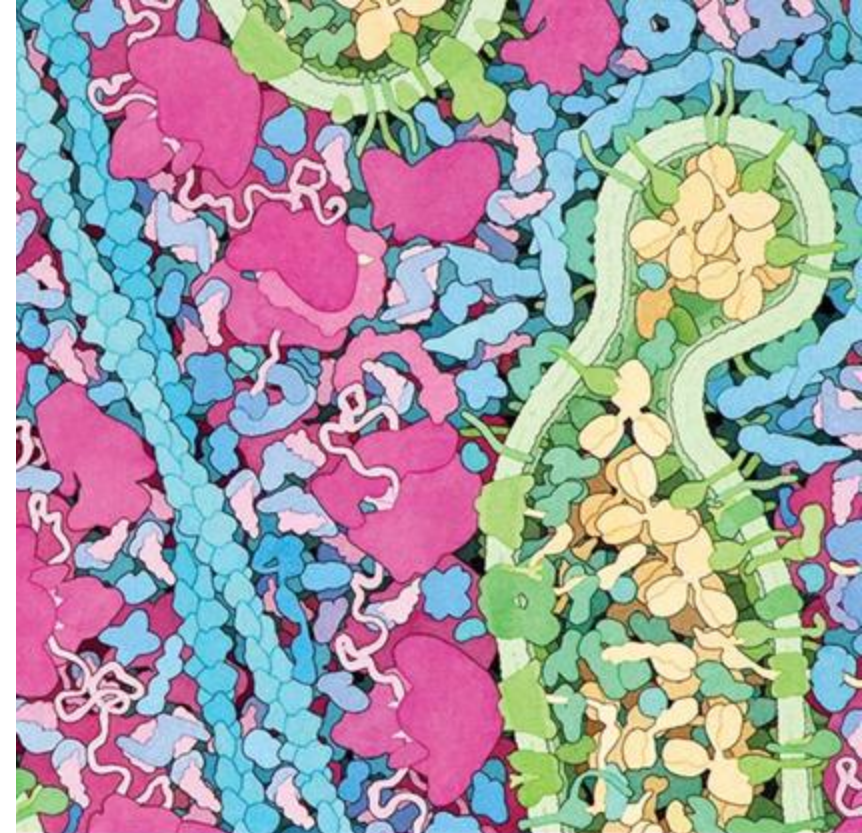
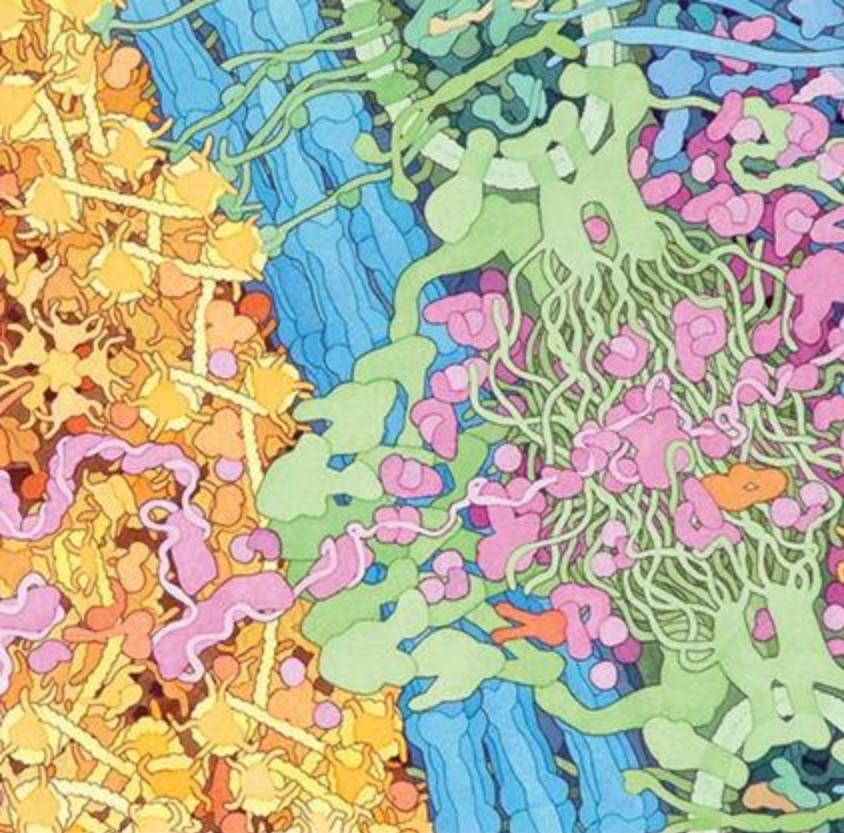




THANK YOU!!

Remember the
conference discount
code: **SC23**

Keri Shingleton
kerishingleton@gmail.com

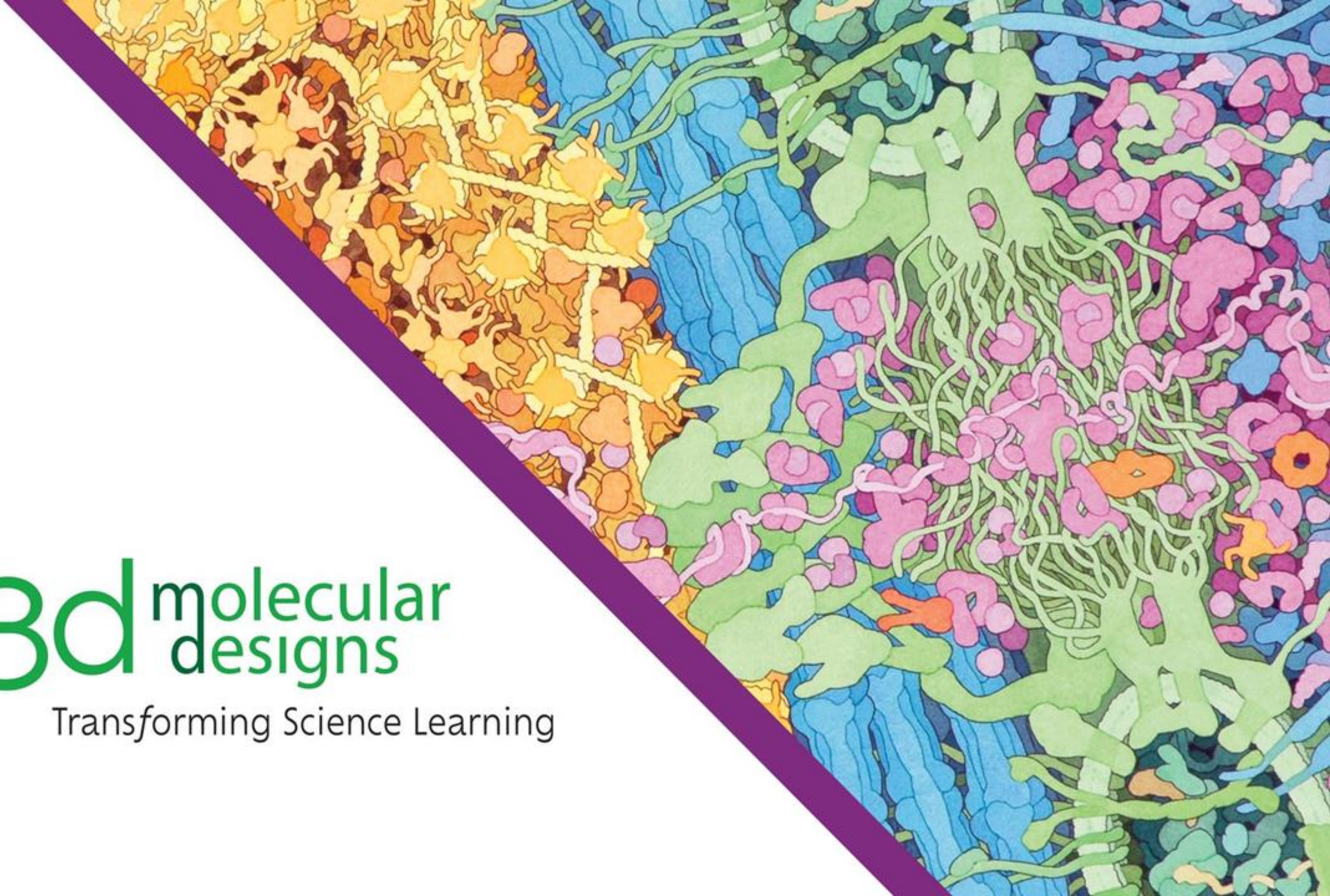


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