DNA Week 2: Structure

SKILLS/OBJECTIVES

- Re-emphasize last week's exploration concerning "what is DNA" by analyzing key structural and replicative features of DNA and understanding why strands are formed in the way they are.
- Building a model guided by a set of rules and understanding how these seemingly arbitrary patterns influence the real life power of DNA.

MATERIALS

- Pictures of full DNA & labeled Nucleotide– a few to disperse throughout group
- 8 Model kit baggies (7 with enough for 10 nucleotides/5 BP long strands, 1 with only 8NT/4BP)
- Twizzlers (for homemade DNA strands)
- Pastel Marshmallows (for homemade DNA strands)
- Toothpicks

NOTES

A good idea for Activity 2 and on is to break the big group down into smaller groups and have the guided exploration be led by a few different volunteers for these groups, probably less difficult to stay focused/on track with more individual attention. As there are only so many DNA model kits, each person can monitor and help out a few groups with building – volunteers will want to look at the model kit booklets BEFORE arriving at the school so they will be prepared to help out – it won't be easy, especially for youngers.

BACKGROUND

- What did we do last week? We talked about what DNA is, how big it is, even extracted and observed some DNA of our own from strawberries and from cheek cells.
- This week, we're going to go in and look at DNA on the molecular level, at a very small scale. How do we look at things that are so small? (*Microscopes that look using electrons or x-rays instead of light)*
- Have you ever heard of H_2O? It's the molecular formula for water – two hydrogen and one oxygen atoms make up 1 little water molecule. Just like everything else in our bodies, DNA is also made up molecules that are in turn made up of hydrogen atoms, oxygen atoms, and a few other atoms you may have heard of such as carbon, nitrogen, and phosphorus.

Activity 1	**DNA Intro/Human DNA**
Materials	Picture of DNA ladder and nucleotides

- Based on this picture, what would you say the structure of DNA looks like? Kind of like a ladder, right? What part do you think comprises each individual molecule making up DNA, called a nucleotide? It's actually not an entire "rung" of the DNA ladder, just half a rung is a DNA molecule.
- There are two parts to every nucleotide – the part on the outside, which is identical in each unit, which is called the backbone and is made up of phosphorus and sugar molecules, but for our model these parts will just be the backbone unit. Each part of the backbone connects directly to the next part of the backbone, forming a strong and stable unit. STABILITY of the DNA strand is one of the two most important features of DNA. Why is it so important? Because DNA holds all our genetic information, and we need to ensure that is it protected so we can exist properly.
- The other part, the part of the ladder on which you step, is the base pair part. It's called a base pair because, as you can see, they are not all identical and actually pair up with a different base to form the full ladder rung.
- HUMAN DNA Activity – To visualize a full DNA.
    - Make a DNA strand with the kids. Each kid can be either a phosphate, sugar, or nucleotide. The backbone parts should link together by the phosphates holding each sugar beside it, and the sugars should also hold onto the nucleotide next to it. The assigned nucleotides should each have their hands in a different conformation such that A's fit into T's only and same for G's and C's (i.e. one hand vs two hands, fists fitting into open palms)

Activity 2	**Building DNA Models**
Materials	DNA Model kits (see booklets from kit for details on putting them together) Purple = Deoxyribose sugar Yellow = Phosphate Red = adenine Black = thymine Silver = guanine Green = cytosine White tubes = Hydrogen bonds (for between bases) Clear tubes = to connect phosphate-sugar-base (the individual nucleotide)

- Now that you know how the bases interact, **build up a strand of DNA!** Make nucleotides first – one sugar, one phosphate, one base and connections –

and use those pieces to make the DNA ladder. *LOTS OF VOLUNTEER HELP*

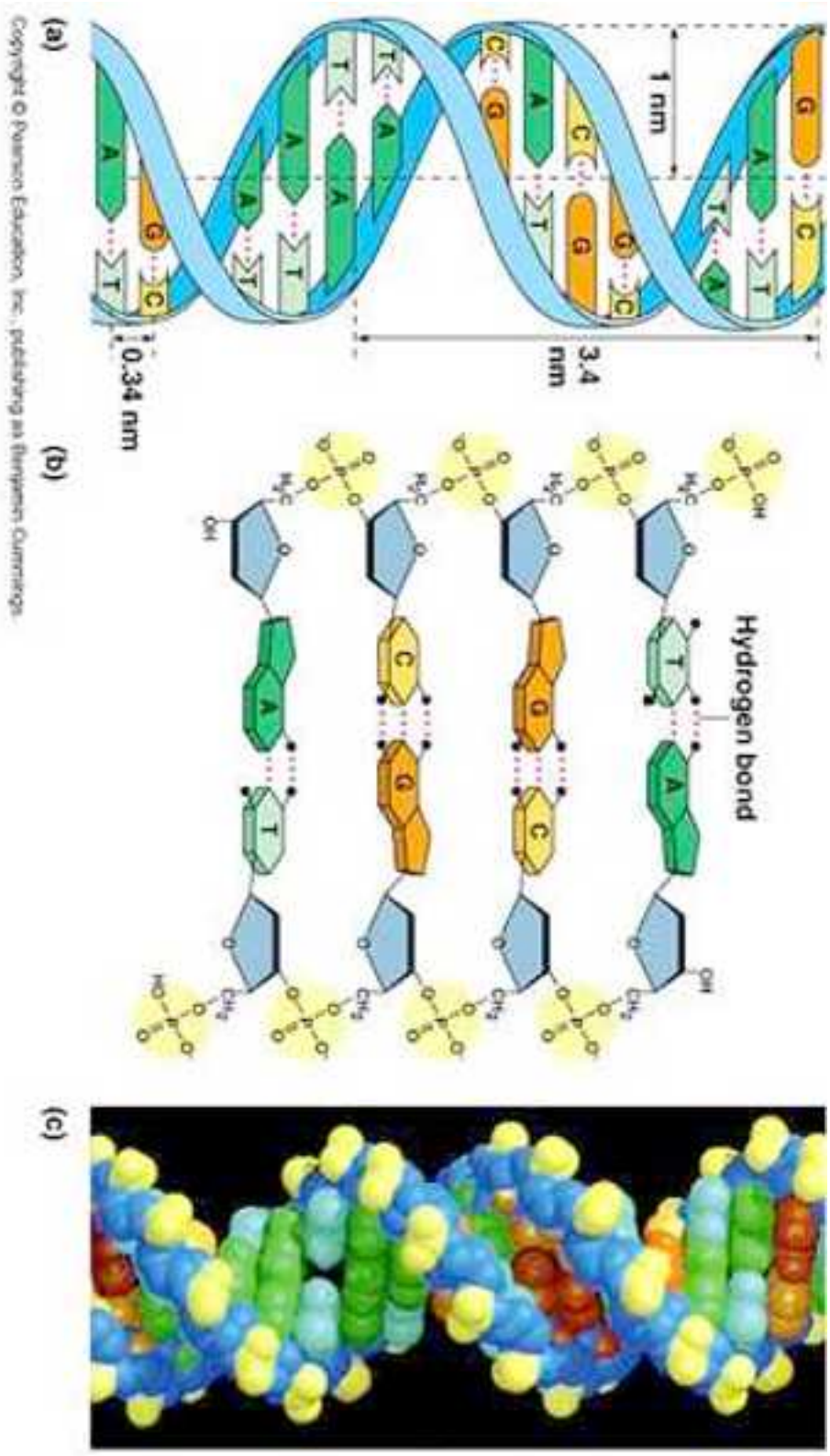
- Once your model is built, compare it with your neighbors. Are they identical, or very different? What parts are the same throughout and what changes?

Activity 3	**Replicating DNA**
Materials	Toothpicks Twizzlers = backbone Yellow marshmallows = adenine Pink marshmallows = thymine Orange marshmallows = cytosine Green marshmallows = guanine

- As we said before, stability is one of the most important features of this DNA model. The second feature is the ability for these DNA strands to be replicated easily. Each cell replicates via the same mechanism, but it is the differences between each model – the base pairs – that ensure that each of our cells get our DNA when they divide. Any ideas as to how DNA does it?
- Make a new DNA segment using marshmallows and twizzlers. Connect yellow and pink marshmallows (A:T) with two toothpicks, and orange and green marshmallows with three toothpicks (G:C)
- Separate the two strands and trade one strand with a partner (don't take apart your kept half). Use more materials to make the complementary strand to the one your partner gave you, keeping in mind the base pair rules. Once done, compare the new strand with the partner's old strand – they should be identical. This is how DNA replicates at an extremely fast rate. The ladder-like structure can be zipped and unzipped very easily, and either side can be used as a template strand on which a new piece for another cell can be modeled off of.
- <u>BACTERIAL CELL DIVISION GAME</u>:
  Background: Bacteria DNA is like our DNA, and when a cell reproduces it will divide itself into two identical daughter cells. The way human DNA transfers from parents to children is slightly more complicated.
  Activity. In small groups, have one person – mother cell - start by building a small DNA strand. When its time to divide, have them give one strand to a partner and then have both "daughter cells" build their DNA back up to two strands. When it is time to divide again, each daughter cell should now become a mother cell and give a strand to another person, and now all four new daughter cells can replicate the DNA for four identical sets of DNA.

CONCLUSIONS

We've said before that DNA is what stores our genetic information, and each of us has different genetic information. The difference between my information and your information comes from the pattern of bases, which is read directly to inform the molecular makeup of our proteins. It's amazing how a language of just four different pieces can create such diversity of life. Next week we'll talk more about how DNA makes us different and this information is passed on – this is called genetics!



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