

Green Genes: a DNA Curriculum

Massachusetts 4-H Program

Activity #2: Build Your Own DNA Model from Paper Parts

Time: 45-60 minutes

Introduction to Group:

Ask the group what DNA is. Make sure the key concept of it being a genetic code is brought up. It is a language that is made up of 4 characters unlike the English language, which has 26 letters. The arrangement is critical, so spelling counts. Do they know what a DNA helix looks like? What are models and why are they used? Explain that they will work in pairs or small groups to make a small section of a DNA model. Each character (Nucleotide Base) will correspond to a different color in their model.

Goals:

- DNA has only 4 different nucleotide bases.
- The nucleotides always pair up the same.
- Each strand runs in opposite direction.
- There is a backbone made up of a sugar and phosphate group.
- Models are often used to show an object that is either too large to be practical, like model cars, or too small, in the case of DNA.

Group Size: 2-4 youth per group

Supplies:

- Scissors
- Tape or staplers and extra staples
- Base templates (See Handouts 2-1 through 2-4)
- Sugar and Phosphate Templates (See Handout 2-5)

Teaching Tips:

- Print handouts onto card stock (which will stand up to the handling involved in this activity).
- To be able read the sequence of the assembled DNA molecule without looking at the written names on the bases, you can use the following color scheme* for your card stock. (These card stock colors are easy to obtain at most copy shops or stationary supply stores.)

Green → G → Guanine

Red → Cardinal or Crimson → C → Cytosine

Blue → Azure → A → Adenine

Yellow → Tweety Bird → T → Thymine

Purple → Phosphates & Sugars make up the backbone



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- (We generally prefer to make the backbone a single color. While Brown would be more consistent with Backbone, purple card stock is easier to find and makes the model more colorful.)
- *This DNA color scheme is part of the DRuMS suite of color schemes, developed for use in 3D computer graphics. See <http://www.umass.edu/molvis/drums/> for complete details.
- Each sheet of base pairs can be cut in half and split between two groups. If each group gets a half-sheet of each nucleotide base pair, the group will need two full sheets of the sugar/phosphates. (It is recommended that these be purple.) 5 each of 4 base pairs = 20 matching sugar/phosphate groups.
- Although this activity seems "easy" at first, our experience with different groups shows that building the paper model of the DNA helix is surprisingly challenging. People work in pairs to cut down on the cutting required to generate the parts. The model itself is fairly simple, yet assembly demands that the participants recognize the components of a DNA building block, figure out that the base-pairs fit together as a consequence of the size and shape of the helix and then discover that the strands in the DNA double helix must go in opposite directions in order for the parts to fit!

Directions:

1. Cut out the patterns for the 4 bases, sugars, and phosphates. Give everyone in the group some of each.
2. Each person tapes a chemical base to a sugar molecule by matching up the dots.
3. Tape a phosphate group onto your model by matching up the stars. You now have one basic building block of DNA – a nucleotide!
4. Make as many nucleotides as your materials or the time will allow.
5. Now check in with the group leader/teacher before proceeding! If you have to wait, play around with your nucleotides to see how they might all fit together!
6. After step 5, proceed with making one DNA strand, and then the other. Admire your model!
7. Select one person from each group to tape your group's model to another model.
8. Twist carefully, and hang it up where everyone can admire it!



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Debriefing/Reflecting:

- What have you made? (A representation of DNA that includes the double helix structure.)
- How do the colors line up? Why? (Purple on outside/give structure. Blue always pairs with yellow, and green always pairs with red.)
- What do the different colors represent? (Blue – The Adenine nucleotides, Green – the Guanine nucleotides, Yellow – the Thymine nucleotides, Red – the Cytosine nucleotides, & Purple – Deoxyribose Sugar and Phosphate.)
- How do the nucleotides pair up? (C-G and A-T)
- What do the rungs represent? (The nucleotide base pairs)
- How many different nucleotides are there in the rungs? (Four)
- In which ways does your model represent a real DNA molecule? (Base pairs, double helix...answers will vary)
- How does your model vary from a real DNA molecule? (Size, materials....)
- What does DNA carry? (Information necessary for us to live and develop.)

Apply:

- In what other things have you made models?
- When else might a model be helpful?
- Are there others things that always match up?
- We say DNA is a molecular language – what other languages are there and what are they used for?

Go further:

- Study more about nucleotides and how groups of three correspond to a particular amino acid.
- Learn more about RNA and its role in making proteins- how does it's structure compare to DNA's?
- Visit the human genome project website or other project mapping the genome of rice, corn, dogs....

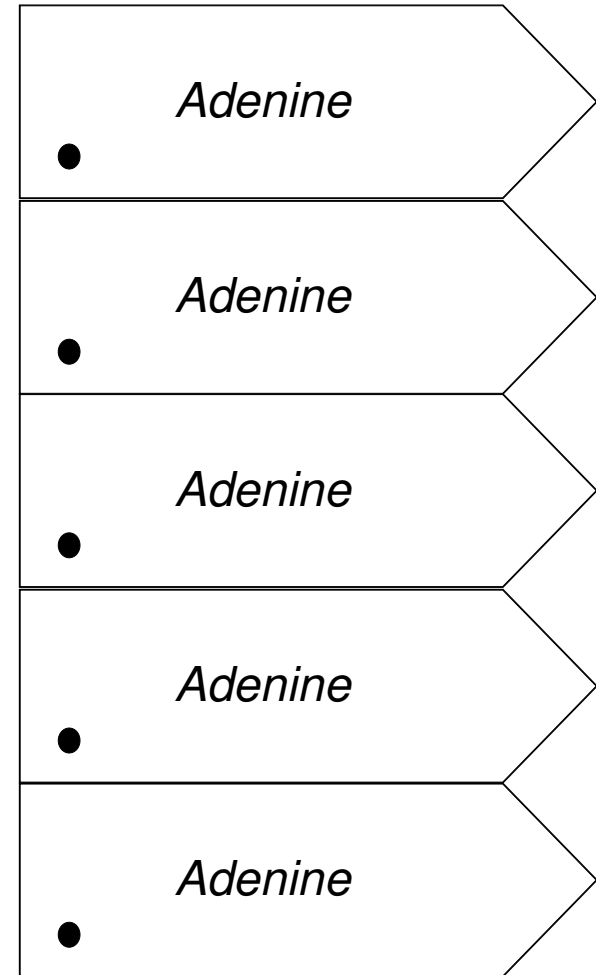
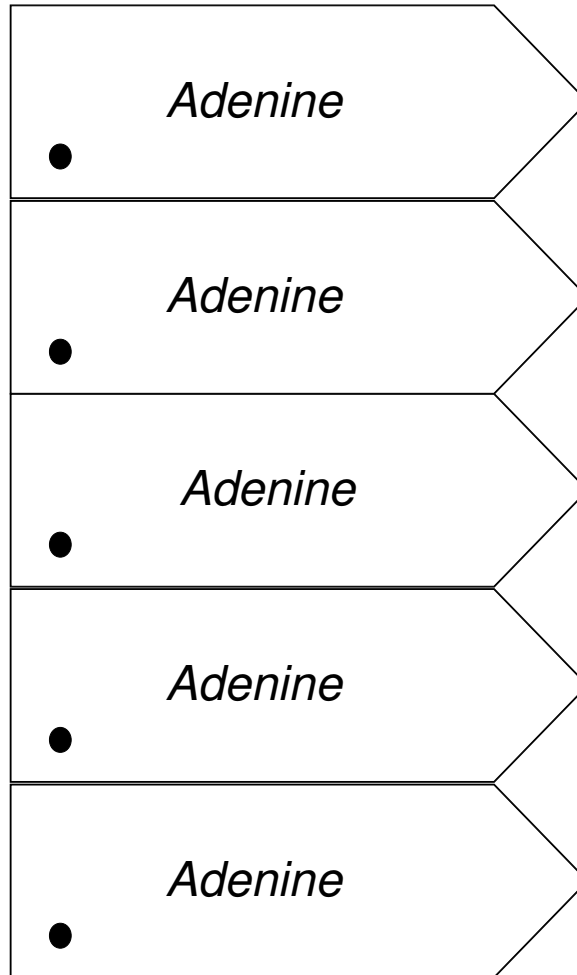
Reference:

Adapted from online <http://www.mcps.k12.md.us/departments/isa/ninvest/dogma/ballesson.htm>



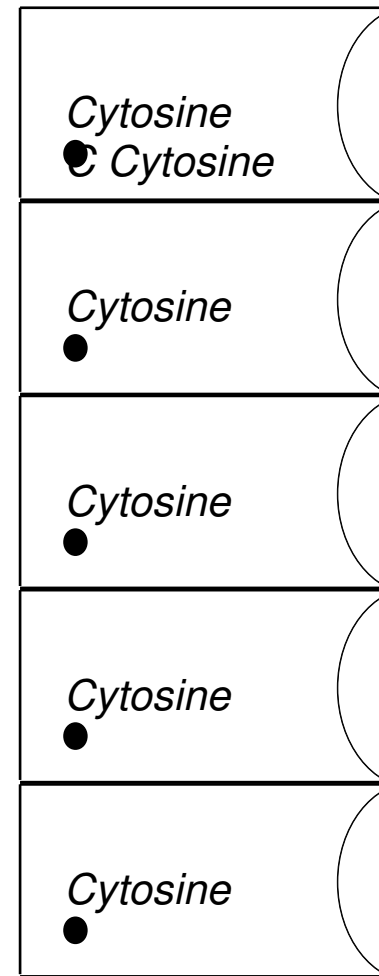
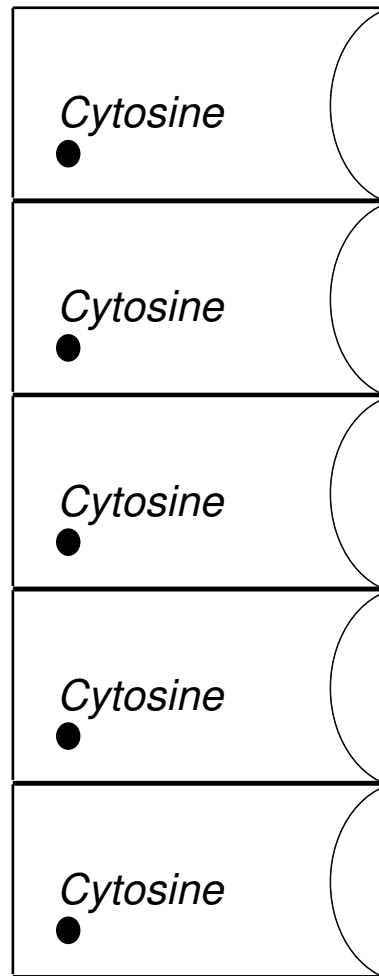
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Handout 2-1-(Print on Blue Cardstock)













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Handout 2-2-(Print on Red Card Stock)

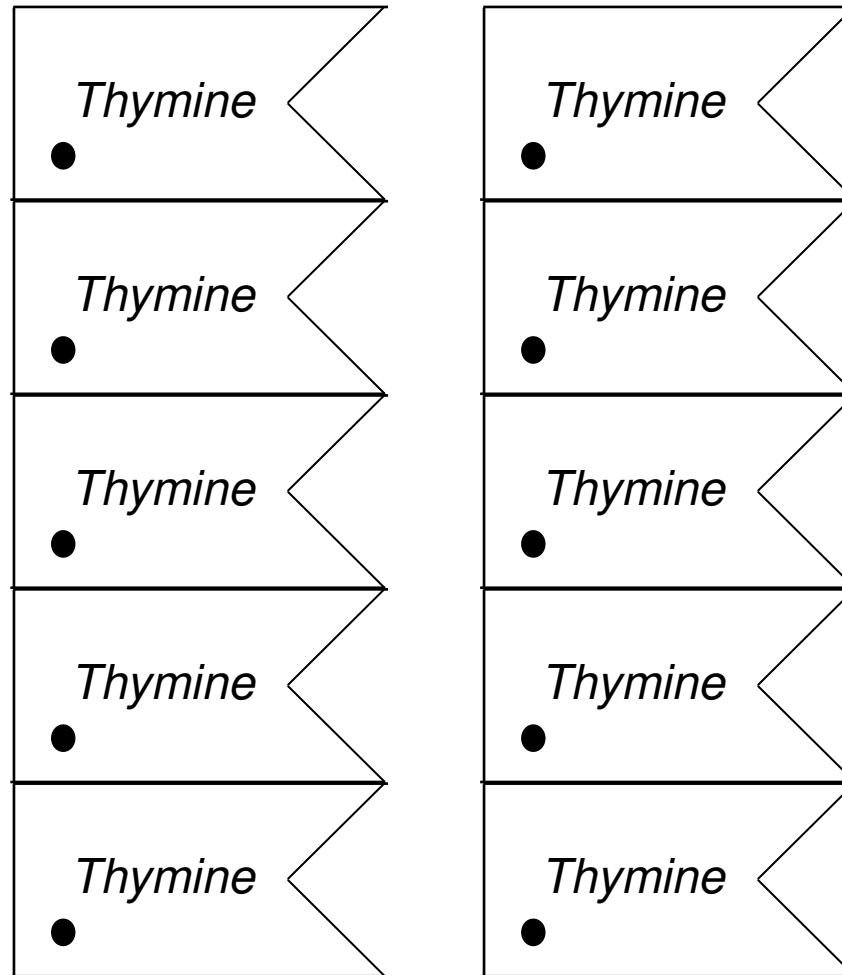


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Handout 2-3-(Print on Green Card Stock)

 <i>Guanine</i>	 <i>Guanine</i>
 <i>Guanine</i>	 <i>Guanine</i>
 <i>Guanine</i>	 <i>Guanine</i>
 <i>Guanine</i>	 <i>Guanine</i>
 <i>Guanine</i>	 <i>Guanine</i>

Handout 2-4 – (Print on Yellow Card Stock)



Handout 2-5

(Print on Purple Card Stock)

