

C. Rudolph & L. Williams

Adventures in Cellandia

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A Protein Synthesis Story

1. All the members of the kingdom of Cellandia are candy makers. In some capacity or another everyone is responsible for the production of candy. As a matter of fact, candy is what makes Cellandia and its neighboring kingdoms function in the proper manner. Without candy, Cellandia would be no more because candy is the driving force behind every function in the kingdom. Candy was what made Cellandia, ...well.."Cellandia."
2. Cellandia has a King. His name is King DNA. The only frustrating thing in the kingdom is no one but the king knows what candy is to be made on which day or at what time. This normally wouldn't be a big deal except for the fact that King DNA would never ever leave his Nucleus Castle. It's not that he would never leave; the fact is he couldn't leave. He often wanted to go out into the cytoplasm to meet his subjects for he is a good King and loves his citizens, but he is just too fat. King DNA is a double helix and a double helix is just too large to get through the Nuclear Pore gates to wander about in the cytoplasm. Another problem experienced by the King is his language barrier. The King speaks DNAsian, a language that only his scribe can understand, but the remainder of the Cellandia citizens can't. Even though the king never leaves his castle, he controls every aspect of the candy making activities. He even decides when new candy factories should be established by regularly consulting his Nucleolus Journal.
3. Nevertheless, the king keeps tight control on the processes that occur in Cellandia so that candy is delivered on time to keep his kingdom in good working order. The candy that is used by Cellandia itself is also used by other surrounding kingdoms for important and vital functions.
4. The King calls in his scribe each day to write down his candy recipe instructions. He keeps his recipe inside his front coat for safety purposes. The scribe is a single stranded, skinny fellow named "Herald." He got his name from the Ribosome assembly workers because he is a messenger of important news. Herald announces the crucial news of which candy is to be made in the factory. Herald is an mRNA molecule (the m standing for "messenger"). Because he is skinny he can easily fit through the Nuclear Pore gates that allow one to move into and out of the Nuclear Castle.
5. When the scribe arrives the king unzips the front of his jacket and pulls out the secret candy recipe that is written in DNAsian code. The code is in a sequence of four letters, A, C, T, and G that are written in groups of three. These groups of three letters each are called codons.
6. Writing the recipe code is a rather tedious process and not without its issues. Herald the mRNA doesn't just write the DNA code, he writes the "complementary"

Cindy Rudolph & Leigh Ann Williams - Hopewell High School - Huntersville, NC

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mRNA code. This means that if DNA has a G then he writes a C. This whole complementary code concept came about because mRNA is single stranded and not a double helix, thus he never learned to write the letter T, so instead of using the letter T as in DNA he uses the letter U. (This should be a lesson to us all that if we don't work hard in school and learn the right things that it makes life much more difficult in the future!)

7. Herald holds one of the most important jobs in the kingdom. If he makes a mistake he could damage the entirety of the candy production and upset the balance of Celandia and the neighboring kingdoms. Occasionally a mistake is made of one kind or another; when this happens Herald calls his mistake a mutation. Yet, most of the time, he is right on the money!
8. Herald the mRNA takes the transcribed message from the Nucleus Castle to the ribosome factories so the candy can be made. This whole hullabaloo of getting the recipe from King DNA to the factory is called transcription.
9. Once the recipe arrives at the factory and workers decipher which type of candy is to be made, one of the factory workers calls for the transfer trucks. The transfer trucks bring the raw materials to the Ribosome Factory so the candy can be assembled.
10. These transfer trucks (called tRNAs) haul the raw materials one by one to the ribosome factory where they unload their raw material and place it in the order that the mRNA transcribed message calls for. There is one raw material for each three letter code. These transfer truck drivers not only haul the raw material but have to translate the candy recipe so that the other citizens of Celandia can understand it and use it for a specific purpose.
11. Each tRNA backs into the Ribosome Factory dock and unloads his raw material. The workers then bind the individual raw materials together to make a chain. The process of getting the specific raw materials to the factory and translating Herald's mRNA code is called translation. The mRNA code is translated so that each chain is a piece of candy that has a specific use.
12. Often the ribosome factory makes hundreds or thousands of these chains each day. Sometimes the ribosome factory even changes recipes during the same shift depending on the needs of the citizens or fellow kingdoms. Each candy chain develops a special shape and has a special job within Celandia. Some even act as keys to break down other materials that are locked together.
13. To make the factory work and supply the transfer trucks with gas, a lot of energy is needed. This energy is supplied by Celandia's own Mitochondria Power Plant. This power plant takes the energy from food that is stored in chemical bonds and turns it into ATP energy. Everything in Celandia uses this ATP energy to function.



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14. Once the candy chain is made, the workers dump the chain down a chute called the ER chute. The ER chute takes the chain to the Golgi Packaging Center. Once the chains are at the Golgi Packaging Center they are packaged up and orders are filled by a delivery truck delivering the candy chains to the appropriate places.
15. If more of a particular type of candy is needed for a process within Cellandia, then King DNA is notified and the entire candy making process starts over again!

Questions:

1. What do you think "Cellandia" stands for?
2. The story says "candy is the driving force behind every function in the kingdom." What do you think this means?
3. Using your knowledge of biology, what does "candy" represent in the story?
4. Where is DNA located in the cell?
5. What is King DNA's shape?
6. Can DNA ever leave his location? Explain.
7. What does King DNA consult when he wants to build a new candy Ribosome Factory? So what cell organelle must control the building of new ribosomes?
8. What are the two main responsibilities that Herald has?
9. What is a "scribe?"
10. How did Herald the mRNA get his name? If you could give Herald another name what would you name him?
11. When King DNA unzips his coat so that Herald can copy the information, what types of bonds are broken? Name another process in which these types of bonds are broken as the first step of the process?
12. How is the recipe "code" written? What word is used for the three letter code?
13. Given the information in the story, what are the two major differences between RNA and DNA?

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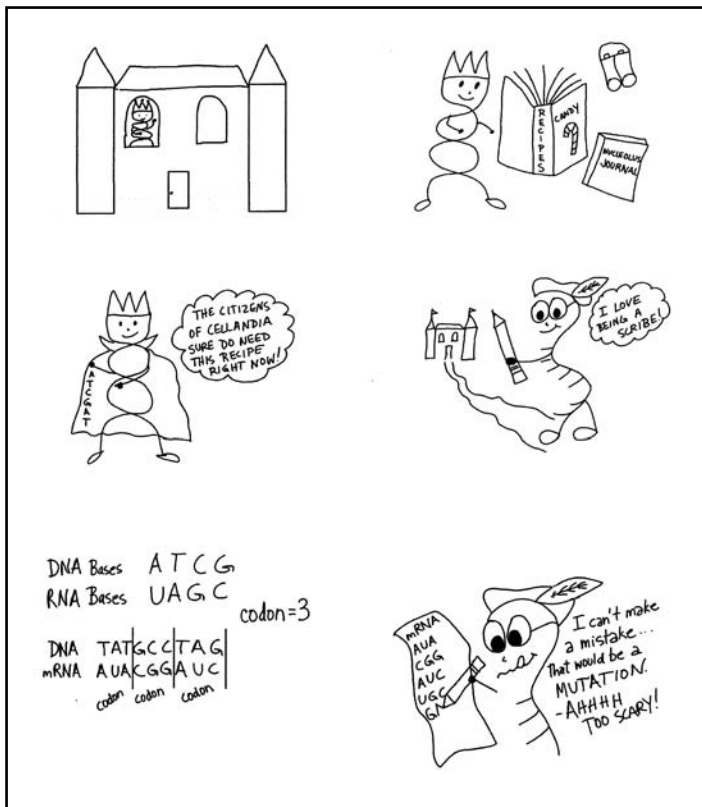
14. What do the letters A, C, T, G, and U stand for?
15. What is a mutation? What could happen if Herald makes a mistake when he copies the DNA code?
16. What would happen if King DNA gave Herald the wrong code? Could that also be considered a mutation? Explain.
17. If King DNA had a mistake in the recipe, would there ever be any chance that Herald could get it right by himself?
18. Where does Herald take the candy recipe?
19. What is the job of the transfer trucks? What is their official name?
20. What do the "raw materials" in the story represent?
21. What shape is the candy manufactured? Would this represent a monomer or a polymer?
22. What do you think the chains are used for?
23. How does Cellandia get the energy that is needed to make the candy?
24. Using the story as a guide, describe the process of transcription.

25. Using the story as a guide, describe the process of translation.

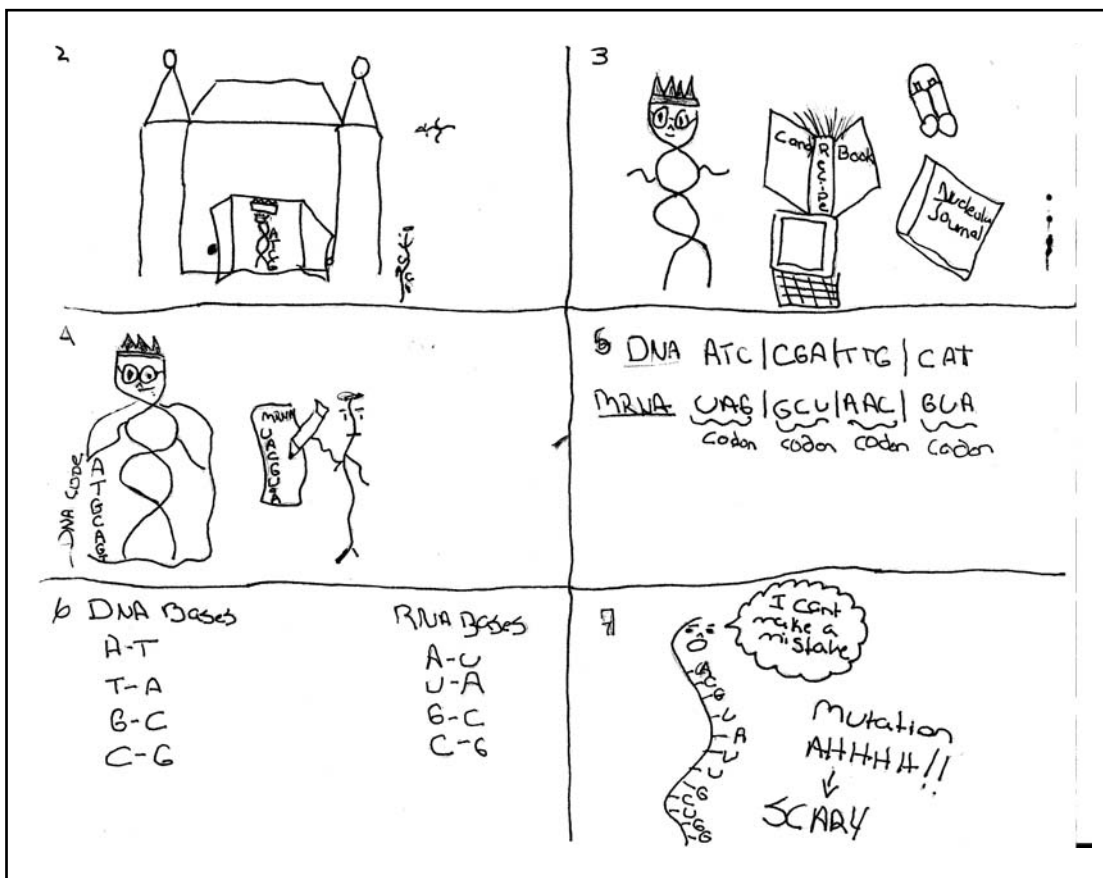
26. Choose a paragraph and illustrate what is occurring in that paragraph.



METAPHORS—STORY USING METAPHORS FOR PROTEIN



Cindy Rudolph provides a teacher example so students may use her ideas for illustration or may come up with their own. Below: A student uses her guidelines but also adapts these to suit her needs.



Cindy Rudolph
Hopewell High School
Huntersville, NC

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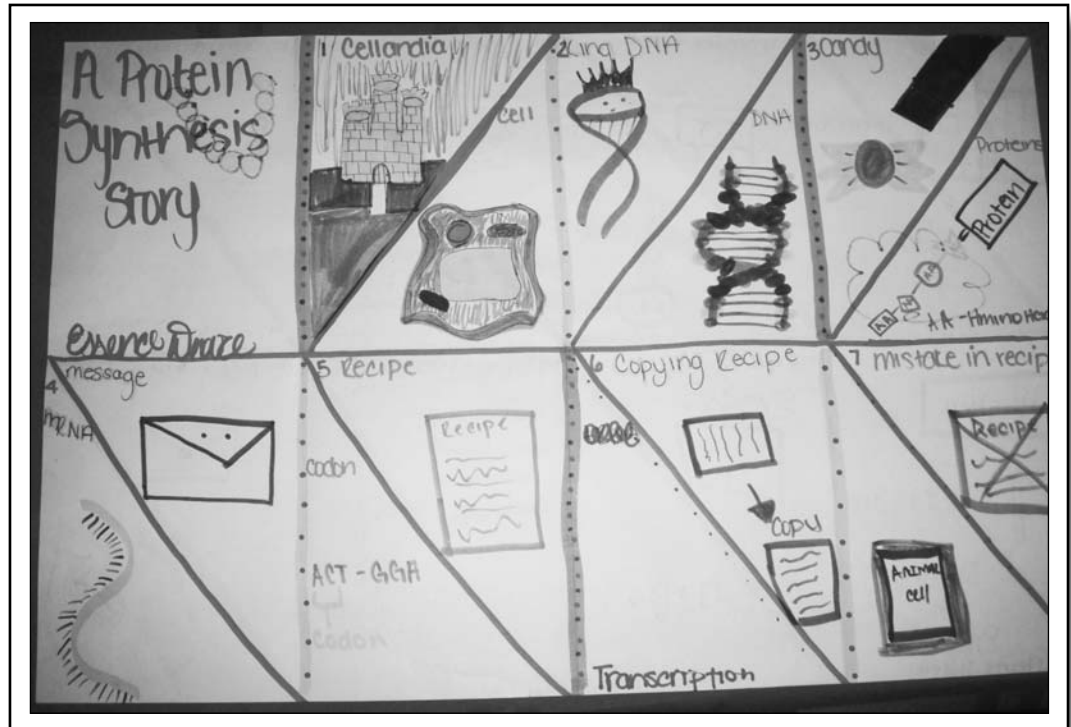
Using an 11x17 sheet of paper, and folding to create boxes, students have 16 boxes to illustrate the protein synthesis story.

By dividing each box in half, students may illustrate the story in one half and illustrate the components of protein synthesis in the other half.

Connections between the familiar aspects of the fairy tale and the unfamiliar aspects of protein synthesis helps students to remember this difficult process.

Stories can be written for almost any process.

Have students create the stories!!!



Renée Brice
Hopewell High School
Huntersville, NC

