- **Unit**: DNA
- **Lesson Title**: Programing and Healthcare
- **Standards Addressed**: Next Generation Science Standards, HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **Objectives**:
  - Students will be able to demonstrate the role of DNA in biological organisms.
  - Students will understand that scientists are able to program and manipulate DNA in bacteria and simple organisms.
  - Students will model the process of transcription and translation.
- **Vocabulary**: DNA, RNA, Protein, Nucleus, Transcription, Translation, Amino Acid, Base Pair, Sense Strand, mRNA, tRNA, rRNA, mutation, Anti-sense Strand, Codon
- **Prior Knowledge**: Students will know the structure and function of DNA, the structure and function of RNA, the role of mRNA, rRNA, and tRNA, the processes of transcription and translation, and the effect of mutations on protein synthesis.
- **Lesson Plan**:
  1. Warm Up: Students will respond to the prompts - How can humans use programming to treat diseases? How does programming relate to our cells?
     a. Students will write on their own then share with elbow partners then discuss with class.
  2. Students will break into groups of four to model transcription and translation in the human body. For this activity each person serves a different role.
     a. Transcriber/mRNA: goes into the "nucleus" and transcribes the DNA sequence into mRNA. Once completed, returns to "cytoplasm" and hands code to ribosome.
     b. Ribosome (1): Translates mRNA sequence into amino acids using codon chart.
     c. tRNA: Brings appropriate amino acids (colored paper) into the ribosome.
     d. Ribosome (2): Assembles the protein and checks with instructor when complete.
  3. Students will repeat the simulation four times, checking for understanding. The instructor will mutate sequences as time goes on. Students will have to adapt their strategy as mutations occur. This will cause chains to be structured abnormally. Students will have to describe what happened and how to the cell would have fixed the mistake.
  4. Students will watch an excerpt from the PBS show *Cracking the Code of Life*. They will discuss the role of DNA in the body and the importance of knowing the human genome.
  5. Students will read *A Programming Language for Living Cells* by Anne Trafton of MIT.
     a. While reading they will annotate the text by circling terms they do not understand and highlighting important information.
     b. After reading they will answer the warm up prompts again, applying new information from the article. They will discuss with elbow partners and the class.
  6. Exit Ticket: How else do you think humans use DNA programming?
- **Materials:**
  - Class set of *A Programming Language for Living Cells* by Anne Trafton of MIT.
  - Class set of Codon Charts
  - DNA relay lab activity – sequences of DNA written by instructor, a list of amino acid to color charts (one for each group), an answer key with correct mRNA and color sequences.
  - Paper, pencils, small pieces of colored paper, tape