DNA at a Glance (approximately 8 traditional class days):

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| Seg | Model Move | Est Time  (min) | Overview | Resources | What did we figure out? |
| 1 | **P🡪Q** | 30 | We return to our families from Classical Genetics and reason that proteins are causing the different diseases. Yet we think that DNA is the molecule that is passed down across generations. So we formulate a driving question: How does that work? What is the link between DNA and protein? | * D 01 Underlying Causes of Some Genetic Conditions handout * D Doodle Sheet | We noticed that proteins cause the diseases but the protein is not passed from parent to offspring. DNA is. So we are ready to explore some new connections. |
| 2 | **Q🡪M** | 20-30 | We review the relationships between chromosomes, genes and DNA and use this a motivation to list what we already know and what we want to know about DNA. | * D Doodle Sheet | We confirmed the relationship between chromosomes, DNA, and genes. We have a list of what we know, or think we know about DNA, and we have even more questions. |
| 3 | **M** | 55 | We look at data and evidence from previous research studies to uncover the structure of DNA. | * D DNA Doodle Sheet * D 03 Determining DNA Structure * D 03 Nucleotide Shapes | DNA structure has a pattern in which there are base pairs: In DNA, A pairs with T and C pairs with G. We may have also figured out that the structure of DNA pairs bases via weak hydrogen bonds. We’ll leverage these model ideas to make sense of replication next. |
| 4 | **M🡪P** | 30 | We return to our question about transmission of DNA, which includes the idea of replication. We leverage the ideas we just pieced together about DNA’s structure in order to generate an explanation for how the cell makes an exact copy of the DNA prior to mitosis or meiosis. | * D DNA Doodle Sheet * D 03 Nucleotide Shapes * D 04 DNA Replication Group Task Instructions | We used our structural model to figure out how cells make an exact copy of DNA before they divide. |
| 5 | **M** | 20 | We dig a little deeper into the history of the discovery of the structure of DNA to help develop our model. | * D DNA Doodle Sheet * D 05 Letter from Francis Crick to His Son | We’ve reinforced the model ideas we’ve generated so far by reading Francis Crick’s letter to his son. |
| 6 | **Q🡪M** | 30-55 | We return to wondering how DNA and proteins are connected. Since we know about the structure of DNA, we look at what makes up a protein and try to make some connections between the two molecules.  *At the end of this segment, we have a conversation about the state of our model before moving on.* | * D DNA Doodle Sheet * D 06 PKU and OI Amino Acid and Nucleotide Sequence Cards * D 06 How the DNA Code Works * D 06 DNA Sequences for How the DNA Code Works * D 06 Student Reading Protein\* (if not covered in other models) | DNA is the hereditary material that codes for the protein. Every 3 nucleotide is a codon that codes for 1 amino acid in a protein and this code has a redundancy. These ideas begin to directly address our Driving Question. |
| 7 | **P🡪M** | 40 | We further problematize an aspect of the DNA to protein process that we just figured out: how does DNA isolated in the nucleus inform protein synthesis in the cytoplasm? With this new phenomenon of spatial separation, we need to add to our model in order to generate a sensible explanation. | * D Doodle Sheet * D 07 mRNA / Protein Synthesis Reading * D 07 Protein Synthesis Reading Summary Table | We figured out that messenger RNA (mRNA) provides the link between nuclear-bound DNA and the protein-making machinery in the cytoplasm. Our ideas about the link from gene to protein are fairly well fleshed-out. |
| 8 | **P🡪M** | 55 | We return to the family pedigrees to figure out how changes (mutations) in the DNA sequence can lead to the observed health conditions and begin to reinforce some of our understanding of the link between DNA and traits. | * D DNA Doodle Sheet * D 08 What Does a Mutation Do | We tracked variation in traits to the source: mutation.  Mutations are a source of genetic variation that may lead to changes in protein sequences. But we are perhaps still left with some questions about the connection between the protein changes and the variants in the traits. |
| 9 | **P🡪M** | 30 | We now more completely discuss proteins for two of the family pedigrees to examine what is happening with the patterns of inheritance and their explanations at the molecular level. | * D Doodle Sheet * Your Classroom Family Pedigrees | Depending on the function of the protein, you will see different patterns of phenotypes in the heterozygote (dominance versus codominance) resulting from the protein-protein interactions of the two alleles. |
| 10 | **M🡪P** | 25 | We apply our model back to an old phenomenon: variation in traits in a population. This allows us to reflect on the complex nature of some traits and also to recognize a key concept: the variation we see in nature arises from mutation. | * D Doodle Sheet | We recognized that not all mutations are bad. We’ve connected our ideas about inheritance and how genes code for traits to our evolutionary models through our ideas about mutations. They are the original source of variation that is carried along in complex ways in our mapping of DNA to traits. Changes in traits not only depend on changes in proteins, but also on the interactions of those proteins whether stemming from one or multiple genes. |
| 11 | **P** | 15 | We briefly examine some data that makes us recognize that much of our DNA “doesn’t code for anything”. So, what is it for? We table this for now, assuring students we’ll come back to it later. | * D Doodle Sheet | We’ve discovered that only a small fraction of our DNA is made up of genes that code for protein. This leaves us wondering: what is the rest of it for? |
| A | **Q🡪M** | 55 | How do we know DNA is the “molecule of inheritance”? We review the historical experiments that helped 20th century scientists develop a body of evidence for DNA as the carrier of hereditary information. | * D Optional A DNA is the Molecule of Inheritance - TEACHER GUIDE * D Optional A DNA is the Molecule of Inheritance - TEACHER GUIDE | We reviewed the historical experiments that provided evidence for DNA as the hereditary molecule (thus confirming the role of chromosomes in transmission of hereditary information) and reinforced our ideas of science as a process, not only a body of knowledge. |
| B | **Q🡪M** | 110 | The Details of Protein Synthesis.  This Optional Learning Segment can serve as a substitute for LS06 in order to more deeply track the processes of transcription and translation. Note: NGSS no longer calls us to explore the details of these process (e.g. no requirement to cover modifications to mRNA or the role of tRNA.) | * D Optional B Mini Doodle * D Optional B Protein Synthesis Reading * D Optional B Protein Synthesis Summary Protocol * D Optional B Protein Synthesis Scramble * D Optional B DNA kits * D Optional B Simulating Protein Synthesis Directions for Groups * D Optional B Protein Synthesis Explanation * D Optional B Card Sort | We figured out how DNA codes for a protein! |