UNIT 4

GENETICS

TEACHER NOTES

PREVIEW

DETAILS FOR HOW TO BEST IMPLEMENT
THIS CURRICULUM IN YOUR CLASSROOM

Created by: IT'S NOT ROCKET SCIENCE®

Included by Folder in Zip File:

1- Implementation

- Read First *(this document)* with **12** pages of teacher notes for how to implement this curriculum
  - Includes links to YouTube video lectures for each set of PowerPoint notes on ***page 13***
- Lab Details – 14 additional pages with tips for setting up activities
- Distance Learning Tips
- NGSS Alignment Overview
- Unit Plans for CP and Honors, both 50-minute and 90-minute *(block)* pacing + editable versions
- How to Write a Great Study Guide pdf

2-Packets

- Two packets, differentiated for CP *(37 pages)* and Honors *(40 pages)*, of all student handouts for the entire unit including:
  - Cornell note outlines, activities, labs, projects, and practice
- Packet answer keys
- 4-page guide to accessing and using the **paperless digital version** of the packets through Google Drive™

3-Notes

- Concept 1 CP Notes: DNA Structure and Replication – 13 slide ppt
- Concept 2 CP Notes: Protein Synthesis – 18 slide ppt
- Concept 3 CP Notes: Meiosis – 22 slide ppt
- Concept 1 Honors Notes: DNA Structure and Replication – 23 slide ppt
- Concept 2 Honors Notes: Protein Synthesis – 19 slide ppt
- Concept 3 Honors Notes: Meiosis – 22 slide ppt

*****All ppts have editable text and are fully animated in presenter mode*****

4-Activities

- 2 implementation slides for the Intro. to Concept 1 Inquiry Activity
- Editable clues for protein synthesis scavenger hunt
- 20 Protein Syn-thingo game cards
- Children's Book Project editable pages + Gallery Walk Feedback sheet
- 6 QR-Code based station cards + editable version
- (optional) Cracking the Code of Life video questions

5-Assessments

- Unit 4 Test CP – Versions A and B (Multiple choice rearranged)
  - 5 page test of multiple choice and open response + 2 page answer sheet
- Unit 4 Test Honors – Versions A and B (Multiple choice rearranged)
  - 5 page test of multiple choice and open response + 3 page answer sheet

****All assessments come with an editable version and detailed answer key****

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Teacher Notes:

Overview:

This unit is designed to be everything you need to teach a genetics unit in a high school Biology 1 course. Content covered includes: DNA and RNA structure, DNA replication, protein synthesis, and meiosis. This product includes PowerPoint notes (with corresponding lecture videos), a packet of student handouts for all activities, labs, practice, and projects, and unit tests. Everything is provided for two levels – CP (College Prep, or "on grade level") and Honors (advanced). The student packets also come in paperless digital versions that can be used in Google Drive™ and/or Microsoft OneDrive™.

Packet instead of Interactive Notebook:

I started creating packets for my students over six years ago, and I love them so much more than interactive notebooks. While interactive notebooks are great resources that work for many teachers, I have found the packet strategy to be a more appropriate tool for using in the secondary classroom setting with my students. I love using the packet for many reasons:

1. I only have to make copies **one time** each unit instead of copying handouts every day. Even though it takes a while to copy the packets for each student, it saves so much time on a day to day basis. (Also I've often recruited seniors to be my "Teacher's Aide" and have trained them to copy all of my packets for me. I haven't seen a copier in YEARS and it's glorious!) You can also now go **DIGITAL** and **PAPERLESS** with the Google Drive™ version of the packet, if you prefer!
2. It puts responsibility back on the students to maintain their biology binder with their packet, while also aiding them in practicing organization skills. It has been incredibly effective for my lower level students especially. Even though it is a lot of papers to receive at once, I can watch them put it in their binder and leave it there, rather than having to hang on to numerous individual papers passed out each day. It has really eliminated the need for a textbook too, so students really only have to remember to bring ONE thing to class – their binder with their packet!
3. It makes it so easy to be absent last minute. If you or your child gets sick, sub plans are a breeze. You don't have to send your teacher neighbor to make copies for you – because your students already have everything they need. You just have to tell the sub which pages the students need to work on for the day. It was especially helpful for my long-term substitute when I was on maternity leave!
4. The structure of the packet provides a more helpful method than interactive notebooks in preparing students for college – which should be one of our goals as high school teachers. The packet helps students learn how to structure notes (one of the reasons why I love teaching them how to write Cornell notes) and how to stay organized.
5. They are a time saver in so many ways – no more time wasted regularly passing out handouts or having to cut and paste things into a notebook.
6. Students do a better job keeping up with returned graded work because every page is numbered, so they can put graded assignments right back into the packet where it came from, setting them up to more likely refer back to graded work as they study.
7. You no longer need a filing cabinet – you can keep all of your curriculum and keys organized into easy to grab binders! See picture on ***page 13.***

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Teacher Notes:

In short...

The best statistical evidence I have in support of why I love the packet strategy so much is that I had a **96% pass rate** on my state's standardized End-of-Course Biology exam for non-Honors students and a **100% pass rate** for Honors students, using this same strategy in my Biology 1 course. This was at a South Carolina public school with over 50% of the students being below the poverty line. My average score on the EOC (all 200+ students combined that I taught during my time there) was a 90%. I believe this success is due to multiple factors, but I attribute a lot of it to the packet-based curriculum I have designed. Honestly, I could go on and on about the packet as an organizational resource and why I love it so much, but I think you will find that you feel the same if you choose to test it out!

Next Generation Science Standard Alignment:

This unit covers content related to the following NGSS Standards:

- **HS-LS1-1.** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
- **HS-LS1-6.** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- **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.
- **HS-LS3-2.** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

You can find more information about the incorporation of the crosscutting concepts, science and engineering practices, and suggestions for teaching with phenomena in the **"NGSS Alignment"** document in the **Implementation** folder.

Prior Knowledge:

This is the second unit I teach in Biology, so I would expect students to have prior knowledge on topics covered covered in my **Biology Basics unit** (including basic lab equipment, safety, measurement, experimental design, water properties, and macromolecules), my **Cells unit** (including cell theory, organelles, transport, mitosis and cancer), and my **Energy Flow unit** (including enzymes, ATP, trophic pyramids, photosynthesis, and cellular respiration). I also do not presume that all of the students in my course have a solid background in learning through the NGSS style. Because of this, I try to scaffold how I instruct my students throughout the year. At the beginning of the year with my freshmen I provide a lot more support and guidance as we move towards greater autonomy and critical thinking skills by the end of the year. You will see this reflected in the way this 4th unit is designed vs. how the extension mini-units (that I use to end the year) are designed.

When to use:

This is designed to be the fourth and final unit before my midterm in my biology course, but it doesn't have to be in yours. I believe the resources I have provided in this product are everything you need to teach this unit. ***However***, if you know that your students don't have the prior knowledge I've mentioned above, or if you teach through a section of this unit and realize your students want to go deeper or need more support, you may need to make some additions for your students. Every class is different and some will need more support than others – and that is totally okay! An editable version of the student packet cannot be provided, due to the reasoning detailed in the product description, but you can easily add pages manually prior to copying the packet for your class.

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Teacher Notes:

Assessment:

I did not include point values on any of the handouts in the packet in order to provide you the freedom to grade things how you so desire. On the next few pages I am going to provide you an overview of **my** grading strategy for you to reference. Feel free to adopt this or do entirely your own thing. It is completely up to you!

After much research and number crunching over the last few years, this is the simplest and most accurate grading technique that I have come up with. I divide my gradebook into two simple categories: **MAJOR** grades and **MINOR** grades. Within each category, different assessments are worth different amount of points based on length, depth, and complexity. Below I will give you an idea of what goes into each category.

Major Grades = 60% of the student's overall grade

- **Tests** = **100 pts**
  - Unit 4 only has 1 test, which would count as a 100 pt major grade.
- **Quizzes** = **25 pts**
  - Unit 4 does not have any quizzes.
- **Projects** = **50-100 pts**
  - I like to do at least 1 project per quarter to give students an opportunity to show their understanding of the content in a non-traditional way. For this unit I grade the Project: Design a Children's Book as a 100 pt major grade.

Minor Grades = 40% of the student's overall grade

- **Activities/Labs/Practice** = **10-100 pts**
  - The amount of points I give students is **completely dependent** on the length and depth of the activity. I also do not grade many of the in-class assignments the students do, because there are so many of them! Instead, we would just go over them as a class. If I did want to assign a grade, I often just circle the class and do a spot check grade for completion before drawing names and going over as a class. For instance, in this unit, I would not collect and grade:
    - Practice: DNA Structure and Replication
    - Practice: Transcribing and Translating
    - Practice: Protein Synthesis
    - Activity: Protein Synthesis Digital Breakout Escape Room *(I would give them a **25 pt** completion grade for completing this)*
    - Webquest: Epigenetics *(I would spot check for **25 pts** for completion)*
    - Practice: Haploid vs. Diploid
    - Practice: Meiosis
    - Stations: Putting it All Together *(I would spot check for **30 pts** that they did each station)*
  - In general, an activity that lasts only half of a 50-minute class period would usually only be worth about 25 pts. An activity that lasts a full class period or two is usually worth about 50 pts, and an activity that takes more than two class periods to complete would be worth 100 pts. For instance, in this unit I would collect and grade for accuracy:
    - Activity: Understanding DNA Structure for **25 pts**
    - Activity: Building a Candy Model for **25 pts**
    - Activity: Protein Synthesis Scavenger Hunt for **25 pts**

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Teacher Notes:

Minor Grades = 40% of the student's overall grade

- **Daily Quizzes/Bell Ringers** = **5 pts per day**, usually totaling **25 pts for the week** (if there is one every day)
  - This is something I have fallen in love with doing, but not every teacher does which is why I do not include my daily quizzes/bell ringers with this product (if you would like to purchase for this unit, you can find them in my store. They are $5 per unit or cheaper as a bundle.)
  - I call my bell ringers "Prime Times" because I believe that the first 5 minutes of class is the most important time of the day. I love that my students are in a routine and come in ready to work as soon as they get to my room because they know they will have a Prime Time.
  - If you would like to know more about how I implement these, again, check them out in my store! The gist is that students have 3-5 questions a day on the board when they come in. They use the same sheet of paper each day to write their answers on. I give them 5 minutes at the start of class to answer the questions, then they pass them over and I collect them and grade each day. They count for 5 pts a day. At the end of the week I add up the points based on how many we did and give them a score for the week.
  - **I grade these for accuracy but I allow students to use their notes.** This way I ensure students are writing good notes, keeping up when they are absent, and getting the basics of what we covered the day before. I also like it because I go over the answers as soon as I collect them so I know if the majority of students are getting what we did the day before so I can address issues before we move on to new material. It is my favorite way to check in with each student **DAILY** to know where they are with the material!!

- **Homework** = **Concept Study Guides** = **10 pts each**
  - Biology can be so much memorization, so the most important use of a student's time at home *(in my opinion)* is to be **studying**. However, most students don't know how to study! This is why I have students create their own study guides to practice this skill. Here is how I do this:
    - I divide each unit into 3-6 concepts (Note: This unit has 3 concepts.) Students make a study guide for each concept and turn them in at different points throughout the unit to be graded for 10 pts each. I return them **within a day** so they can have them to study for their unit tests.
    - For their study guide they must **answer all objectives** and **define all vocabulary** on the first page of the packet. They do not have to write anything for the *italicized objectives*, as those represent skills that would be hard to show mastery of on paper, however they do need to be able to do ALL of the objectives on the assessment.
  - All summative assessments provided in this product and future products are aligned with the objectives and vocabulary outlined on the front page(s) of each packet, making this an effective resource to base their study guides off of.
  - I do allow them some freedom in this. Some students like to type these, some hand write them. I also encourage students to make them as **visual** as possible. *They shouldn't write their study guides in paragraph form.* I encourage them to make Venn diagrams, tables, and other charts to make their study guides visually appealing – and something they would actually like to study from. I do not show them examples of how to do this, because I want them to find their own method that works best for them!
    - For instance, a lot of students make flashcards, flipcharts, or use Quizlet (an online flashcard making tool) for the vocabulary portion. This is great, but I do make them turn these in with their study guide so I can check them. For Quizlet, students just print them out and staple to the back of their objectives.
    - To provide guidance for students as they make their first study guide, see the **How to Write a GREAT Study Guide** document in the **Implementation** folder.
  - I find these especially useful because so much of this course builds upon itself, and I want to encourage my students to really learn material for the long-term, and not just cram it in the night before a test. Because of this, all of my unit tests are cumulative. If students make good study guides, they will be incredibly useful resources for them to reference throughout the year as they review for future tests. It will also be a valuable skill for them to have if they move on to higher education.

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Teacher Notes:

Materials:

- Hole-punched copies of packet for each student to put in their binders *(or distributed digital paperless packets to students via Google Drive™ or Microsoft OneDrive™)*
- Ability to project and use PowerPoints during lecture
- Access to technology for activities where students will need to conduct research and scan QR codes
- (optional) Ability to use Google Slides for Activity: Protein Synthesis Digital Breakout Escape Room
- Printed (and I prefer laminated so that they hold up each year – you won't regret it!!) copies of the following (can be found in the **Activities** folder):
  - Game: Protein Syn-thingo cards
    - 1 set = 20 cards (you only need 1 set, regardless of how many students)
  - Stations: Genetics
    - 1 set = 6 stations
      - *If you have a larger class, make 3-4 copies of each station so students can stay spread out.*
- Materials needed for the Activity: Building a Candy Model
  - 1-2 packs of multi-colored mini-marshmallows, 4 different colors needed for each of the nitrogen bases in DNA
    - Each student will need 24-30!
  - 1 pack of white mini marshmallows to represent uracil
    - Each student will only need a few (exact number depends on amount of adenine in template DNA strand)
  - Several packages of Twizzlers, or a similar style of candy
    - Each student needs 3!
  - Box of toothpicks
- Materials needed for the Activity: Protein Synthesis Scavenger Hunt
  - Print and cut scavenger hunt clues – enough for each group to get 1 of each clue (see **page 7** of **Lab Details** pdf in the **Implementation** folder)
  - 8 envelopes (1 for each set of clues) hidden around the room (see where to hide on **page 6** of **Lab Details** pdf in the **Implementation** folder)
  - Class set of the special genetic code on **page 8** of **Lab Details** pdf printed for students to reference when translating
- Copies of tests *(I print class sets of tests that students can't write on so I can reuse them year after year to save copies. Students only get the 2-page answer sheet.)*
- (optional) Cracking the Code of Life video
  - As I type this, it is currently available to stream for free on **PBS here**.
  - You can also purchase the DVD version **on Amazon** or **from PBS**.
- (optional) General art supplies like computer paper, scissors, and coloring utensils like markers or colored pencils for the Project: Design a Children's Book
- (optional) Headphones *(I have students bring their own in when needed, but always like to have **a few extra** just in case)*

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Teacher Notes:

Implementation:

Over the next few pages I will be providing commentary for how to implement this unit, based on the **unit plans** included in the **Implementation** folder. Be sure to have a copy of the unit plan open or printed out as you read through this so it makes the most sense. For this unit, I use a lot of the same resources for both my CP (on grade level) and Honors students, and just have lower expectations for the assessments for my lower level classes. For general implementation, I give CP students a lot more support and guidance as I teach them, and the honors students are expected to work more independently. If there are any other differences between implementation for both levels, I will include those in the notes. Also, check out the **NGSS Alignment** document in this folder for tips on how to teach through this unit using NGSS phenomena.

Please use the unit plans and these notes as a ***guideline*** for your class. Teaching and plans have to be flexible and be able to be adjusted based on students' needs. This unit is written to take 22 days, but you can cut out some of the activities, have them do some of the practice at home, do the Children's Book Project entirely at home, skip the video days, or use the YouTube lecture videos (links on ***page 13***) to do a flipped classroom style if you need to squeeze it into a shorter period of time. Editable versions of unit plans are provided for that exact reason!

Note: *All implementation notes are based off a 50-minute class period. A 90-minute block unit plan is provided in the* ***Implementation*** *folder for reference.*

- Day 1: (OPTIONAL) I really like to start off this unit by watching the "Cracking the Code of Life" video, linked on p.7. This is an oldie, but a goodie! I know a lot of people don't show videos, which is why I included the video questions separate from the packet (they are in the **Implementation** folder) so you could easily not do this if you don't want to or are short on time. You can also just save it for a great lesson for a substitute! I just think this video does a great job setting the stage for the relevance of this unit, and creating some connections between what we will cover in this unit and our next one on Heredity. It takes about 2.5 class periods to watch it all.

- Day 2: (OPTIONAL) Continue watching Cracking the Code of Life. Students answer video questions as they watch.

- Day 3: Finish Cracking the Code of Life, if you chose to watch it. I would probably collect questions and give students 15 pts for completing them (since they were just fill in the blank.) Then project the **Inquiry Activity – Intro to Concept 1** ppt slide in the **Activities** folder. There are two options for you to choose between, depending on what works best for you and your students. If doing Option 1, I'd have students work with their neighbor to figure this out. I have mini white boards I would let each pair use to try to process through this and make a visual/concept map, if that helps them. Give partners around 5-10 minutes to work on this. Then have each pair find another pair and talk through each other's in groups of 4. Circle around, and have them make a revised draft together. Last, come up with a class version on your whiteboard and talk through any of their miscon[illegible] to [illegible] numbers. Have students physically mo[illegible] corner they think is most corre[illegible] with reasoning. After, begin [illegible] Concept [illegible] notes. Note the add[illegible] commentary in the "Notes secti[illegible]" of ea[illegible] lec[illegible] to [illegible] before the notes on DNA replication!!

PREVIEW
More Teacher Notes in actual product
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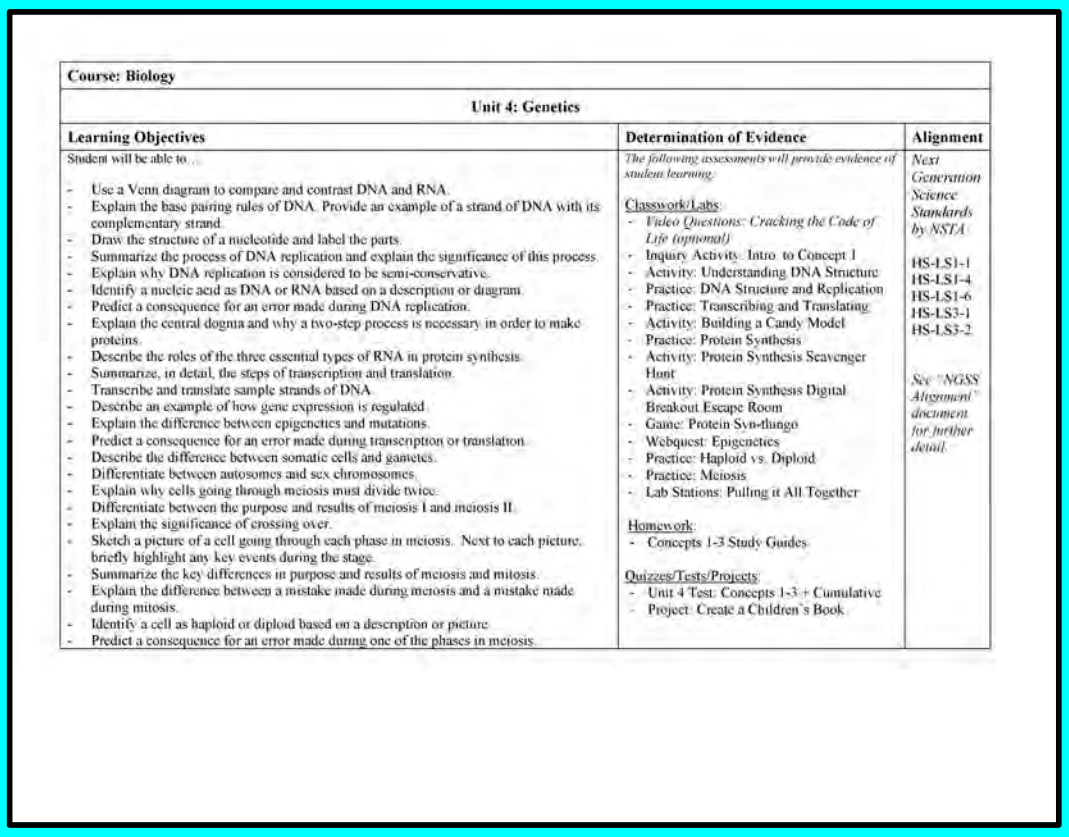

Course: Biology

Unit 4: Genetics

Learning Objectives	Determination of Evidence	Alignment
Student will be able to… - Use a Venn diagram to compare and contrast DNA and RNA. - Explain the base pairing rules of DNA. Provide an example of a strand of DNA with its complementary strand. - Draw the structure of a nucleotide and label the parts. - Summarize the process of DNA replication and explain the significance of this process. - Explain why DNA replication is considered to be semi-conservative. - Identify a nucleic acid as DNA or RNA based on a description or diagram. - Predict a consequence for an error made during DNA replication. - Explain the central dogma and why a two-step process is necessary in order to make proteins. - Describe the roles of the three essential types of RNA in protein synthesis. - Summarize, in detail, the steps of transcription and translation. - Transcribe and translate sample strands of DNA. - Describe an example of how gene expression is regulated. - Explain the difference between epigenetics and mutations. - Predict a consequence for an error made during transcription or translation. - Describe the difference between somatic cells and gametes. - Differentiate between autosomes and sex chromosomes. - Explain why cells going through meiosis must divide twice. - Differentiate between the purpose and results of meiosis I and meiosis II. - Explain the significance of crossing over. - Sketch a picture of a cell going through each phase in meiosis. Next to each picture, briefly highlight any key events during the stage. - Summarize the key differences in purpose and results of meiosis and mitosis. - Explain the difference between a mistake made during meiosis and a mistake made during mitosis. - Identify a cell as haploid or diploid based on a description or picture. - Predict a consequence for an error made during one of the phases in meiosis.	*The following assessments will provide evidence of student learning:* Classwork/Labs: - *Video Questions: Cracking the Code of Life (optional)* - Inquiry Activity: Intro. to Concept 1 - Activity: Understanding DNA Structure - Practice: DNA Structure and Replication - Practice: Transcribing and Translating - Activity: Building a Candy Model - Practice: Protein Synthesis - Activity: Protein Synthesis Scavenger Hunt - Activity: Protein Synthesis Digital Breakout Escape Room - Game: Protein Syn-thingo - Webquest: Epigenetics - Practice: Haploid vs. Diploid - Practice: Meiosis - Lab Stations: Pulling it All Together Homework: - Concepts 1-3 Study Guides Quizzes/Tests/Projects: - Unit 4 Test: Concepts 1-3 + Cumulative - Project: Create a Children's Book	*Next Generation Science Standards by NSTA:* HS-LS1-1 HS-LS1-4 HS-LS1-6 HS-LS3-1 HS-LS3-2 *See "NGSS Alignment" document for further detail.*

Unit Plans (+ EDITABLE VERSIONS)

for both CP and Honors

Includes 50-MINUTE and 90-MINUTE pacing

Day	Learning Objectives	Methods/Activities	Assessments	Homework	Standards
1	*Introduction to Genetics*	*-Watch Video: Cracking the Code of Life and have students answer the video questions while watching*	*-Informal questioning and discussion*		HS-LS1-1 HS-LS1-6 HS-LS3-1 HS-LS3-2
2	*Introduction to Genetics*	*-Watch Video: Cracking the Code of Life and have students answer the video questions while watching*	*-Informal questioning and discussion*		HS-LS1-1 HS-LS1-6 HS-LS3-1 HS-LS3-2
3	DNA Structure and Function	*-Finish Video: Cracking the Code of Life, as needed, option to collect questions to grade* -Inquiry Activity: Intro. to Concept 1 -Start Concept 1 Notes p.2-3 (stop before notes on DNA replication) -If time, students can start to color their Activity: Understanding DNA Structure p.5	*-Video questions for Cracking the Code of Life* -Informal questioning and discussion		HS-LS1-6 HS-LS3-1
4	DNA Structure and Function	-Activity: Understanding DNA Structure p.5-6. Collect p.6 from students when they finish their individual contribution to the class model from p.5. -Work on Concept 1 SG (if time)	-Activity: Understanding DNA Structure p.5-6		HS-LS1-6 HS-LS3-1
5	DNA Replication	-Finish Concept 1 Notes p.3-4 on DNA replication -Practice: DNA Structure and Replication p.7, go over after -Work on Concept 1 SG (if time)	-Informal questioning and discussion	-Concept 1 study guide	HS-LS3-1 HS-LS3-2
6	Protein Synthesis	-Collect Concept 1 study guide -Start Concept 2 Notes p.8-9 (stop after transcription and before translation!!) -Practice: Transcribing and Translating p.13 (only do the transcribing portion!)	-Concept 1 SG -Informal questioning and discussion		HS-LS1-1 HS-LS1-6 HS-LS3-1
7	Protein Synthesis	-More Concept 2 Notes p.9-11 on translation -Finish Practice: Transcribing and Translating p.13 (do the translating portion) -Work on Concept 2 SG (if time)	-Informal questioning and discussion		HS-LS1-1 HS-LS1-6 HS-LS3-1
8	Protein Synthesis	-Activity: DNA Candy Model p.14-15	-Activity: DNA Candy Model p.14-15		HS-LS1-1 HS-LS1-6 HS-LS3-1

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37-page CP Packet with all student handouts for the entire unit

Unit Topic: Genetics

Essential Question: Why is genetic information significant for organisms and their potential future offspring?

Concept 1: *DNA Structure and Replication*	**Concept 2:** *Protein Synthesis*	**Concept 3:** *Meiosis*
Objectives: 1. Use a Venn diagram to compare and contrast DNA and RNA. 2. Explain the base pairing rules of DNA. Provide an example of a strand of DNA with its complementary strand. 3. Draw the structure of a nucleotide and label the parts. 4. Summarize the process of DNA replication and explain the significance of this process. 5. Explain why DNA replication is considered to be semi-conservative. 6. *Identify a nucleic acid as DNA or RNA based on a description or diagram.* 7. *Predict a consequence for an error made during DNA replication.* **Vocabulary**: Nucleic acid Nucleotide Chromosome Gene	**Objectives**: 1. Explain the central dogma and why a two-step process is necessary in order to make proteins. 2. Describe the roles of the three essential types of RNA in protein synthesis. 3. Summarize, in detail, the steps of transcription and translation. 4. Transcribe and translate the following strand of DNA. TACACCGGAGCGTTTATT 5. Describe an example of how gene expression is regulated. 6. Explain the difference between epigenetics and mutations. 7. *Predict a consequence for an error made during transcription or translation.* **Vocabulary**: Protein synthesis Polypeptide Transcription Genetic code Codon Anticodon Amino acid Translation Epigenetics	**Objectives**: 1. Describe the difference between somatic cells and gametes. 2. Differentiate between autosomes and sex chromosomes. 3. Explain why cells going through meiosis must divide twice. 4. Differentiate between the purpose and results of meiosis I and meiosis II. 5. Explain the significance of crossing over. 6. Sketch a picture of a cell going through each phase in meiosis. Next to each picture, briefly highlight any key events during the stage. 7. Summarize the key differences in purpose and results of meiosis and mitosis. 8. Explain the difference between a mistake made during meiosis and a mistake made during mitosis. 9. *Identify a cell as haploid or diploid based on a description or picture.* 10. *Predict a consequence for an error made during one of the phases in meiosis.* **Vocabulary**: Diploid Haploid Karyotype Meiosis Sexual reproduction Fertilization Homologous chromosomes Sister chromatids

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The cover page of the packet splits the unit into 3 concepts: DNA Structure and Replication, Protein Synthesis, and Meiosis. Each concept is broken down into objectives and vocabulary that students will use to create study guides from. An editable version of this cover page is included for you to customize for your class!

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40-page Honors Packet with all student handouts for the entire unit.

Unit Topic: Genetics Honors

Essential Question: Why is genetic information significant for organisms and their potential future offspring?

Concept 1: *DNA Structure and Replication*	**Concept 2**: *Protein Synthesis*	**Concept 3**: *Meiosis*
Objectives: 1. Use a Venn diagram to compare and contrast DNA and RNA. 2. Explain the base pairing rules of DNA. Provide an example of a strand of DNA with its complementary strand. 3. Draw the structure of a nucleotide and label the parts. 4. Describe the difference between purines and pyrimidines, including which nitrogen bases are which. 5. Explain, in detail, the structure of a DNA molecule. 6. Summarize the process of DNA replication, including the enzymes involved, and explain the significance of the process. 7. Describe the difference between the leading strand and lagging strand. 8. Explain why DNA replication is considered to be semi-conservative. 9. *Identify a nucleic acid as DNA or RNA based on a description or diagram.* 10. *Predict a consequence for an error made during DNA replication.* **Vocabulary**: Nucleic acid Nucleotide Chromosome Gene RNA primer Okazaki fragments	**Objectives**: 1. Explain the central dogma and why a two-step process is necessary in order to make proteins. 2. Describe the roles of the three essential types of RNA in protein synthesis. Include a sketch to represent each one. 3. Summarize, in detail, the steps of transcription and translation. Include the location of each process and the enzymes involved. 4. Transcribe and translate the following strand of DNA. TACACCGGAGCGTTTATT 5. Explain how the mRNA is modified after transcription. 6. Describe an example of how gene expression is regulated. 7. Explain the difference between epigenetics and mutations. 8. *Predict a consequence for an error made during transcription or translation.* **Vocabulary**: Protein synthesis Polypeptide Transcription Introns Exons Genetic code Codon Anticodon Amino acid Translation Epigenetics	**Objectives**: 1. Describe the difference between somatic cells and gametes. 2. Differentiate between autosomes and sex chromosomes. 3. Explain why cells going through meiosis must divide twice. 4. Differentiate between the purpose and results of meiosis I and meiosis II. 5. Explain the significance of crossing over. 6. Sketch a picture of a cell going through each phase in meiosis. Next to each picture, briefly highlight any key events during the stage. 7. Summarize the key differences in purpose and results of meiosis and mitosis. 8. Explain the difference between a mistake made during meiosis and a mistake made during mitosis. 9. *Identify a cell as haploid or diploid based on a description or picture.* 10. *Predict a consequence for an error made during one of the phases in meiosis.* **Vocabulary**: Diploid Haploid Karyotype Meiosis Sexual reproduction Fertilization Homologous chromosomes Sister chromatids

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The cover page of the packet splits the unit into 3 concepts: DNA Structure and Replication, Protein Synthesis, and Meiosis. Each concept is broken down into objectives and vocabulary that students will use to create study guides from. An editable version of this cover page is included for you to customize for your class!

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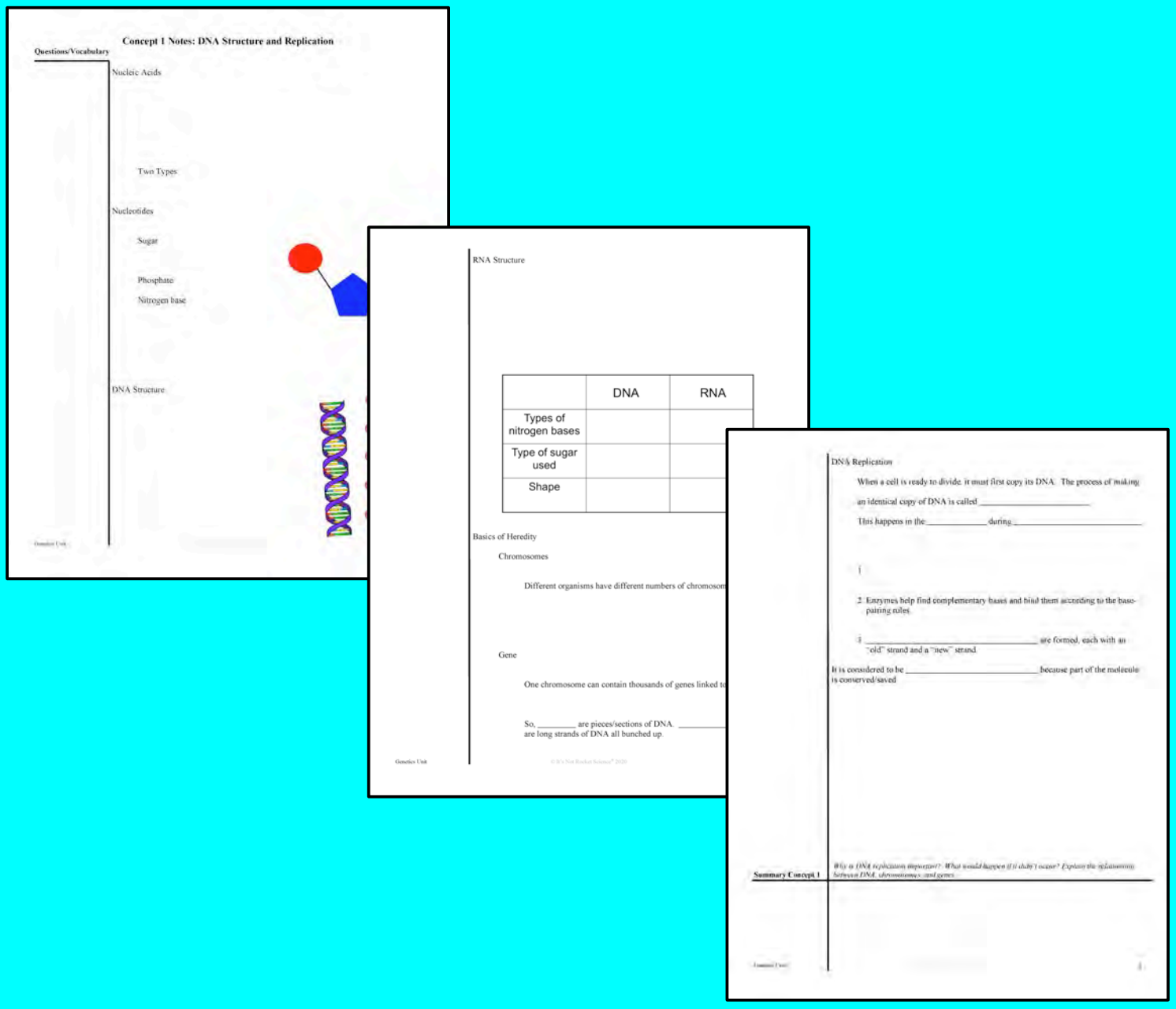
Along with practice, activity overviews, and lab investigation handouts, the packets also include **Cornell note outlines** that go along with each PowerPoint.

Sample Concept 1 Notes: DNA Structure and Replication **Cornell Note outline**



Concept 1 Notes: DNA Structure and Replication

Questions/Vocabulary

Nucleic Acids

Two Types

Nucleotides

Sugar

Phosphate

Nitrogen base

DNA Structure

RNA Structure

	DNA	RNA
Types of nitrogen bases		
Type of sugar used		
Shape		

Basics of Heredity

Chromosomes

Different organisms have different numbers of chromosom

Gene

One chromosome can contain thousands of genes linked t

So, _____ are pieces/sections of DNA. _____ are long strands of DNA all bunched up.

DNA Replication

When a cell is ready to divide, it must first copy its DNA. The process of making an identical copy of DNA is called _____

This happens in the _____ during _____

1

2. Enzymes help find complementary bases and bind them according to the base-pairing rules

3 _____ are formed, each with an "old" strand and a "new" strand.

It is considered to be _____ because part of the molecule is conserved/saved

Summary Concept 1

Why is DNA replication important? What would happen if it didn't occur? Explain the relationship between DNA, chromosomes, and genes.

Cornell Notes leave a margin for students to highlight terms and write questions as they go back and study their notes. Cornell Notes also leave room at the end of notes for students to summarize what they learned. The CP summary sections have questions to help them summarize.

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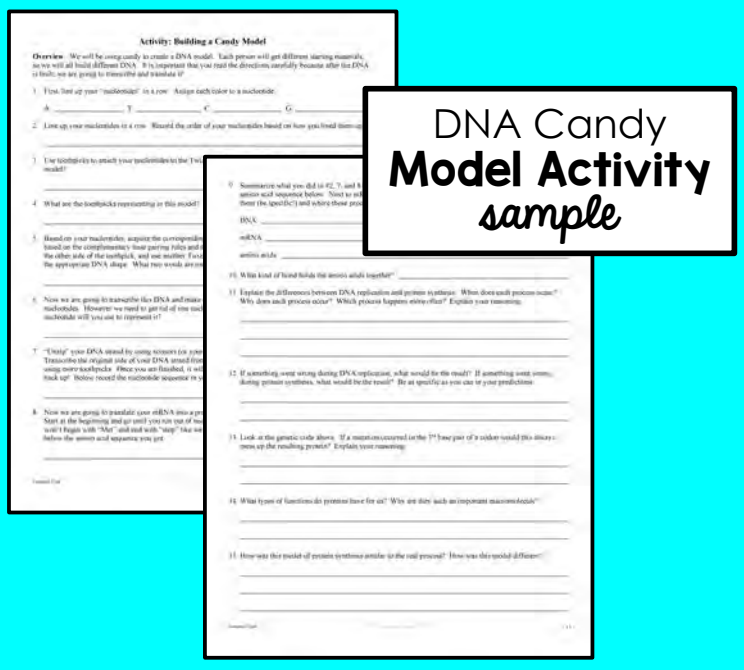
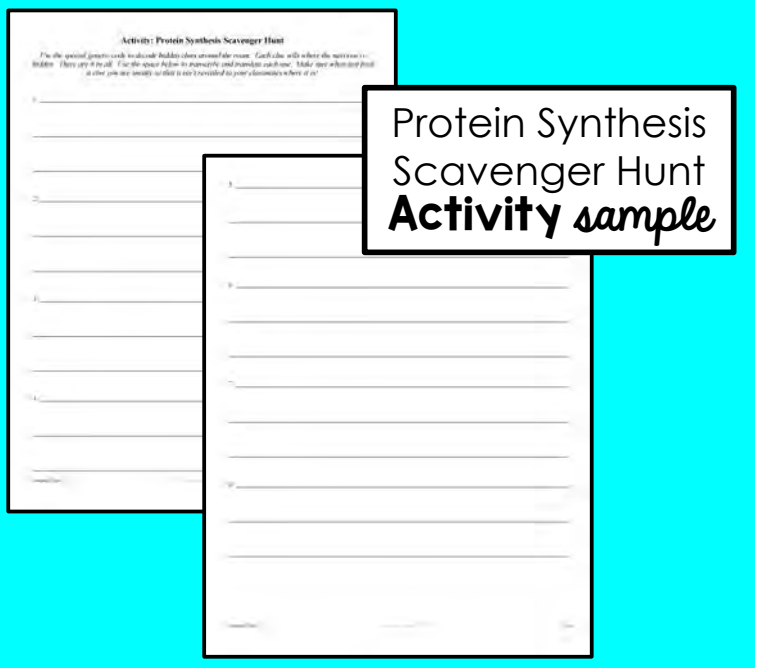
Packet includes student handouts for:

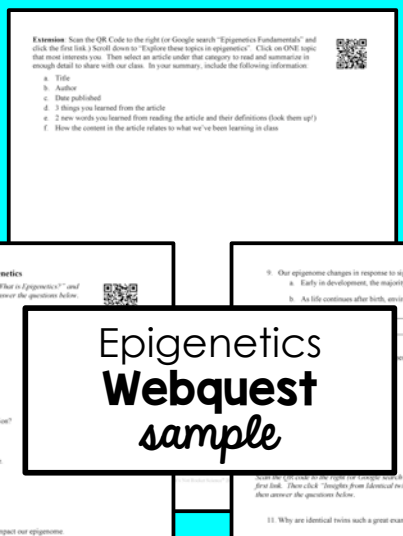
Building DNA Candy **Model Activity**
Protein Synthesis Scavenger Hunt **Activity**
Epigenetics **Webquest**
Protein Synthesis **Digital Breakout Escape Room**

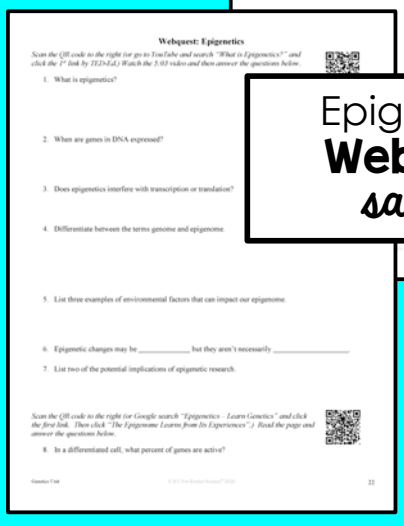


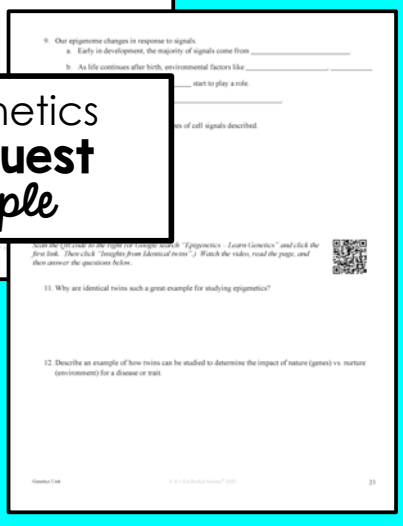
DNA Candy
Model Activity
sample



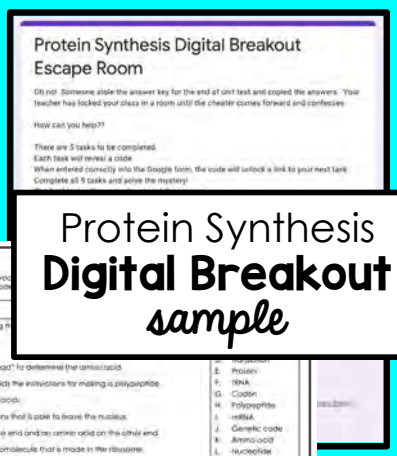
Protein Synthesis
Scavenger Hunt
Activity *sample*

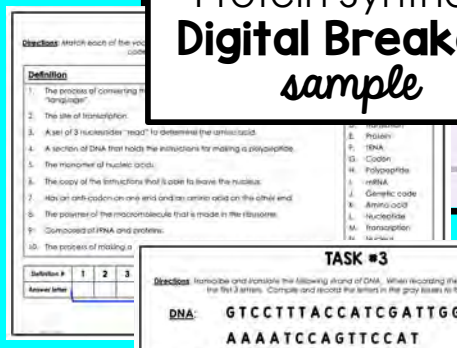




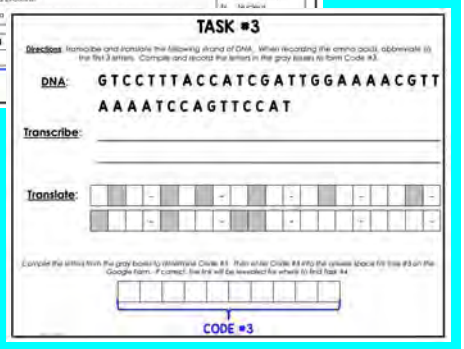


Epigenetics
Webquest
sample





Protein Synthesis
Digital Breakout
sample



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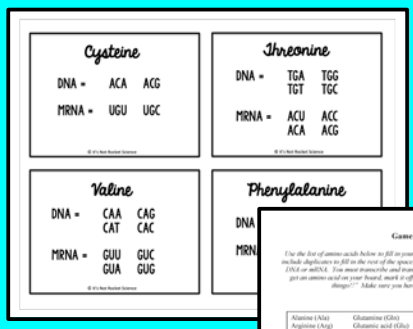
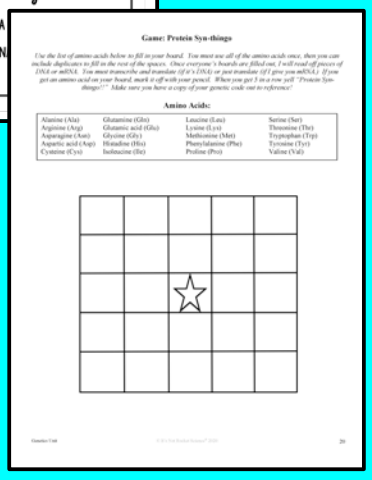
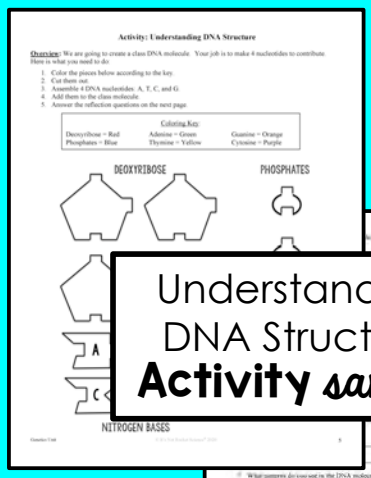
Packet includes student handouts for:

20 Protein Syn-thingo **Game Cards**
Understanding DNA Structure **Activity**
Intro. to Concept 1 **Inquiry Activity**
6 QR Code **Stations**

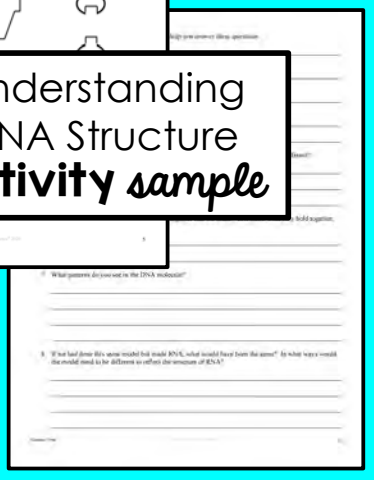


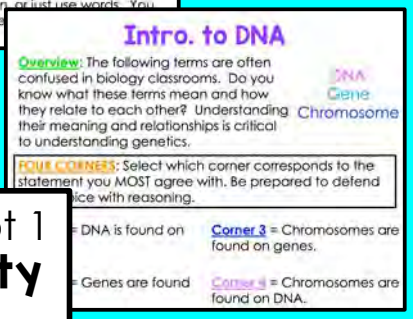
Protein Syn-thingo
Game Cards
sample



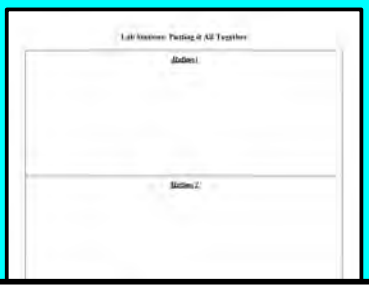


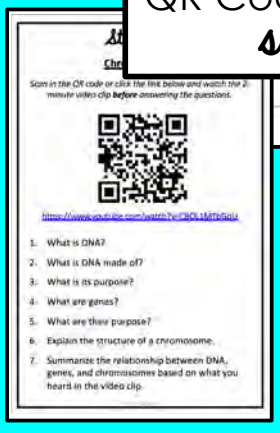
Understanding
DNA Structure
Activity *sample*

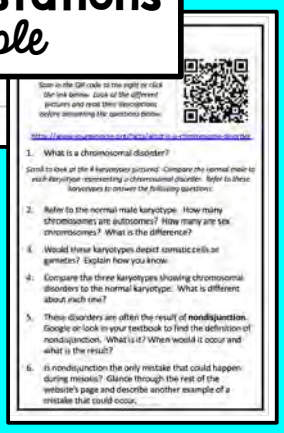




Intro. to Concept 1
Inquiry Activity
sample







QR Code **Stations**
sample

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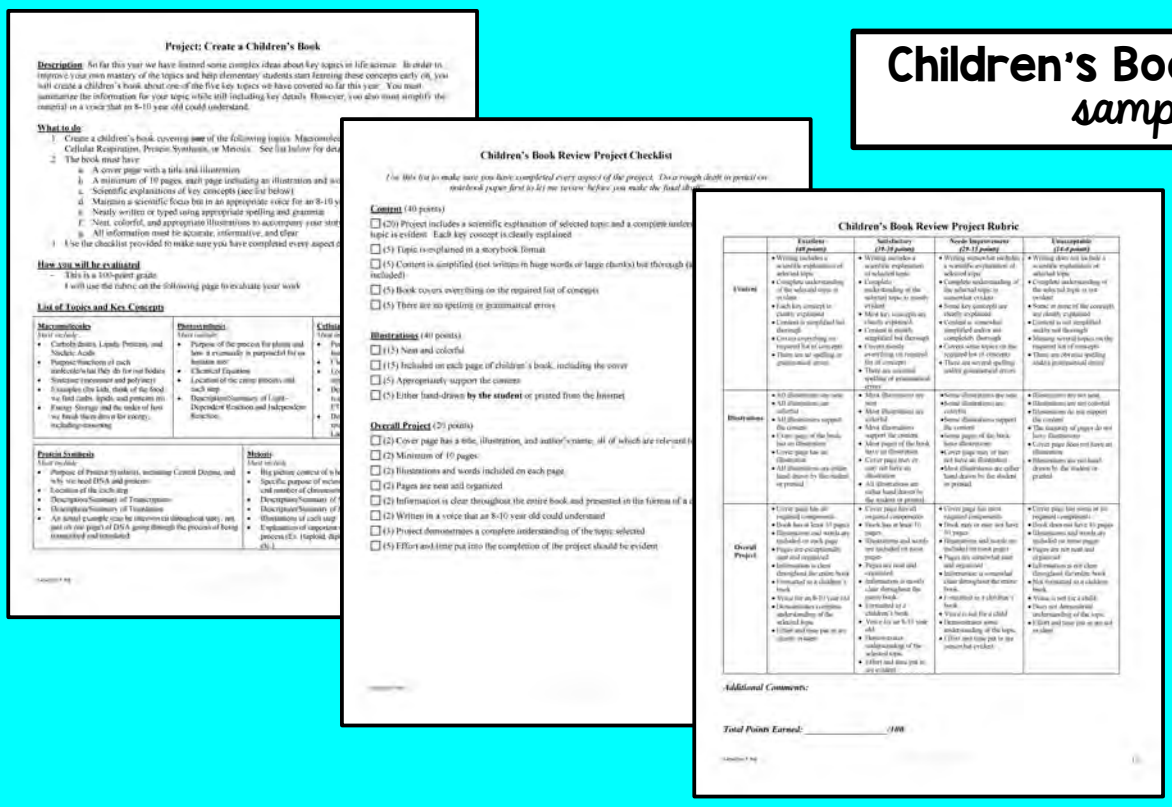
Also included in this unit:

Design a Children's Book **Project** description and rubrics
Practice for DNA structure, replication, protein synthesis, meiosis, and more!

Children's Book Project *sample*



Project: Create a Children's Book

Description: So far this year we have learned some complex ideas about key topics in life science. In order to improve your own mastery of the topics and help elementary students start learning these concepts early on, you will create a children's book about one of the five key topics we have covered so far this year. You must summarize the information for your topic while still including key details. However, you also must simplify the material in a voice that an 8-10 year old could understand.

What to do

1. Create a children's book covering one of the following topics: Macromolecules, Cellular Respiration, Protein Synthesis, or Meiosis. See list below for details
2. The book must have:
   a. A cover page with a title and illustration
   b. A minimum of 10 pages, each page including an illustration and
   c. Scientific explanations of key concepts (see list below)
   d. Maintain a scientific focus but in an appropriate voice for an 8-10
   e. Neatly written or typed using appropriate spelling and grammar
   f. Neat, colorful, and appropriate illustrations to accompany your
   g. All information must be accurate, informative, and clear
3. Use the checklist provided to make sure you have completed every aspect

How you will be evaluated

- This is a 100-point grade.
- I will use the rubric on the following page to evaluate your work

List of Topics and Key Concepts

Macromolecules	Photosynthesis	Cellu
Must include: • Carbohydrates, Lipids, Proteins, and Nucleic Acids • Purpose/function of each • Structure (monomer and polymer) • Examples (for kids, think of the food we find (carbs, lipids, and proteins in) • Energy Storage and the stokes of how we break them down for energy, including/removing	Must include: • Purpose of the process for plants and how it eventually is purposed for us • Chemical Equation • Location of the cellular process and each step • Description/Summary of Light-Dependent Reactions and Independent Reactions	
Protein Synthesis	**Meiosis**	
Must include: • Purpose of Protein Synthesis, including Central Dogma, and why we need DNA and proteins • Location of the each step • Description/Summary of Transcription • Description/Summary of Translation • An actual example (can be improvised throughout text, not just on one page) of DNA going through the process of being transcribed and translated	Must include: • Big picture context of w • Specific purpose of meio and number of chromosom • Description/Summary of • Description/Summary of • Illustrations of each stag • Explanation of important process (Ex. haploid, dipl etc.)	

Children's Book Review Project Checklist

Use this list to make sure you have completed every aspect of the project. Do a rough draft in pencil on notebook paper first to let me review before you make the final draft

Content (40 points)

- ☐ (20) Project includes a scientific explanation of selected topic and a complete index
- topic is evident. Each key concept is clearly explained
- ☐ (5) Topic is explained in a storybook format
- ☐ (5) Content is simplified (not written in huge words or large chunks) but thorough (
- included)
- ☐ (5) Book covers everything on the required list of concepts
- ☐ (5) There are no spelling or grammatical errors

Illustrations (40 points)

- ☐ (15) Neat and colorful
- ☐ (15) Included on each page of children's book, including the cover
- ☐ (5) Appropriately support the content
- ☐ (5) Either hand-drawn **by the student** or printed from the Internet

Overall Project (20 points)

- ☐ (2) Cover page has a title, illustration, and author's name; all of which are relevant t
- ☐ (2) Minimum of 10 pages
- ☐ (2) Illustrations and words included on each page
- ☐ (2) Pages are neat and organized
- ☐ (2) Information is clear throughout the entire book and presented in the format of a
- ☐ (2) Written in a voice that an 8-10 year old could understand
- ☐ (3) Project demonstrates a complete understanding of the topic selected
- ☐ (5) Effort and time put into the completion of the project should be evident

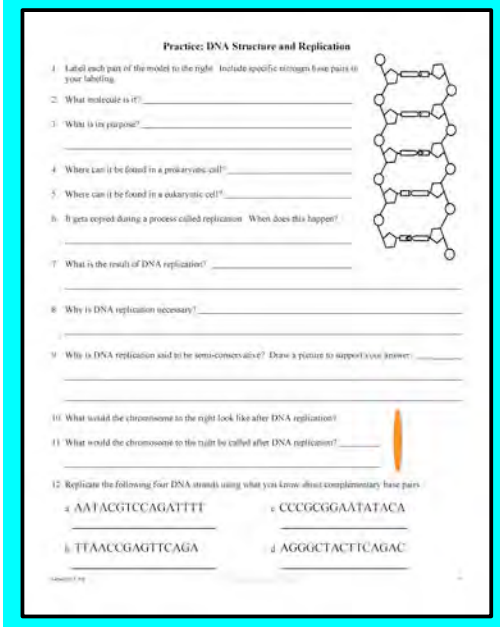
Children's Book Review Project Rubric

	Excellent (40 points)	Satisfactory (29-39 points)	Needs Improvement (20-28 points)	Unacceptable (19-0 points)
Content	• Writing includes a scientific explanation of selected topic • Complete understanding of the selected topic is evident • Each key concept is clearly explained • Content is simplified but thorough • Covers everything on required list of concepts • There are no spelling or grammatical errors	• Writing includes a scientific explanation of selected topic • Complete understanding of the selected topic is evident • Most key concepts are clearly explained • Content is mostly simplified but thorough • Covers most everything on required list of concepts • There are minimal spelling or grammatical errors	• Writing somewhat includes a scientific explanation of selected topic • Complete understanding of the selected topic is somewhat evident • Some key concepts are clearly explained • Content is somewhat simplified and/or not completely thorough • Covers some topics on the required list of concepts • There are several spelling and/or grammatical errors	• Writing does not include a scientific explanation of selected topic • Complete understanding of the selected topic is not evident • Some or none of the concepts are clearly explained • Content is not simplified and/or not thorough • Missing several topics on the required list of concepts • There are obvious spelling and/or grammatical errors
Illustrations	• All illustrations are neat • All illustrations are colorful • All illustrations support the content • Every page of the book has an illustration • Cover page has an illustration • All illustrations are either hand-drawn by the student or printed	• Most illustrations are neat • Most illustrations are colorful • Most illustrations support the content • Most pages of the book have an illustration • Cover page may or may not have an illustration • All illustrations are either hand-drawn by the student or printed	•Some illustrations are neat •Some illustrations are colorful •Some illustrations support the content •Some pages of the book have illustrations •Cover page may or may not have an illustration •Most illustrations are either hand-drawn by the student or printed	• Illustrations are not neat • Illustrations are not colorful • Illustrations do not support the content • The majority of pages do not have illustrations • Cover page does not have an illustration • Illustrations are not hand-drawn by the student or printed
Overall Project	• Cover page has all required components • Book has at least 10 pages • Illustrations and words are included on each page • Pages are exceptionally neat and organized • Information is clear throughout the entire book • Formatted as a children's book • Written for an 8-10 year old • Demonstrates complete understanding of the selected topic • Effort and time put in are clearly evident	• Cover page has all required components • Book has at least 10 pages • Illustrations and words are included on most pages • Pages are neat and organized • Information is mostly clear throughout the entire book • Formatted as a children's book • Written for a 8-10 year old • Demonstrates understanding of the selected topic • Effort and time put in are evident	• Cover page has most required components • Book may or may not have 10 pages • Illustrations and words are included on most pages • Information is somewhat clear throughout the entire book • Formatted as a children's book • Written for a child • Demonstrates some understanding of the topic • Effort and time put in the somewhat evident	• Cover page has some or no required components • Book does not have 10 pages • Illustrations and words are included on some pages • Pages are not neat and organized • Information is not clear throughout the entire book • Not formatted as a children book • Written is not for a child • Does not demonstrate understanding of the topic • Effort and time put in are not evident

Additional Comments:

Total Points Earned: _____/100

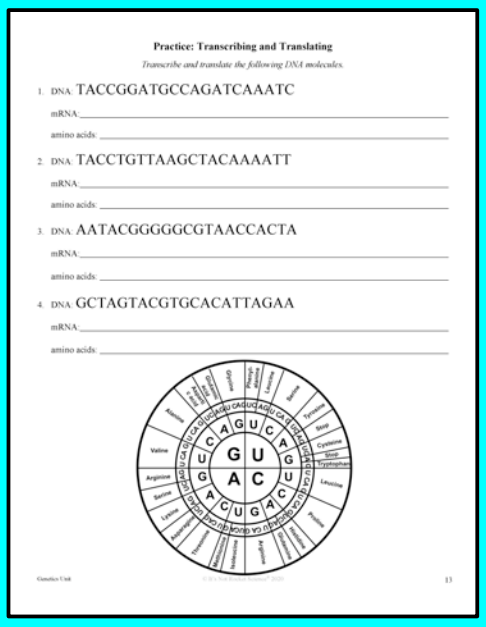
Practice *samples* - more included in student packet!



Practice: DNA Structure and Replication

1. Label each part of the model to the right. Include specific nitrogen base pairs in your labelling.
2. What molecule is it?
3. What is its purpose?
4. Where can it be found in a prokaryotic cell?
5. Where can it be found in a eukaryotic cell?
6. It gets copied during a process called replication. When does this happen?
7. What is the result of DNA replication?
8. Why is DNA replication necessary?
9. Why is DNA replication said to be semi-conservative? Draw a picture to support your answer:
10. What would the chromosome to the right look like after DNA replication?
11. What would the chromosome to the right be called after DNA replication?
12. Replicate the following four DNA strands using what you know about complementary base pairs.

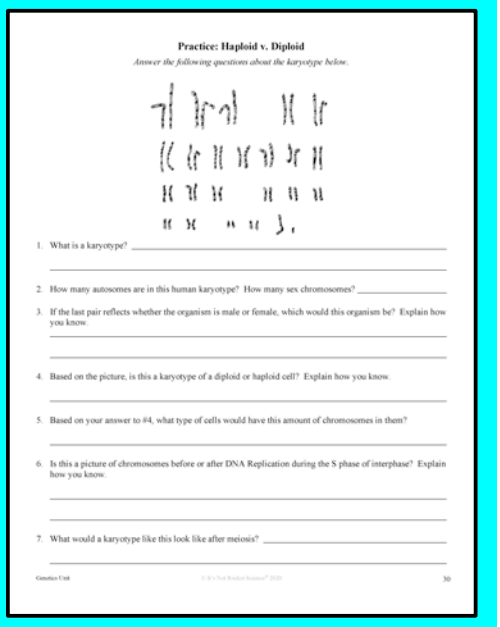
a. AATACGTCCAGATTTT
c. CCCGCGGAATATACA
b. TTAACCGAGTTCAGA
d. AGGGCTACTTCAGAC



Practice: Transcribing and Translating

Transcribe and translate the following DNA molecules.

1. DNA: TACCGGATGCCAGATCAAATC
   mRNA:
   amino acids:
2. DNA: TACCTGTTAAGCTACAAAATT
   mRNA:
   amino acids:
3. DNA: AATACGGGGGCGTAACCACTA
   mRNA:
   amino acids:
4. DNA: GCTAGTACGTGCACATTAGAA
   mRNA:
   amino acids:



Practice: Haploid v. Diploid

Answer the following questions about the karyotype below.

1. What is a karyotype?
2. How many autosomes are in this human karyotype? How many sex chromosomes?
3. If the last pair reflects whether the organism is male or female, which would this organism be? Explain how you know.
4. Based on the picture, is this a karyotype of a diploid or haploid cell? Explain how you know.
5. Based on your answer to #4, what type of cells would have this amount of chromosomes in them?
6. Is this a picture of chromosomes before or after DNA Replication during the S phase of interphase? Explain how you know.
7. What would a karyotype like this look like after meiosis?

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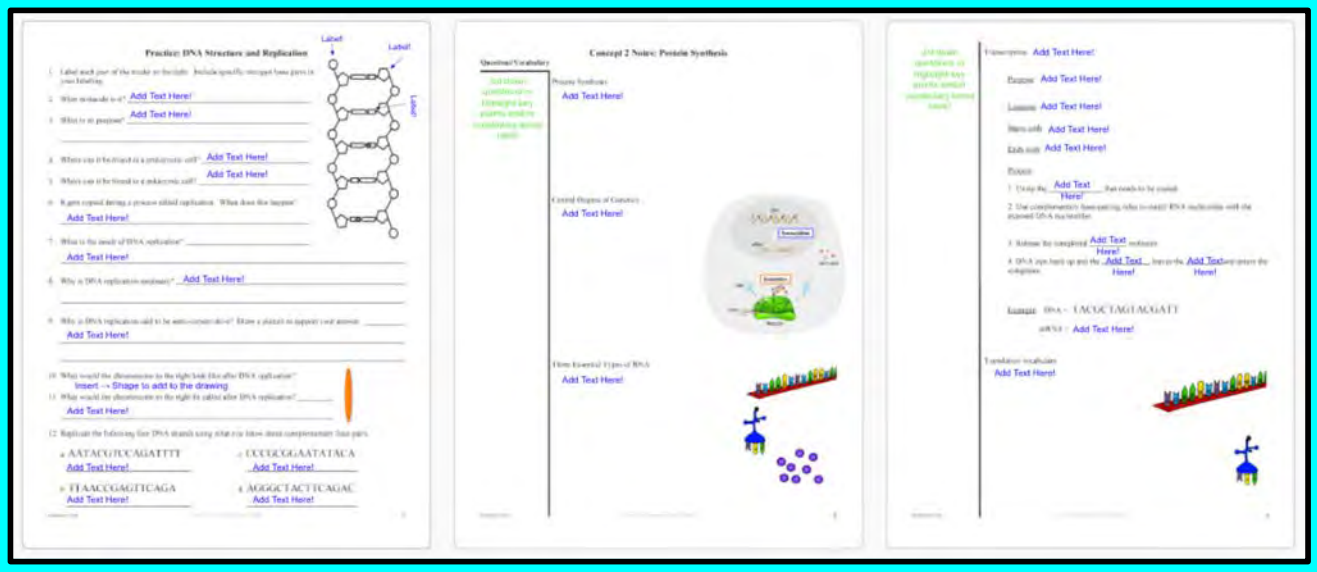
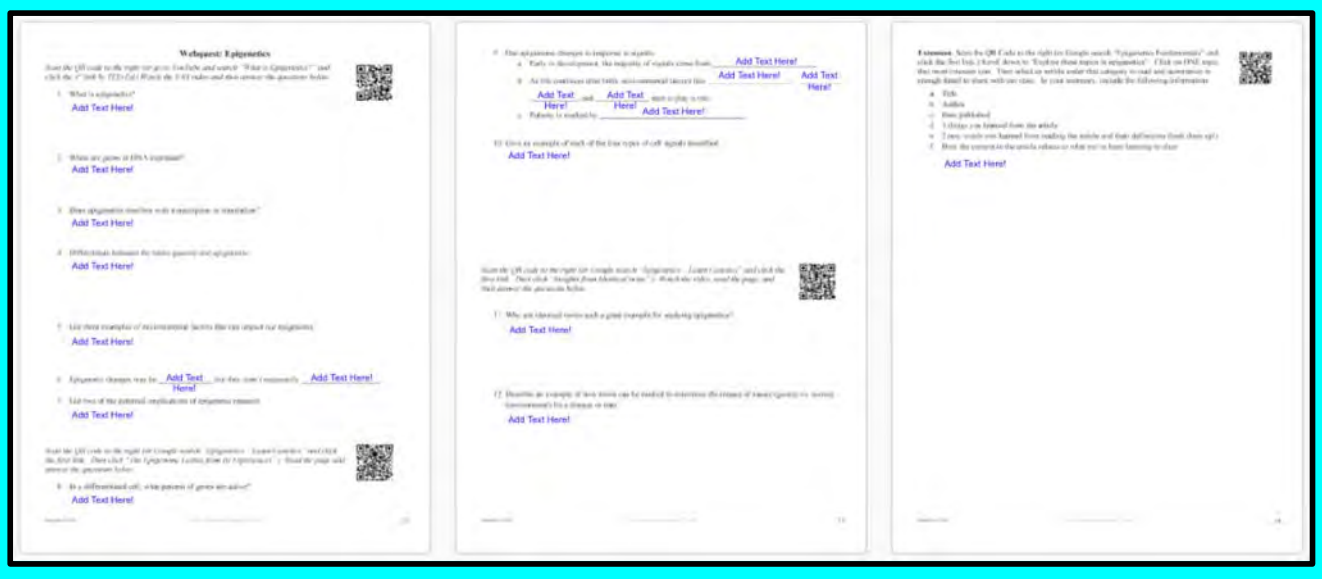
Includes access to **Paperless Digital** versions of the **student packets** that can be used in GOOGLE DRIVE™ or MICROSOFT ONEDRIVE™





Perfect for teachers in 1:1 classrooms, looking to integrate more educational technology, or go PAPERLESS! Get all of the same content, organization, and ease of the paper packets, without all of the copies!

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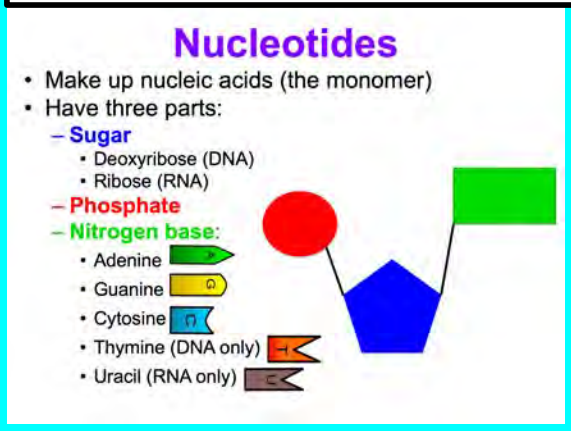
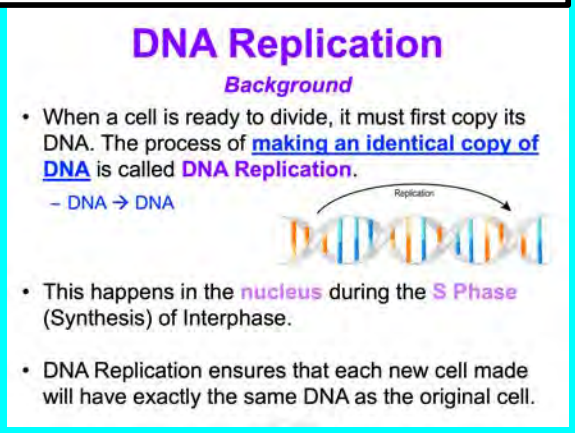
6 Powerpoints of Notes

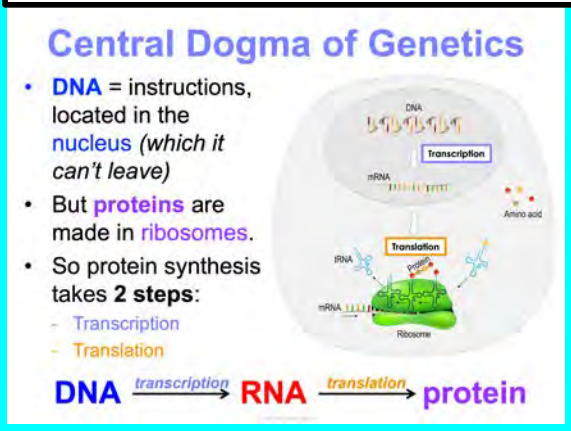
Covering **3** different concepts, CP and Honors version for each
Over 100 slides, all with *editable text*
Fully animated presentations in slide show mode

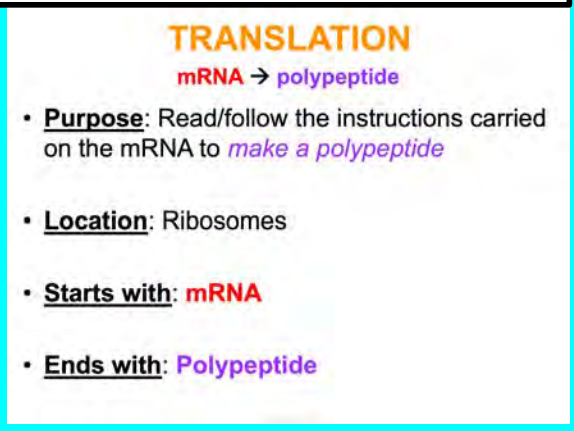
Sample slides from Concept 1 Notes: DNA Structure and Replication



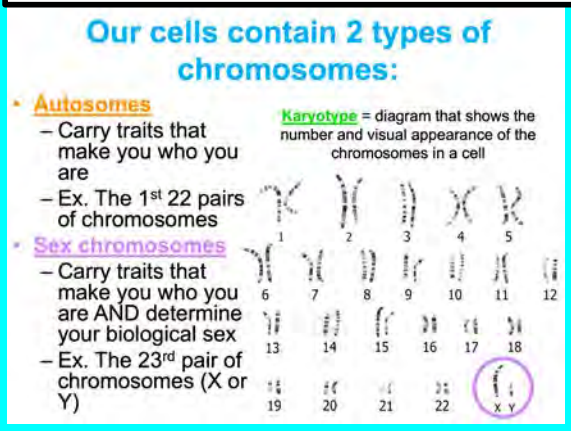


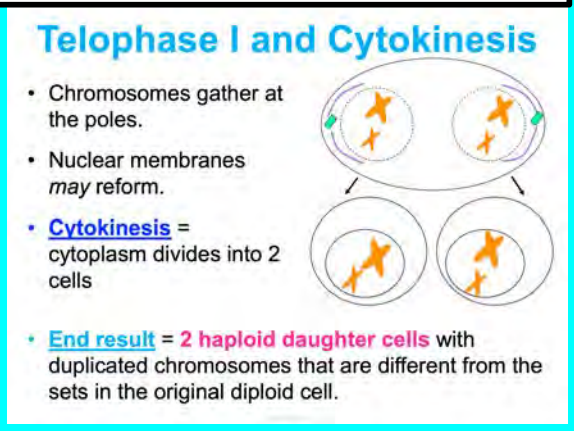
Sample slides from Concept 2 Notes: Protein Synthesis





Sample slides from Concept 3 Notes: Meiosis





PLUS check out my **YouTube channel** for **lecture videos** that go with each set of notes!

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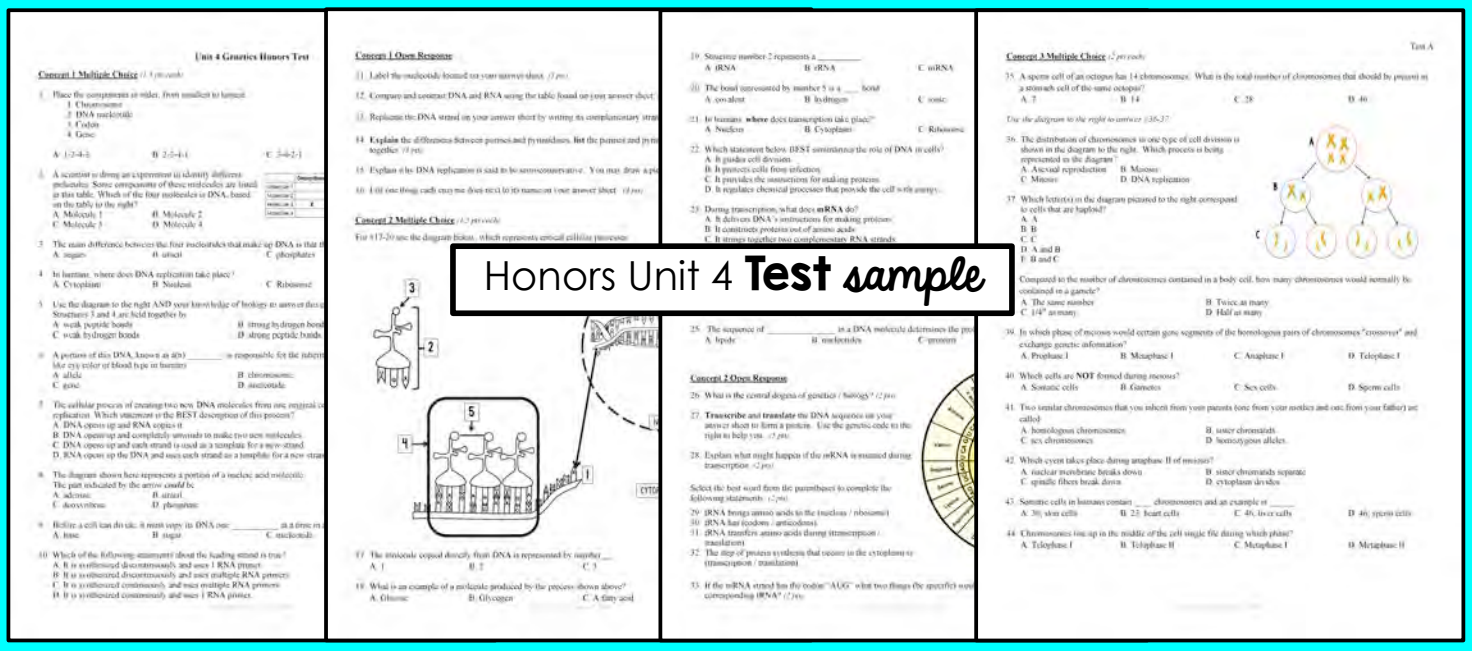
4 Multiple Choice and Open Response **Tests**

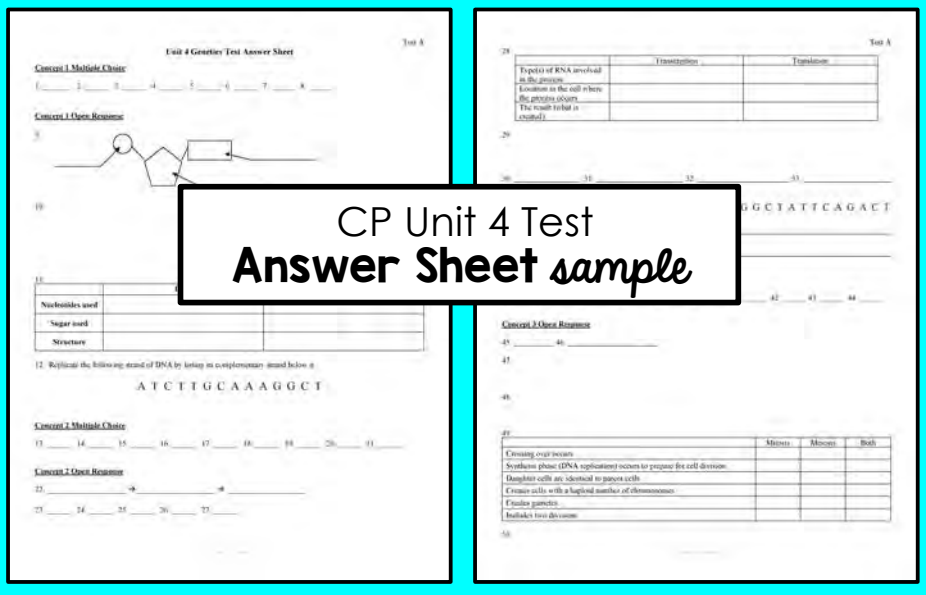
CP and Honors

Versions A and B for both

(MC rearranged to prevent cheating)



Honors Unit 4 **Test** *sample*



CP Unit 4 Test
Answer Sheet *sample*

Detailed **Answer Keys**

• **Editable Versions** of all assessments are included!

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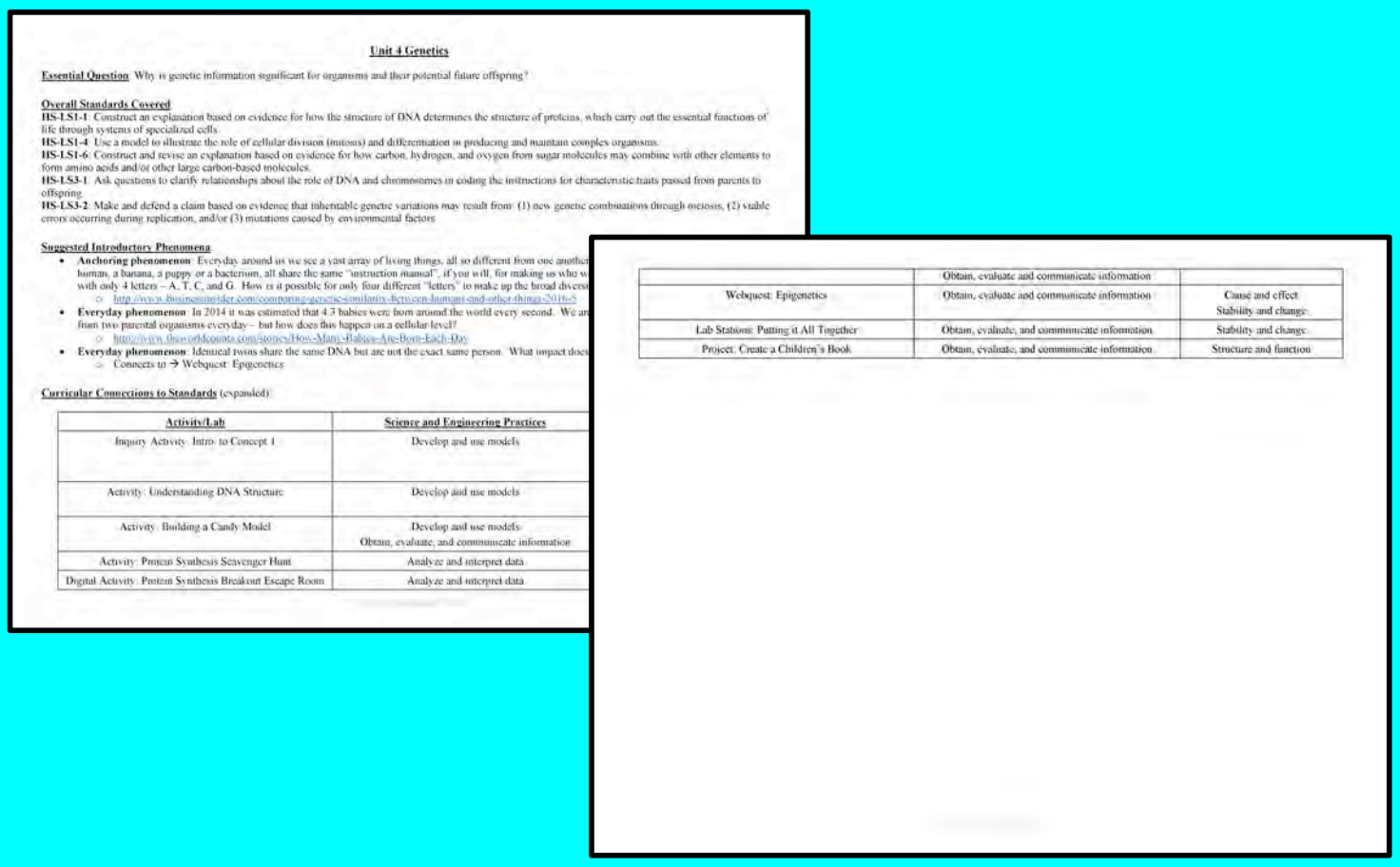
NGSS Alignment Overview



Unit 4 Genetics

Essential Question: Why is genetic information significant for organisms and their potential future offspring?

Overall Standards Covered:
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintain complex organisms.
HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
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.
HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors

Suggested Introductory Phenomena:

- **Anchoring phenomenon**: Everyday around us we see a vast array of living things, all so different from one another
  - human, a banana, a puppy or a bacterium, all share the same "instruction manual", if you will, for making us who w
  - with only 4 letters – A, T, C, and G. How is it possible for only four different "letters" to make up the broad diversi
  - http://www.businessinsider.com/comparing-genetic-similarity-between-humans-and-other-things-2018-5
- **Everyday phenomenon**: In 2014 it was estimated that 4.3 babies were born around the world every second. We ar
  - from two parental organisms everyday – but how does this happen on a cellular level?
  - http://www.thoughtco.com/stories/How-Many-Babies-Are-Born-Each-Day
- **Everyday phenomenon**: Identical twins share the same DNA but are not the exact same person. What impact does
  - Connects to → Webquest: Epigenetics

Curricular Connections to Standards (expanded):

Activity/Lab	Science and Engineering Practices
Inquiry Activity: Intro to Concept 1	Develop and use models
Activity: Understanding DNA Structure	Develop and use models
Activity: Building a Candy Model	Develop and use models Obtain, evaluate, and communicate information
Activity: Protein Synthesis Scavenger Hunt	Analyze and interpret data
Digital Activity: Protein Synthesis Breakout Escape Room	Analyze and interpret data

	Obtain, evaluate and communicate information	
Webquest: Epigenetics	Obtain, evaluate and communicate information	Cause and effect Stability and change
Lab Stations: Putting it All Together	Obtain, evaluate, and communicate information	Stability and change
Project: Create a Children's Book	Obtain, evaluate, and communicate information	Structure and function

This 2-page document is a helpful resource for teachers who are using the Next Generation Science Standards* while they teach an underclassmen Biology course. It organizes the various instructional methods to show alignment of the unit to high school life science DCIs, as well as the incorporation of science and engineering practices and crosscutting concepts.

This document also includes a list of suggested phenomena teachers can use to develop storylines for their classes, based on their students' interests. Tips for transitioning to NGSS can be found on my blog **here**. Tips for using phenomena can be found **here**.

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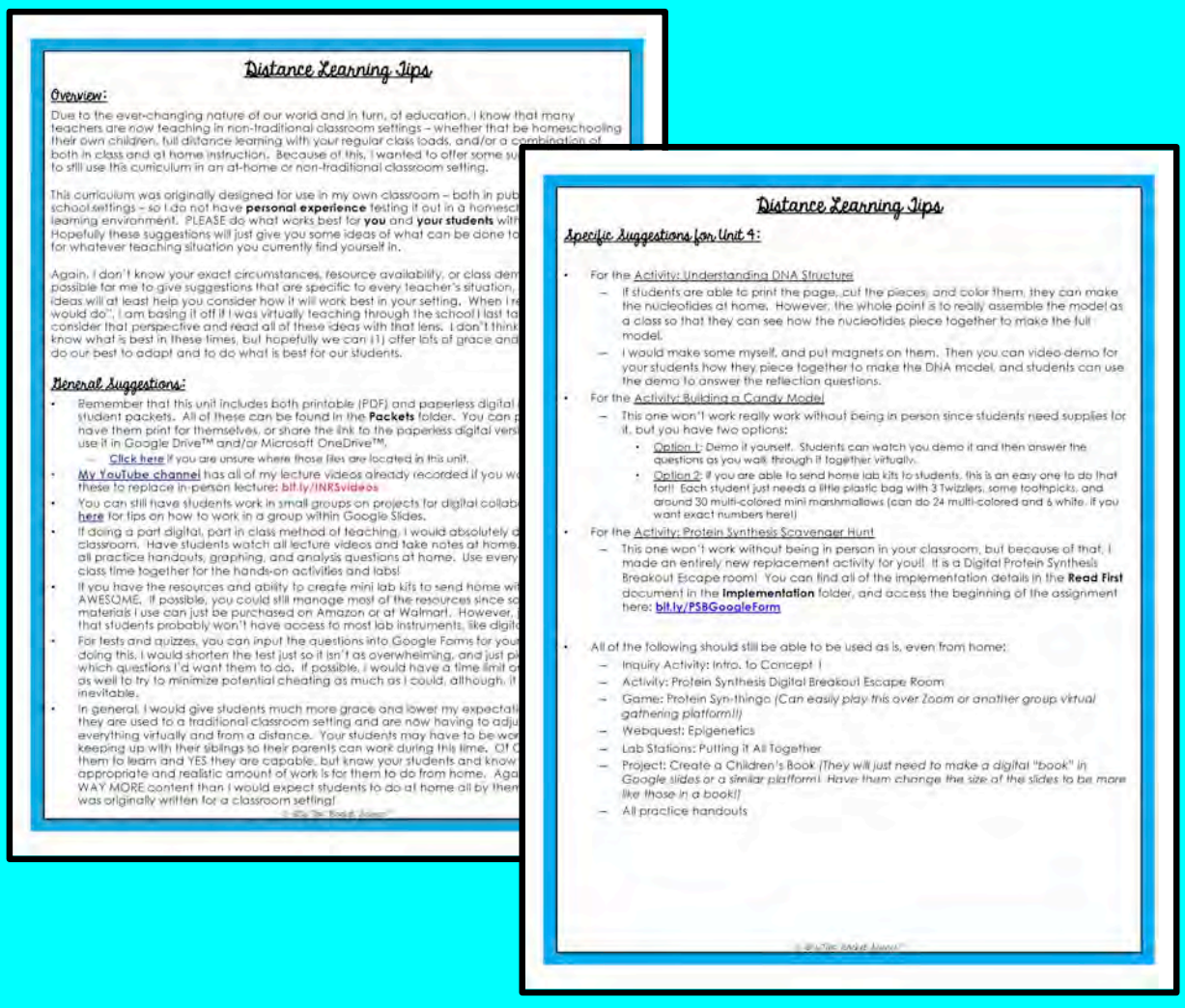
Distance Learning Tips

In light of current circumstances, I recently added a 2-page document with tips for teaching this class virtually. Although the unit wasn't specifically written to be taught in a distance learning or homeschool setting, many of the resources can still be used and/or adapted in some way to fit either of these two types of classrooms. The YouTube lecture videos and paperless digital version of the student packets are especially helpful for teachers who are transitioning between virtual and in-person teaching, as they help to maintain consistency and organization for the students.



Distance Learning Tips

Overview:

Due to the ever-changing nature of our world and in turn, of education, I know that many teachers are now teaching in non-traditional classroom settings – whether that be homeschooling their own children, full distance learning with your regular class loads, and/or a combination of both in class and at home instruction. Because of this, I wanted to offer some suggestions to still use this curriculum in an at-home or non-traditional classroom setting.

This curriculum was originally designed for use in my own classroom – both in public school settings – so I do not have **personal experience** testing it out in a homeschool learning environment. PLEASE do what works best for **you** and **your students** with Hopefully these suggestions will just give you some ideas of what can be done to for whatever teaching situation you currently find yourself in.

Again, I don't know your exact circumstances, resource availability, or class dem possible for me to give suggestions that are specific to every teacher's situation, ideas will at least help you consider how it will work best in your setting. When I would do", I am basing it off if I was virtually teaching through the school I last to consider that perspective and read all of these ideas with that lens. I don't think know what is best in these times, but hopefully we can (1) offer lots of grace and do our best to adapt and to do what is best for our students.

General Suggestions:

- Remember that this unit includes both printable (PDF) and paperless digital student packets. All of these can be found in the **Packets** folder. You can p have them print for themselves, or share the link to the paperless digital vers use it in Google Drive™ and/or Microsoft OneDrive™.
  - Click here if you are unsure where those files are located in this unit.
- My YouTube channel has all of my lecture videos already recorded if you w these to replace in-person lecture: bit.ly/INKSvideos
- You can still have students work in small groups on projects for digital collab here for tips on how to work in a group within Google Slides.
- If doing a part digital, part in class method of teaching, I would absolutely c classroom. Have students watch all lecture videos and take notes at home, all practice handouts, graphing, and analysis questions at home. Use every class time together for the hands-on activities and labs!
- If you have the resources and ability to create mini lab kits to send home wi AWESOME. If possible, you could still manage most of the resources since s materials I use can just be purchased on Amazon or at Walmart. However, that students probably won't have access to most lab instruments, like digit
- For tests and quizzes, you can input the questions into Google Forms for you doing this, I would shorten the test just so it isn't as overwhelming, and just p which questions I'd want them to do. If possible, I would have a time limit a as well to try to minimize potential cheating as much as I could, although, i inevitable.
- In general, I would give students much more grace and lower my expectati they are used to a traditional classroom setting and are now having to adju everything virtually and from a distance. Your students may have to be wo keeping up with their siblings so their parents can work during this time. Of c them to learn and YES they are capable, but know your students and know appropriate and realistic amount of work is for them to do from home. Aga WAY MORE content than I would expect students to do at home all by them was originally written for a classroom setting!

Distance Learning Tips

Specific Suggestions for Unit 4:

- For the Activity: Understanding DNA Structure
  - If students are able to print the page, cut the pieces, and color them, they can make the nucleotides at home. However, the whole point is to really assemble the model as a class so that they can see how the nucleotides piece together to make the full model.
  - I would make some myself, and put magnets on them. Then you can video demo for your students how they piece together to make the DNA model, and students can use the demo to answer the reflection questions.
- For the Activity: Building a Candy Model
  - This one won't work really work without being in person since students need supplies for it, but you have two options:
    - Option 1: Demo it yourself. Students can watch you demo it and then answer the questions as you walk through it together virtually.
    - Option 2: If you are able to send home lab kits to students, this is an easy one to do that for!! Each student just needs a little plastic bag with 3 Twizzlers, some toothpicks, and around 30 multi-colored mini marshmallows (can do 24 multi-colored and 6 white, if you want exact numbers here!)
- For the Activity: Protein Synthesis Scavenger Hunt
  - This one won't work without being in person in your classroom, but because of that, I made an entirely new replacement activity for you!! It is a Digital Protein Synthesis Breakout Escape room! You can find all of the implementation details in the **Read First** document in the **Implementation** folder, and access the beginning of the assignment here: bit.ly/PSBGoogleForm
- All of the following should still be able to be used as is, even from home:
  - Inquiry Activity: Intro. to Concept 1
  - Activity: Protein Synthesis Digital Breakout Escape Room
  - Game: Protein Syn-thingo *(Can easily play this over Zoom or another group virtual gathering platform!!)*
  - Webquest: Epigenetics
  - Lab Stations: Putting it All Together
  - Project: Create a Children's Book *(They will just need to make a digital "book" in Google slides or a similar platform). Have them change the size of the slides to be more like those in a book!)*
  - All practice handouts

Have questions?

Please do not hesitate to contact me with any questions **prior to purchasing**! Due to the nature of digital resources, this resource **cannot** be returned and refunded, so please ask before you buy! You can see the TpT refund policy here.

I respond to Q&A's as well as email at **itsnotrocketsciencestore@gmail.com**!

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THANK YOU!

I hope you find this resource to be useful to you in your classroom and that your students enjoy it as well!

WANT TO SHARE YOUR THOUGHTS?

If you enjoy this resource, PLEASE leave feedback for me! I'd love to hear specifically what you enjoyed and how you used this in your classroom so that I can continue to create resources that are beneficial to you and your students. Your encouragement and feedback mean so much to me!

If you have negative feedback, I would love for you to email me first (itsnotrocketsciencestore@gmail.com) so that I can serve you best on an individual basis to guarantee your satisfaction with my products. I will consider any changes you suggest for the product or product description.

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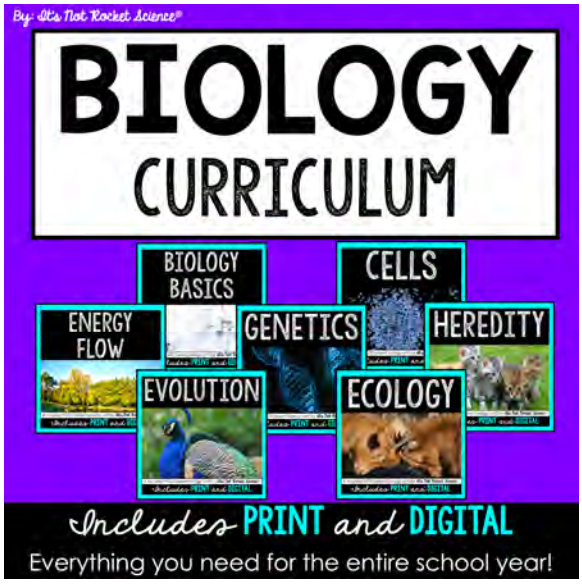
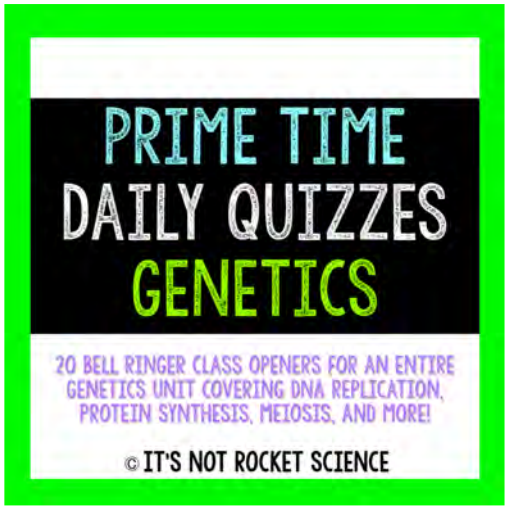
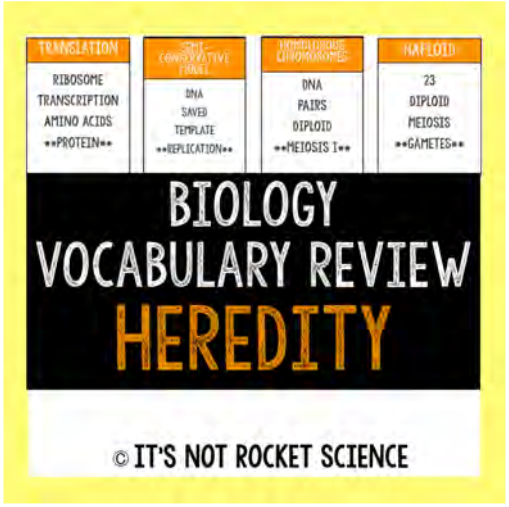
This unit is a part of my **FULL YEAR Biology** Curriculum Bundle: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