

# INDEPENDENT RESEARCH PROJECTS:

## Physical Science **PREVIEW**

### Overview:

This resource includes everything you need to administer semester-long or yearlong independent research projects in your physical science class. It is a perfect way to differentiate your instruction by providing more advanced students with this project-based challenge. Teachers can assign students a topic from the list of suggested driving questions, let students pick from the list, or let write their own question. This resource has all of the support documents you need to bring structure to using a PBL-style assessment over the course of a semester or yearlong class – plus editable versions of all student handouts!

### Project Based Learning:

I have always LOVED so many of the characteristics of PBL (Project Based Learning). I especially love the emphasis on student voice and choice, student autonomy, and the value of the investigative process to create products that communicate an answer to the original essential/driving question. However, this resource isn't 100% true to PBL in that the focus is more on the long-term nature of investigating the topic independently rather than working collaboratively with peers to learn about a unit through the completion of a project. You will see throughout the pages in the resource where I have pulled in my favorite components from PBL to create my vision for these independent research projects, but know that this resource wasn't designed to be 100% PBL. However, I've included helpful hints to make it more fully PBL on **p.14**.

### Why you should use:

I love so many things about projects and specifically PBL, but especially that PBL is student-led, multidisciplinary, and relevant. I love how PBL incorporates student choice, community relevance, and communicating findings of the learning process through multiple products. Why? Because this type of learning engages students and gives them essential practice with critical skills they will use their entire lives, including: researching, synthesizing ideas, asking questions, collaborating, revising, managing time, project planning, making community and cross-curricular connections, varying communication formats, and reflecting. **If you've been looking for a different way to summatively assess your students at the end of the year, or a way to challenge students to see the relevance and interconnectedness of every topic covered in physical science all year long, this resource is for you.**

### When to use:

These projects are designed to get students to spend the entire time they are in your course making connections between what they are learning in class and what they are researching for their project at home. The projects require a significant amount of student time and research to fully complete them. Because of this, I would introduce the project at the beginning of the year, do regular check ins with students throughout the year, and culminate the year with student presentations of their products. See my suggested pacing guidelines on **p.9-10** for how to implement these projects over the course of a semester or a full school year in order to best meet you and your students' needs.

### How to use:

This is best used as a semester or yearlong independent research project, but can be adapted to be done entirely in class, as a partner or small group project, or as a PBL-style final assessment for your course.

## The process:

The traditional PBL process is as follows:

1. Establish or select a driving question.
2. Design a plan for the project\*.
3. Set a schedule for executing the plan.
4. Work through the plan and monitor progress.
5. Assess the product(s)\*.
6. Evaluate and reflect upon the experience.

## Implementation options:

I believe this resource is best implemented over the entire length of the course – whether you are on a semester block schedule or a yearlong schedule. See the mock pacing schedules on **p.9-10**.

## Project components:

Since the project is the process in PBL, the following components will be part of the assessment for the project:

- **Planning** = establishing/selecting a driving question, designing the plan for the project, and setting a schedule for executing the plan.
- **Check ins** = students will complete check in forms on their process ~biweekly, at the end of each unit, and at the halfway point (*end of the first semester if following the yearlong pacing, or end of the first quarter if following the semester long pacing*)
- **Peer Revision** = both in the middle and at the end of the project students will receive peer feedback and be expected to reflect and respond to the feedback.
- **Products** = the culmination of the project will be three products that demonstrate their understanding and ability to answer the initial driving question → a visual product, written product, and oral product.
- **Reflection** = students will complete a final reflection evaluating the overall experience.

## Assessment:

You can assess this however is best for YOU and your students. I use a simple two category grading system of minor (*formative*) and major (*summative*) grades. I weight by points within each category. Based on my grading policy, I would grade each component as the following:

- **Planning** = 50 pt minor grade for completing all planning sheets on **p.7-11** in the student handouts
- **Check ins** = 10 pt minor grade per check in  
See sample paper check ins on **p.12-13** of the student handouts, and a link to the Google Form version on **p.11** of this document.
- **Peer Revision** = 30 pt minor grade per revision/reflection
- **Products** = 100 pt major grade for the written product, 100 pt major grade for the visual and oral products (assessed together)
- **Final Reflection** = 50 pt major grade for the final reflection.

See an example of a point tally for this project on p.13 of this document.

## Materials:

There are no required materials other than the student handouts included in this resource. If you choose to provide your students with additional materials, that is totally up to you!

\*In PBL, the **project** is defined as the entire learning process to get to the end result, whereas the **product** is defined as the outcome that students actually create to represent their learning. Since this resource is designed to be used over the length of an entire physical science course, the project covers the entire year (or semester) the course runs, while the products are what will be submitted at the end for assessment.

# REVIEW

## 12 additional pages of

# teacher implementation notes

### INDEPENDENT RESEARCH PROJECTS: Physical Science

In this resource you will find the following:

- **READ FIRST PDF** (this document)
- **Student Handouts folder**
- **Editable Student Handouts folder**

I recommend reading this document first because the not so subtle titled "READ FIRST PDF" got a thorough understanding of how this resource is designed to be used. This is a **YOUR** teacher guide to walk you through everything you need to know to implement this project with confidence.

Print or pull up the **Student Handouts PDF** to reference as you read this document. This PDF contains everything your **STUDENTS** will need to complete this project. I will reference different page numbers from the Student Handouts throughout the teacher guide, so it will be helpful for you to be able to look up both of them at the same time.

Prior to administering the student handouts to your students, feel free to make changes to form using the files in the **Editable Student Handouts folder**.

**Note:** The course level **KS-120** corresponds to **KS Blank Space Sold** and **KS-120** corresponds to **KS Blank Space Sold**.

In this document on **p.2-3** will walk through a general overview of this entire resource. On **p.4-14**, you will find more specific guidelines for implementation. This resource was designed to be done over the span of a full year Physical Science course. If you teach a yearlong class, refer to the year mock scoring guide on **p.7** for when to do each step of the process. If you teach a semester-long class, refer to the semester mock scoring guide on **p.10**.

I want to point out that I have written this up as if corresponds to my full year physical science curriculum bundle. I reference 9 units, but this can easily be used independently from my curriculum. Just know you will need to tweak some things for your class. This is why I included the **Editable Student Handouts folder**. I hope you have the resources you need to have a successful year!

Rebecca

### THE PROCESS PART ONE: Establishing or selecting a driving question.

A driving question is a **big** or **essential** question that is **open**. It is the main question that students should be able to answer by the end of the process. It has to be broad enough that it is not too narrow, but also specific enough that it is not too broad. It should be a question that is **open** and **essential** to the course.

**Tip #1-4:** The "why" or "how" of a driving question is what you are looking for. It is the main question that students should be able to answer by the end of the process. It has to be broad enough that it is not too narrow, but also specific enough that it is not too broad. It should be a question that is **open** and **essential** to the course.

**Tip #5-8:** A good driving question is one that is **open** and **essential** to the course. It should be a question that is **open** and **essential** to the course. It should be a question that is **open** and **essential** to the course.

**Tip #9-12:** A good driving question is one that is **open** and **essential** to the course. It should be a question that is **open** and **essential** to the course. It should be a question that is **open** and **essential** to the course.

### Examples of Driving Questions:

DRIVING QUESTION	NOTES
What does physics have to do with us?	Aligns with the main theme of physics. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
What role does physics play in modern forensic studies?	Aligns with the main theme of physics. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
What role does chemistry play in modern forensic studies?	Aligns with the main theme of chemistry. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
How do engineers design roller coasters that don't fall off?	Aligns with the main theme of engineering. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
Are space limits determined?	Aligns with the main theme of space. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
Can the game of football continue to play without damage on its players?	Aligns with the main theme of football. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.
What do my sneakers do?	Aligns with the main theme of sneakers. It is a broad question that is open and essential to the course. It is a question that is open and essential to the course.

### PART THREE: Selecting the plan.

Students will select a plan that they will use to complete the project. They will select a plan that they will use to complete the project. They will select a plan that they will use to complete the project.

### When to use the resource:

When	Use the resource
Early in year: between training 1st unit and starting unit 2nd	Part one of the process: establish or select a driving question.
Mid year	Part two of the process: establish or select a driving question.
End of year	Part three of the process: selecting the plan.

### How to use the resource:

How to use	Use the resource
Establish or select a driving question	Part one of the process: establish or select a driving question.
Selecting the plan	Part three of the process: selecting the plan.

### How to use the resource:

How to use	Use the resource
Establish or select a driving question	Part one of the process: establish or select a driving question.
Selecting the plan	Part three of the process: selecting the plan.

### PART SIX: Share the experience.

Students will share their experience with the project. They will share their experience with the project. They will share their experience with the project.

### How to use the resource:

How to use	Use the resource
Establish or select a driving question	Part one of the process: establish or select a driving question.
Selecting the plan	Part three of the process: selecting the plan.

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Establish or select a driving question	Part one of the process: establish or select a driving question.
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### How to use the resource:

How to use	Use the resource
Establish or select a driving question	Part one of the process: establish or select a driving question.
Selecting the plan	Part three of the process: selecting the plan.

Program Check #1	10
End of Unit #1 Check-in	10
End of Unit #2 Check-in	10
End of Unit #3 Check-in	10
End of Unit #4 Check-in	10
Mid-Year Peer Evaluation and Reflection	30
Program Check #7	10
Program Check #8	10
Program Check #9	10
Program Check #10	10
End of Unit #5 Check-in	10
End of Unit #6 Check-in	10
End of Unit #7 Check-in	10
Final Written Project	100
Final Presentation and Peer Evaluation	100
<b>Total Score:</b>	<b>500</b>

# PREVIEW

including

# 15 sample driving questions for potential research

**Examples of Driving Questions:**

DRIVING QUESTION	NOTES
What does physics have to do with music?	Arguably the most familiar physical of all time – a guitar! Einstein, once wrote in a journal that if he weren't a physicist he would be a musician. This could be a fun investigation for our musically-minded students.
What role does physics play in modern forensic studies?	Show the CSI, Law and Order, and Criminal Minds as popular nowadays. This question would be fun for visual students to see the connections between physical topics (even ones as simple as Newton's Laws) and how they are essential in forensic investigation.
What role does chemistry play in modern forensic studies?	Similar to the question above, but focusing on how every the smallest of quantum topics, like the Bohr model, connected to an introductory physical course like this. Students can have a LOT of fun with their chemistry classes with this one.
How do engineers design roller coasters that don't kill us?	For all the engineer-minded students in your class, this would be a fun way for them to see ALL of the physics that goes into designing roller coasters that are equal parts thrilling AND safe.
How are speed limits determined?	Why can I go 45 mph on one road but only 25 mph in my neighborhood? The question seems simple but has a lot of implications. Students can investigate concepts related to momentum, impulse, velocity, acceleration, kinetic energy, and more. They can look into how brakes and air bags work. They can see what the impact is of going 3 mph over the speed limit vs. 15 mph. Students could even research this to investigate the impact of "rolling while driving and how" that changes our response times.
Can the game of football continue to exist without causing long-term damage on its players?	Students can investigate the history of football equipment that has been used to protect (or not really protect) players as well as how rules have changed over the years. They can hypothesize equipment and rule changes that will allow the sport to continue while still protecting its players. A movie like <i>The Concussion</i> or a documentary like <i>Larger of Same</i> could be a highly engaging entry event (inspired by HS-PS2-3).
Where do all my Snapchat go?	The question opens an investigation into the storage of digital information. Students can also look into whether or not there is REALLY such thing as privacy in a digital age. Since so many of our students use apps like Snapchat and technology that has been made for it, they work. This could be incredibly relevant for them (inspired by HS-PS4-2).

**Examples of Driving Questions:**

DRIVING QUESTION	NOTES
Is it safe to sleep with your phone by your pillow every night?	This question opens them to an investigation of all the different ways that waves (and electromagnetic in our everyday world) and if their impact is from a medical standpoint. So many students sleep with their phones on and under their pillows, so the question is relevant to them. A similar question could be "Are X-ray machines in airport safe for frequent travelers?" (inspired by HS-PS4-4)
Can a solar-powered cell phone charger be designed?	All I mentioned above, can students have their phones. This hands-on investigation could give students the opportunity to really what they are learning is class and researching to build a device they could actually use (inspired by HS-PS3-3).
Could understanding the physics of golf allow you to always make a hole-in-one?	The connection between physics and sport is so fun. I love the relevance and hands-on nature of this question. Alternatively, students could even look into the physics of a free throw – what you need to know to always make the extra point! A fun and engaging entry event could be having students go into the gym to shoot free throws.
How do bioengineers create artificial devices, like prosthetics, to enable people to walk?	Love the opportunity for students interested in physics AND medicine to investigate what it means to be a bioengineer and the science behind what they study do.
Does lightning REALLY never strike the same place twice?	I love giving students an opportunity to investigate common myths. If you will, like the one. It is important only into an investigation of electricity, but also weather!
Will Chemistry ever be obsolete again?	Students can investigate the long term impact of nuclear weapons – the historic event, immediate impact, long-term impact, and potential future recovery of the lives where it all happened.
What are the implications of biochemical warfare?	Shows the acid byron and 23 have hypothesized about biochemical warfare for years. But what does it really mean? How does it work? What would be the implications of that type of war tactic? Students could investigate a comparison of biochemical weapons to nuclear weapons.
Do "clean" cleaning supplies really work?	I always enjoy a chance for students to investigate everyday phenomena. The cleaning. We all have to do it, but are our cleaning supplies REALLY cleaning? The question opens an investigation into the history of cleaning supplies and sanitation. The chemistry behind how cleaning supplies are designed and an opportunity to experiment with "clean" cleaning supplies to see if they can really get the job done.

**MOCK PACING GUIDE**  
*Yearlong project*

These are marked as MOCK pacing guides for a reason! Use them as a guide, not as law. Do what is best for YOU and your students. Your school schedule may look very unique. Read everything in the "when" column as "approximately". In actuality, it doesn't matter. This is just to give you some structure for such a long time frame.

Note: Depending on your school year calendar and student population, you may have the capacity to build in more class time for completing the project. If not, no sweat! Just follow the guide below. This is designed to be able to be done completely independently.

WHEN	WHAT
Early in year, between finishing your 1 <sup>st</sup> unit and starting your 2 <sup>nd</sup> .	<b>Part one of the process.</b> Use an entry event to increase engagement and introduce the project and driving questions to students.
The next day.	<b>Parts two and three of the process.</b> Create space for students to design a plan and set a personal schedule for the project.
5 times throughout 1 <sup>st</sup> semester	<b>Part four of the process.</b> About every 2-3 weeks, have students at the end of class on Friday submit the progress check-in form (see p.12 of the student handouts).
At the completion of each unit in the 1 <sup>st</sup> semester	<b>Part four of the process.</b> At the end of each unit, have students submit the end of unit check-in form (see p.13 of the student handouts) and return to them so they can keep track of the connections they see in each unit.
At midyear	<b>Part four of the process.</b> Set aside one class period for students to share their work thus far with several teachers. From there they should make revisions.
5 times throughout 2 <sup>nd</sup> semester	<b>Part four of the process.</b> About every 2-3 weeks, have students at the end of class on Friday submit the progress check-in form (see p.12 of the student handouts).
At the completion of each unit in the 2 <sup>nd</sup> semester	<b>Part four of the process.</b> At the end of each unit, have students submit the end of unit check-in form (see p.13 of the student handouts) and return to them so they can keep track of the connections they see in each unit.
At the end of the year	<b>Part six of the process.</b> Students will complete the final written reflection of their experience for submission.

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**MOCK PACING GUIDE**  
*Semester long project*

These are marked as MOCK pacing guides for a reason! Use them as a guide, not as law. Do what is best for YOU and your students. Your school schedule may look very unique. Read everything in the "when" column as "approximately". In actuality, it doesn't matter. This is just to give you some structure for such a long time frame.

Note: Depending on your school year calendar and student population, you may have the capacity to build in more class time for completing the project. If not, no sweat! Just follow the guide below. This is designed to be able to be done completely independently.

WHEN	WHAT
Early in year, at the start of week 3 of school.	<b>Part one of the process.</b> Use an entry event to increase engagement and introduce the project and driving questions to students.
The next day.	<b>Parts two and three of the process.</b> Create space for students to design a plan and set a personal schedule for the project.
3 times throughout 1 <sup>st</sup> quarter	<b>Part four of the process.</b> About every 2 weeks, have students at the end of class on Friday submit the progress check-in form (see p.12 of the student handouts).
At the completion of each unit in the 1 <sup>st</sup> quarter	<b>Part four of the process.</b> At the end of each unit, have students submit the end of unit check-in form (see p.13 of the student handouts) and return to them so they can keep track of the connections they see in each unit.
At midyear, between 1 <sup>st</sup> and 2 <sup>nd</sup> Q2	<b>Part four of the process.</b> Set aside one class period for students to share their work thus far with several teachers and to receive feedback from them they should make revisions to their work.
3 times throughout 2 <sup>nd</sup> quarter	<b>Part four of the process.</b> About every 2 weeks, have students at the end of class on Friday submit the progress check-in form (see p.12 of the student handouts).
At the completion of each unit in the 2 <sup>nd</sup> quarter	<b>Part four of the process.</b> At the end of each unit, have students submit the end of unit check-in form (see p.13 of the student handouts) and return to them so they can keep track of the connections they see in each unit.
The day after	<b>Part six of the process.</b> Students will complete the final written reflection of their experience for submission.

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# Pacing guides for Yearlong and semester block courses

# PREVIEW

**20** student handouts including rubrics, checklists, planning pages, and **MORE!**

### PHYSICAL SCIENCE INDEPENDENT RESEARCH PROJECT

#### Overview

**Goal:** To independently complete a research project of your choice, answering a driving question using information gained from what you learn as you dig throughout the year and from your past research. This project will be the representation of all that you learned in this class at the end of the year, and based on the completion of your project and the final product you will create to demonstrate your learning.

**Components:**

- Planning process
- Progress Check-ins
- Final reflection
- Product (written, visual, or digital)
- Final reflection

**Written Product Requirements:**

- Driving question is answered clearly and in depth. All work is original, informed, and accurate.
- Background information necessary to understand the answer to the question is clearly explained.
- Evidence from research is provided to support every claim made.
- Reasoning for each piece of supporting evidence is clear.
- Detailed connections are made for at least 4 of the info we covered in class.
- Interview with a relevant member of the community is incorporated in a way that supports answering the driving question.
- All research is properly cited, both using in-text citations and a works cited page.

**Visual Product Requirements:**

- Content is clear and visually appealing.
- Clearly demonstrates an understanding of the question.
- Contributes to further expanding the background information and evidence-based reasoning necessary to answer the question.
- Engages audience, presenting an interest in the answer to the driving question.

**Oral Product Requirements:**

- Seems to demonstrate a clear understanding.
- Student demonstrates confidence and clarity.
- The final product is evidenced upon response.
- There is clear evidence that the student has a clear research they found to answer it.
- All information shared is relevant and accurate.

**Assessment:** You will be assessed both on the final product. Assessment throughout the process will be of progress check-ins and participation in peer-to-peer observations on their projects, and receiving and giving assessments of the products will include the written reflection from the experience. These components are:

- Process # 250 pts
- Final progress check-in will be worth 100 pts
- Product # 250 pts
- The written and visual product will be worth 100 pts

### PHYSICAL SCIENCE INDEPENDENT RESEARCH PROJECT

#### Completion Checklist

Throughout the course of the year you will be expected to complete progress check-ins (ongoing class). In addition, use the following checklist to stay on track with what you need to be doing independently!

- Select a driving question.
- Work through the planning pages.
- Set completion schedule.
- Conduct background research.
- Add to "need to know" list after initial research.
- Make final commitment to driving question.
- Conduct an interview to include as a source in written product.
- Conduct follow up research after interview.
- Outline written product.
- Sketch plan for visual product.
- Write rough draft of written product.
- Provide feedback to peers mid-project.
- Evaluate received peer feedback and make adjustments.
- Make final written product.
- Create visual product.
- Create and practice oral product.
- Present visual and product.
- Provide feedback to peers.
- Write final reflection.
- Submit and CELEBRATE!

### PHYSICAL SCIENCE INDEPENDENT RESEARCH PROJECT

#### Written Product Rubric

Criteria	4 (Exceeds Expectations)	3 (Meets Expectations)	2 (Approaches Expectations)	1 (Does Not Meet Expectations)
Background Information	Background information is clearly explained and relevant to the question.	Background information is explained and relevant to the question.	Background information is explained but lacks detail or relevance.	Background information is missing or irrelevant.
Evidence	Evidence is provided to support every claim made.	Evidence is provided to support most claims made.	Evidence is provided but lacks detail or relevance.	Evidence is missing or irrelevant.
Reasoning	Reasoning for each piece of supporting evidence is clear.	Reasoning for each piece of supporting evidence is clear.	Reasoning for each piece of supporting evidence is unclear.	Reasoning for each piece of supporting evidence is missing.
Connections	Detailed connections are made for at least 4 of the info we covered in class.	Detailed connections are made for at least 3 of the info we covered in class.	Detailed connections are made for at least 2 of the info we covered in class.	Detailed connections are made for at least 1 of the info we covered in class.
Interview	Interview with a relevant member of the community is incorporated in a way that supports answering the driving question.	Interview with a relevant member of the community is incorporated in a way that supports answering the driving question.	Interview with a relevant member of the community is incorporated in a way that supports answering the driving question.	Interview with a relevant member of the community is not incorporated.
Citations	All research is properly cited, both using in-text citations and a works cited page.	All research is properly cited, both using in-text citations and a works cited page.	All research is properly cited, both using in-text citations and a works cited page.	All research is not properly cited, both using in-text citations and a works cited page.

### PROGRESS CHECK-IN #0P

The purpose of this form is to check in with you and allow you to provide your own answer to questions to identify the problem.

**WINS:** What have you accomplished since your last check-in? Share some progress along the way!

**OPPORTUNITIES:** What challenges have you encountered and how do you plan to overcome them?

**PLANS:** What do you plan to accomplish before your next progress check-in? Refer back to your completion checklist and address it as well as what you need to do next!

It's time to dig deep, you need from me to help guide you to a great end! Let me know how you're doing!

### PHYSICAL SCIENCE INDEPENDENT RESEARCH PROJECT

#### Final Tally

Component	Date
Planning Pages	
Progress Check-in #1	
Progress Check-in #2	
Progress Check-in #3	
Progress Check-in #4	
Progress Check-in #5	
End of Unit #2 Check-in	10
End of Unit #3 Check-in	10
End of Unit #4 Check-in	10
Midterm Peer Evaluation and Reflection	20
Progress Check-in #6	10
Progress Check-in #7	10
Progress Check-in #8	10
Progress Check-in #9	10
Progress Check-in #10	10
End of Unit #5 Check-in	10
End of Unit #6 Check-in	10
End of Unit #7 Check-in	10
End of Unit #8 Check-in	10
Final Written Product	100
Final Visual and Oral Products	100
Final Reflection and Peer Evaluation	50
<b>Total Score:</b>	<b>500</b>

**PLUS**

All student handouts are **EDITABLE** to customize for your classes!

## THANK YOU!



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

## CREDITS FOR GRAPHICS AND FONTS



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## 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](mailto: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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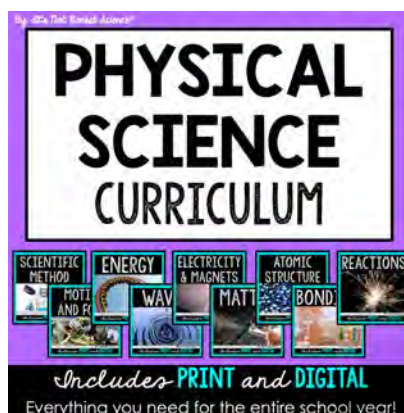
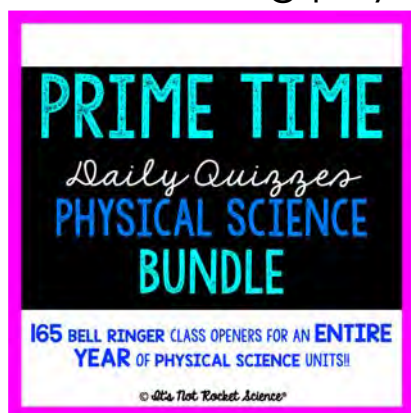
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