

INDEPENDENT RESEARCH PROJECTS:

Biology PREVIEW

Overview:

This resource includes everything you need to administer semester-long or yearlong independent research projects in your biology 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 them design a project around 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 biology 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.

*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 biology 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.

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!

PREVIEW

including

15 sample driving questions for potential research

Example of Driving Questions:

DRIVING QUESTION	NOTES
How is biological sex best defined for something like the Olympics where athletes are classified as males and females in their competitive events?	In 2017 I read an article out of ESPN magazine by Samantha M. Shapiro called, "So-called 'Sex Myster'". It covers the story of South Korean, the Indian summer show Olympic medals were stripped due to a failed gender test (this article would be a great entry event to introduce the driving question). The article talks about the history of how biological sex has been defined through the Olympics as well as introduces the complexities of biological sex standards. This is a PETA controversial topic so choose whether or not it is appropriate for your student population, but I love the ethical issues and implications on the most famous sporting event in the entire world and the on-broadly fascinating driving question to consider.
How many people could New York City ecologically support?	As students attempt to calculate the carrying capacity of NYC, they can investigate 3D many factors like space, resources (like carbon output and necessary food input). They could also investigate Mumbai, as it is considered the most densely populated city in the world.
How many people could (live where you live) ecologically support?	A twist on the previous driving question, but potentially even more engaging for students as they investigate the specific plants that you live.
Can Venice survive?	This question drives a fascinating investigation into the effects of rising sea levels and the impact that may have on one of the most iconic cities of all time. Students can investigate so many research/biotechnology related topics as they research potential solutions for this " sinking city".
Are you more closely related to a fungus or a plant?	I love how this question gets students thinking more about other organisms AND seeing the immense similarities between it being fungi. You can give them a specific fungus and plant to investigate to verify, if you desire.
Are we really "better together"?	This question is designed for students to verify investigate the evolution of traits behavior for both individual AND species chances to survive and reproduce (inspired by HS-LS4-2 from NGSS).
How does eutrophication affect humans?	I love this opportunity for students to look at environmental issues specifically in aquatic ecosystems as we visit other parts to look at what immediately impacts the world directly around us. Students can discuss solutions to mitigate its adverse effects as part of their project (inspired by HS-LS4-4).
Could plant-based diets save the world?	I love how this question connects a common topic to the explosion of being sustainable (inspired by HS-LS4-6).

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Example of Driving Questions:

DRIVING QUESTION	NOTES
Which macromolecule is the most essential for life?	This is a "debate" style question. There is absolutely no right answer, but the purpose is to get students making a claim and defending it with evidence and reasoning. I love this question because we cover macromolecules in EVERY unit so they can make so many connections throughout the school year. Also something I love about debate questions: they are fully searchable on Google since a "right answer" doesn't exist in any capacity.
Which molecule most impacts why you are the way you are - DNA or proteins?	Another great debate style question. I love this connection to macromolecules and heredity. I have this opportunity for students to research epigenetics as well as make connections to disorders caused by transcription and translation errors, and the original DNA being mutated. So many interesting directions students could take this!
What matters most in society's quest for sustainable living - maintaining high biodiversity or controlling carbon emissions?	Again, another potential debate style question. The 30 commentary "A Life on Our Planet" with David Attenborough on Netflix would be a great entry event to this question.
Could planting trees REALLY combat our climate change issues?	This question seems so simple to all our climate change problems, but could it really make a long-term difference? The documentary "A Life on Our Planet" with David Attenborough on Netflix would be a great entry event for this question as well.
How does the introduction of a non-native species impact an ecosystem?	Students can investigate the difference between non-native species and invasive species that are specifically classified as invasive. They can choose one specific species within a specific ecosystem to investigate, and investigate the negative implications of an introduction of a species into an ecosystem that hasn't occurred (i.e. What if tigers were introduced to the African savanna?)
Why can't we cure cancer?	Verify every student will have someone close to them who has experienced cancer, making this a question students really desire to know the answer to. Showing students research about cancer (see https://www.youtube.com/watch?v=8u0t8k8g) would be an impactful entry event.
Are mutations always harmful?	This most commonly known example of this that could serve as an entry event - would be https://www.youtube.com/watch?v=8u0t8k8g . Although the answer to be a simple yes/no question, students could really get into an investigation of many mutations and also the evolutionary implications.

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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, flexed anything 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. This "flexing" is not necessary, 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 st unit and starting your 2 nd .	Part one of the process. Use an entry event to increase engagement and introduce the project and driving questions to students.
The next day.	Parts two and three of the process. Create space for students to design a plan and set a personal schedule for the project.
5 times throughout 1 st semester	Part four of the process. 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 st semester	Part four of the process. 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	Part four of the process. Set aside one class period for students to share their work thus far with several pieces of feedback. From there they should make adjustments to their work.
5 times throughout 2 nd semester	Part four of the process. 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 nd semester	Part four of the process. 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	Part six of the process. Students will complete the final written reflection of their experience for submission.

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MOCK PACING GUIDE
Semester long project

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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. This "flexing" is not necessary, 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.	Part one of the process. Use an entry event to increase engagement and introduce the project and driving questions to students.
The next day.	Parts two and three of the process. Create space for students to design a plan and set a personal schedule for the project.
3 times throughout 1 st quarter	Part four of the process. 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 st quarter	Part four of the process. 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 st and 2 nd Q2	Part four of the process. Set aside one class period for students to share their work thus far with several pieces of feedback and to receive adjustments from there they should make revisions to their work.
3 times throughout 2 nd quarter	Part four of the process. 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 nd quarter	Part four of the process. 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	Part six of the process. 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!**

BIOLOGY 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 at six steps throughout the year and from your own research. This project will be the representation of all that you learned in this class at the end of the year, and should be the completion of your journey 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 prepared, 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.
- Established connections are made for at least 4 of the units 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 appropriately 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.
- Relevant to the driving question.
- Contributes to further expanding the background information and evidence-based reasoning necessary to answer the question.
- Engages audience, prompting 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 thorough research they found to answer it.
- All information shared is relevant and accurate.

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

- Process = 250 pts
- Final product = 250 pts
- The written and visual product will be assessed as follows:

BIOLOGY INDEPENDENT RESEARCH PROJECT
Completion Checklist

Throughout the course of the year you will be expected to complete progress check-ins along with your work. 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 oral product.
- Provide feedback to peers.
- Write final reflection.
- Submit and CELEBRATE!

BIOLOGY INDEPENDENT RESEARCH PROJECT
Written Product Rubric

Criteria	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Background Information	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.	Background information is provided to support every claim made.
Evidence	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.	Evidence from research is provided to support every claim made.
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 clear.	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 clear.	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 clear.	Reasoning for each piece of supporting evidence is clear.
Connections	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units we covered in class.	Established connections are made for at least 4 of the units 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 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 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 incorporated in a way that supports answering the driving question.
Citation	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.	All research is appropriately cited, both using in-text citations and a works cited page.

BIOLOGY INDEPENDENT RESEARCH PROJECT
Planning Pages Part One

Fill in each of these boxes in your notebook and then use your product. Remember to change this up to make it your own. Consider this to be a "working document" as it evolves.

Which driving question are you most interested pursuing?

What ideas do you already have related to investigating these questions?

What is a different question you would like to investigate?

Take some time to consider your outline before attempting to draft the planning process!

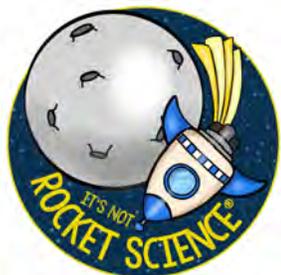
BIOLOGY INDEPENDENT RESEARCH PROJECT
Final Tally

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 #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
Midterm Peer Evaluation and Reflection	30
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
Final Written Product	100
Final Visual and Oral Products	100
Final Reflection and Peer Evaluation	50
Total Score:	500

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!

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!

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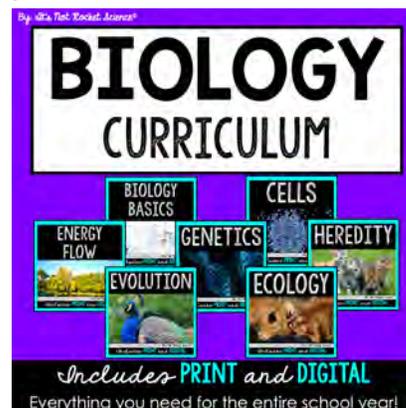
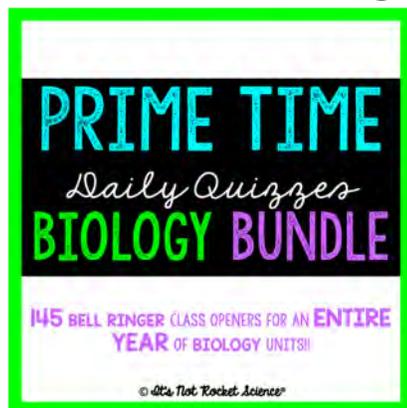
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