



## TOPIC

Life Sciences – Virology, Immunology, Epidemiology

## LEARNING OBJECTIVES

- Learn how researchers create vaccines.
- Learn about what steps are taken to test a vaccine's effectiveness.
- Learn standards-based concepts of how viruses work in body.
- Learn to make a profit from creating a vaccine.

## CONTENTS OF THIS GUIDE

1. Class Preparation
2. Sample Outline
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In the Vaccine Lab activity, students learn about virology and immunology. This is a great activity for those exploring the life sciences or for career exploration.

The game simulates the creation of vaccines for viruses plaguing Whyvillians. Students go through the process of ethical experimental design, clinical trials, governmental approval, and entrepreneurial considerations related to vaccine design. Students can create a vaccine and sell it to other Whyvillians!

First, students are presented with active viruses in Whyville. They design a vaccine they think will help create specific immunity. Next, the vaccine is tested on an animal and if it proves successful, the testing moves on to a trial with humans. If the human trial passes, and no patent exists on the vaccine, the FDA can approve the vaccine. Finally, students will make some decisions about what they'll charge for the vaccine. They can then sell their vaccine to other Whyvillians in the Pharmacy.

## MATERIALS

- Properly configured computers. See our Technical Guide for more information.
- Student handout for daily grade, included in this lesson plan.

## WHAT TO DO BEFORE CLASS

- 1) Watch the associated WhyPak video *Vaccine Lab Walkthrough*.
- 2) Navigate through Whyville and find the Vaccine Lab activity within the BioPlex.
- 3) Browse through the tutorial content and determine whether additional content is needed, based on your particular class's needs.
- 4) Detailed information regarding the vaccine approval process can be found in the associated tutorial content.
- 5) Once you feel comfortable with the process, try the Vaccine Design simulation. Try to make a semi-effective vaccine and make it once through the vaccine approval process.
- 6) Skim through the attached worksheet. Decide if it is applicable for your class.

## SAMPLE LESSON OUTLINE

- 1) Conduct a short class discussion on what the students know about viruses, the immune system, and vaccines. Hand out the student worksheet. [Recall]
- 2) Have your students log into Whyville, direct them to the BioPlex and then to the Vaccine Lab.
- 3) Students should browse through the Design, BioEthics, Testing, and Business tabs of the Vaccine Tutorial prior to playing the Vaccine Design simulation. Have students explore the vaccines for sale at the Pharmacy. Let them explore vaccine creation. [Explore]
- 4) Conduct a short class discussion on what the students learned about the vaccine approval process. There are plenty of vocabulary words in this tutorial they could be asked about. [Reflect]

### WhyPaks Lesson Guide Framework

**Recall** – Ask the students what they already know about the subject.

**Explore** – The students self-direct themselves through the activity. Teacher facilitates.

**Reflect** – Refine the students' understanding by using directed inquiries.

**Accomplish** – The students are presented with a goal to achieve.

**Connect** – Connect what was learned to standards-based content.

*Continued*

- 5) Have students play through the Vaccine Design simulation and try to create a highly effective vaccine with few or no side effects. If the vaccine is not already patented, encourage them to take their product to market! [Accomplish]
- 6) Have students complete the attached worksheet for a daily grade. [Connect]

**WHERE TO NEXT? RELATED CONTENT WITHIN WHYVILLE**

SUBJECT MATTER	WHYVILLE DESTINATION
Immunology, Epidemiology, Virology	BioPlex – Make-a-Virus, Pharmacy, CDC
Laboratory Processes and Procedures	Animal C.A.R.E
Health, Wellness, Nutrition	WhyEat, Cafeteria, Fitzone
Entrepreneurship	Akbar’s Face Parts Mall, PlaneWorks’ Baron von Vendor, Style Studio

**Next Generation Science Standards (NGSS)**

<b>NGSS Subcategory</b>	<b>Standard ID</b>	<b>Standard Description</b>
Interdependence of Science, Engineering, and Technology	MS-PS1-3	Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.
Influence of Science, Engineering and Technology on Society and the Natural World	MS-PS1-3	The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.
Developing and Using Models	MS-PS1-1, MS-PS1-4	Develop a model to predict and/or describe phenomena.
Constructing Explanations and Designing Solutions	MS-PS3-3	Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.
Systems and System Models	MS-PS3-2	Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.
Engineering Design	MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
Engineering Design	MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

<b>NGSS Subcategory</b>	<b>Standard ID</b>	<b>Standard Description</b>
Engineering Design	MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Engaging in Argument from Evidence	MS-PS3-5	Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.
ETS1.B: Developing Possible Solutions	MS-ETS1-3	Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.
ETS1.B: Developing Possible Solutions	MS-ETS1-4	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
ETS1.C: Optimizing the Design Solution	MS-ETS1-3	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.
ETS1.C: Optimizing the Design Solution	MS-ETS1-4	The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
Life Sciences – Structure, Function, and Information Processing	MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.
Life Sciences – Structure, Function, and Information Processing	MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

<b>NGSS Subcategory</b>	<b>Standard ID</b>	<b>Standard Description</b>
Life Sciences – Structure, Function, and Information Processing	MS-LS1-3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

**Common Core – ELA: Science and Technical Subjects (CC-ELA)**

<b>CC Subcategory</b>	<b>Standard ID</b>	<b>Standard Description</b>
Writing for History/Social Studies, Science and Technical Subjects	WHST.6-8.1	Write arguments focused on discipline content.
Writing for History/Social Studies, Science and Technical Subjects	WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
Reading for Science and Technical Subjects	RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
Speaking & Listening	SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Speaking & Listening	SL.8.1.c	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

**Texas Essential Knowledge & Skills (TEKS)**

<b>TEKS Category</b>	<b>Chapter</b>	<b>Standard ID</b>	<b>Standard Description</b>
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<b>TEKS Category</b>	<b>Chapter</b>	<b>Standard ID</b>	<b>Standard Description</b>
Science – Scientific Investigation and Reasoning	112.18 112.19 112.20	6.2.B 7.2.B 8.2.B	Design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology.
Science – Scientific Investigation and Reasoning	112.18 112.19 112.20	6.2.D 7.2.D 8.2.D	Relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
Science – Scientific Investigation and Reasoning	112.19	7.3.B	Use models to represent aspects of the natural world such as human body systems and plant and animal cells.
Science – Organisms and Environments	112.18	6.12.A	Understand that all organisms are composed of one or more cells.
Science – Organisms and Environments	112.18	6.12.D	Identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized Kingdoms.
Science – Organisms and Environments	112.19	7.12.B	Identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems.
Science – Organisms and Environments	112.19	7.12.C	Recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms.
Science – Organisms and Environments	112.19	7.13.B	Describe and relate responses in organisms that may result from internal stimuli such as wilting in plants and fever or vomiting in animals that allow them to maintain balance.

<b>TEKS Category</b>	<b>Chapter</b>	<b>Standard ID</b>	<b>Standard Description</b>
CTE – Career Portals	127.4	1.A	The student explores one or more career clusters of interest. The student is expected to: (A) identify the various career opportunities within one or more career clusters.
CTE – Career Portals	127.4	2.A	The student explores pathways of interest within one or more career clusters. The student is expected to: (A) investigate career opportunities within the pathways.
CTE – Exploring Careers	127.3	4.A	The student evaluates skills for personal success. The student is expected to: (A) implement effective study skills for academic success.
CTE – Exploring Careers	127.3	4.C	Use a problem-solving model and critical-thinking skills to make informed decisions.
CTE – Exploring Careers	127.3	4.D	Use effective time-management and goal-setting strategies.
CTE – Exploring Careers	127.3	4.E	Effectively use information and communication technology tools.
CTE – Exploring Careers	127.3	7.E	The student develops skills for professional success. The student is expected to: (E) explore and model characteristics necessary for professional success such as work ethics, integrity, dedication, perseverance, and the ability to interact with a diverse population.
CTE – Exploring Careers	127.3	7.F	Complete activities using project- and time-management techniques.
CTE – Exploring Careers	127.3	8.A	The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to: (A) complete actual or virtual labs to simulate the technical skills required in various occupations.