

A Look inside the Lab: Centrifuges

OVERVIEW

The VMP Next Step Science resources provide mini lessons, videos, and other materials related to the practice of science. These resources are meant to enhance the exploration of a particular topic or offer insights into the profession of scientific research.

The Next Step Science “A Look inside the Lab” series is comprised of reading passages and videos designed to introduce students to pieces of laboratory equipment and the scientists who use them. The series can be used to enhance an existing lesson or as a starting point for introducing a concept.

Each mini lesson includes:

- Short video featuring scientists from the Children’s Hospital of Philadelphia Research Institute discussing their work and how they utilize the lab equipment on a day-to-day basis
- Related reading passage
- Teacher guide
- Student worksheet

Additional VMP “A Look inside the Lab” videos and materials can be found at vaccinemakers.org/next-step-science.

OBJECTIVES

“A Look inside the Lab” series activities are designed to:

- Introduce students to equipment commonly used in medical research laboratory settings and explore how the technology impacts and serves society
- Introduce students to scientists, science careers, and the types of investigations that scientists conduct on a day-to-day basis
- Provide an opportunity for students to read informational text about scientific topics to enhance their understanding of how science is done and consider how scientists develop possible solutions to problems

Centrifuges Lesson Objectives:

- Students will understand the separation of and function of the different blood components.
- Students will be able to explain how centrifuges work and why they are useful tools both in everyday life and in the laboratory.

LESSON RESOURCES

- Lesson video, *A Look inside the Lab: Centrifuges*, <https://vimeo.com/530447850>
- Video transcript PDF: [https://vaccinemakers.org/sites/default/files/resources/Look in Lab Centrifuges video transcript FINAL.pdf](https://vaccinemakers.org/sites/default/files/resources/Look%20in%20Lab%20Centrifuges%20video%20transcript%20FINAL.pdf)
- Reading passage, *A Roller Coaster for your Cells*, [https://vaccinemakers.org/sites/default/files/resources/Look Lab Centrifuges reading%20opassage FINAL.pdf](https://vaccinemakers.org/sites/default/files/resources/Look%20Lab%20Centrifuges%20reading%20opassage%20FINAL.pdf)
- Student worksheet – Blood components: [https://vaccinemakers.org/sites/default/files/resources/Look Lab Centrifuges worksheet FINAL.pdf](https://vaccinemakers.org/sites/default/files/resources/Look%20Lab%20Centrifuges%20worksheet%20FINAL.pdf)
- Student worksheet – Lesson questions: [https://vaccinemakers.org/sites/default/files/resources/Look Lab Centrifuges Lesson questions FINAL.pdf](https://vaccinemakers.org/sites/default/files/resources/Look%20Lab%20Centrifuges%20Lesson%20questions%20FINAL.pdf)
- Resources related to Centrifuges
 - History of the Centrifuge, The LabWorld Group, <https://www.thelabworldgroup.com/blog/history-of-centrifugation/>
 - Theodor H.E. Svedberg, Encyclopedia Britannica, <https://www.britannica.com/biography/Theodor-Svedberg>
 - The (Theodor) Svedberg, Uppsala Universitat, <https://www.uu.se/en/about-uu/history/nobel-prizes/the-svedberg>
 - The History of the Centrifuge, Marshall Scientific, <https://www.marshallscientific.com/the-history-of-the-centrifuge-a/349.htm#:~:text=In%201864%2C%20Antonin%20Prandtl%20invented,cream%20of%20a%20large%20scale>
 - What Happens to Donated Blood, Red Cross Blood, <https://www.redcrossblood.org/donate-blood/blood-donation-process/what-happens-to-donated-blood.html>
 - What is a Centrifuge: Understanding its Types and Uses, Data Support Company, <https://www.dscbalances.com/blogs/articles/what-is-a-centrifuge-understanding-its-types-and-uses#:~:text=separation%20is%20paramount.-,Applications%20of%20Centrifuges,with%20laboratory%20uses%20of%20centrifuges>

LESSON

The lesson progression outlined below can be completed in 2-3 50-minute class sessions.

Engage

Time: 15-20 minutes

Have students:

- Briefly discuss centripetal force and motion. Brainstorm where they see the use of high-speed circular motion in daily life.
 - Washing machines
 - Fans
 - Car tires
 - DVD players
 - Electric toothbrushes
 - Blenders

Explore

Time: 15-20 minutes

Have students:

- Read the passage, “A Roller Coaster for Your Cells.”
- Watch the video, *A Look inside the Lab: Centrifuges*.

Explain

Time: 20-30 minutes

Have students:

- Work individually to complete the lesson worksheet:
 - Complete test tube image, label the layers of separated blood components and describe the function of each layer.
 - Answer the lesson questions.

Elaborate

Time: 20-30 minutes

Have students:

- Have students work in small groups to find 3-5 interesting facts about centrifuges.
- Give each group 3-5 strips of paper and instruct them to formulate an open-ended or fill-in-the-blank question about each of their facts (1 per strip of paper).

Evaluate

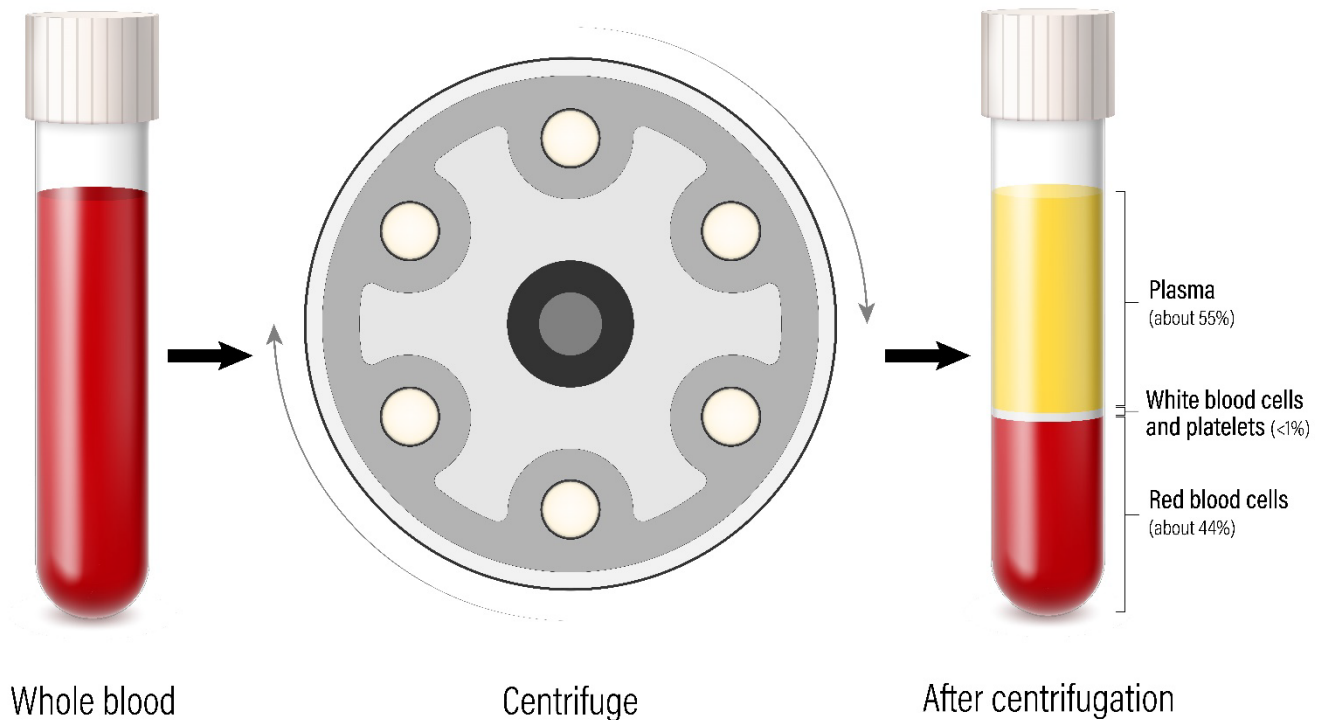
Time: 30-45 minutes

Have students:

- Form teams and play either of the games detailed below.
 - Trivia
 - First, have students collect and mix the strips of paper.
 - Take turns pulling random strips of paper and trying to answer the question or fill-in-the blank. Give points for correct answers.

OR

- Worksheet
 - Use the strips from the previous activity to create a worksheet.
 - Have students complete the worksheet either individually or in teams at the conclusion of the exercise.

RUBRIC: STUDENT WORKSHEET – Blood components

RUBRIC: STUDENT WORKSHEET – Lesson Questions

1. How does density factor into the way a centrifuge works?

Students should be able to articulate that a centrifuge uses an outward force generated during high-speed rotation to separate the components of a mixture by density. Materials with a higher density will separate to the bottom of the tube and materials that have a lower density will end up closer to the top.

2. Why might we need to separate cells from medium in a laboratory setting?

Answers may vary. Students should be able to articulate that cells are often separated from medium to analyze individual components of the sample or these components can be used for more specific experiments.

3. How do you balance a centrifuge? Why is this step important?

To balance a centrifuge, tubes of the same weight need to be placed across from each other so that the weights are symmetrical. If this is not done properly or at all, the rotations will be uneven, causing damage to the machine. In situations in which large centrifuges are being used, the uneven rotation can cause the rotor to break through the side of the machine and fly through the room. Lab accidents of this nature can spread dangerous materials or injure people working in the lab.

4. What substance is used to separate blood into its layers when using a centrifuge?

We use Ficoll to separate blood into its layers.

5. What is the most abundant protein in plasma? What does it do?

The most abundant protein in plasma is albumin. Albumin keeps fluid from leaking out of the blood vessels. It also helps to circulate vitamins, enzymes, and hormones throughout the body.

6. What are the roles of white blood cells in the body? What do elevated levels of white blood cells tell us about the body?

White blood cells primarily act to fight infections in the body. Elevated levels of white blood cells indicate that the body is fighting an infection.

7. What is the role of platelets in the body? What can happen when someone has low platelet counts?

Platelets primarily function to prevent and stop bleeding. Low levels of platelets, a condition called thrombocytopenia, increase the risk of bleeding in affected individuals because their blood is less efficient at clotting.

8. What is the main function of red blood cells?

The primary function of red blood cells is to transport oxygen from the lungs to tissue throughout the body.

9. Who invented the centrifuge? What was the instrument's original purpose?

Anthony Prandtl invented the centrifuge with the original intention of separating milk from cream in large-scale dairy processing.

10. Who invented the ultracentrifuge? What is the instrument's application and how does it differ from the original?

Student answers may vary. Thomas Svedberg invented the ultracentrifuge to effectively study colloids and proteins. Svedberg created the ultracentrifuge with the intention of laboratory use while Prandtl created the original centrifuge for commercial use.