



Lesson 2

Imaging the Body: The MRI Machine | Unit Overview

To further establish a background in understanding how MRI works as a whole, students will learn about the components of MRI machines, what they do independently, how they function together, and general safety measures when using an MRI machine. Students should be able to visualize the components of an MRI machine and understand how a patient and doctors may interact with it by the end of the interactive lesson.

Recommended Grade Levels: 6-8

Learning Objectives:

- Discuss the characteristics of MRI machine and learn about the constraints of imaging a human body
- Talk about MRI safety as a key design constraint in creating an imaging method
- Discuss characteristic of MRI components and their functions
- Describe how each part contributes to the function of the MRI machine
- Develop a model that tests how the MRI machine would function without each component

Lesson Approaches:

The materials and group setups used for the lesson can vary based on three approaches. Each approach uses the interactive online lesson with worksheets and a Google Form available. Supplemental materials and assessments are available for teachers and students to expand on each lesson.

Lecture approach: A lecture style class session that uses one device to show the students the interactive lesson and a correlated worksheet for each student. A Google Form can also be answered as a whole class to both assess and discuss what the students have learned.

Materials used:

- A computer with internet access
- A large screen to project to the class
- A worksheet or access to Google Form for each student



Small group approach: A cooperative student learning approach that organizes the class into small groups, each with their own device to learn from the interactive lesson and fill out a worksheet that highlights areas of focus in the lesson. A Google Form can also be used, either within those groups or as a whole class, to elicit engagement and discussion.

Materials used:

- A computer with internet access for each group of several students
- A worksheet or access to Google Form for each student or group

Individual approach: An individual learning approach that allows students to engage with the interactive lesson at school or at home, answering questions on a worksheet along the way. This approach may be supported with classroom discussions after each lesson.

Materials used:

- A computer with internet access for each student, either a school computer or personal computer at home
- A worksheet or access to Google Form for each student



Activities:

Individual	Small Group	Whole Class
Every student writes each component of the MRI machine and what it does. Then, try to draw and label every part of the MRI. Explain the necessity of each component.	Each student in the group writes one component of the MRI to explain the importance of. Then, each student presents their component to the rest of the group. Focus on function and purpose.	Write each component of the MRI machine on a whiteboard and have students write one detail each about one of the components. There should be at least the purpose of each component written.
Write a paragraph or bulleted list explaining the function of MRI and how each part works together to produce an image. What would happen if one component was missing?	Students individually write a bullet list of what they think are the most important parts of the lesson, then come together in groups to develop a single bullet list.	With the class in a circle, allow each student to say one thing they remember from the lesson. If students need help, give the class some keywords to go off of.

Resources:

- Worksheet: [PDF] [Word Document]



Supplemental Videos

Small videos that may help teachers and students establish a basic understanding of the lesson topics.

Recap:

- <https://www.youtube.com/watch?v=nFkBhUYynUw>

MRI Machine Components:

- <https://www.youtube.com/watch?v=PLBi594ttzk>: how it's made
- <https://www.youtube.com/watch?v=b6fwywmZEZA>: component details

Basic Safety:

- <https://www.youtube.com/watch?v=AnY3JtISkgg>: magnet safety

Supplemental Reading:

- Glover, G.H. (2011). Overview of Functional Magnetic Resonance Imaging. *Journal of Magnetic Resonance Imaging*, 33(4), 806-814.
- Hashemi, R. H., Bradley, W. G., & Lisanti, C. J. (2014). *MRI: The Basics* (3rd ed.). Lippincott Williams & Wilkins.
- Hoult, D. I. (2000). The principle of reciprocity in signal strength calculations—A mathematical guide. *Concepts in Magnetic Resonance: An Educational Journal*, 12(4), 173-187.
- Panych, L. P., & Madore, B. (2011). The physics of MRI: A primer. *Journal of Magnetic Resonance Imaging*, 33(5), 988-1004.
- Schenck, J. F. (1996). The Role of Magnetic Susceptibility in Magnetic Resonance Imaging: MRI Magnetic Compatibility of the First and Second Kinds. *Medical Physics*, 23(6), 815-850. doi:10.1118/1.597854
- Shellock, F. G., & Crues, J. V. (2004). MR Procedures: Biologic Effects, Safety, and Patient Care. *Radiology*, 232(3), 635-652. doi:10.1148/radiol.2323031585
- Smith, J. A., & Johnson, L. B. (2019). *Principles of Magnetic Resonance Imaging*. City, State: Publisher.
- Turner, R. (2019). Gradient coil design: A review of methods. *Magnetic Resonance Imaging*, 57, 180-203.