

A TALE OF TWO CHARGES: TEACHER GUIDE

Subject: Physics

Grade Level: High School

Last Updated: August 22, 2008

Case Summary

A series of instant messages are exchanged between Charles-Augustin de Coulomb and a writer from Encyclopedia Britannica discussing the fundamentals of Coulomb's Law.

Credits

This case was written by Sean A. Lynch (PhD student, Chemistry, Emory University, Atlanta, GA) and Brian Heglund (teacher, Centennial High School, Roswell, GA) fellows of the Emory University PRISM program (<http://www.prism.emory.edu>). Authors may be contacted at slynch2@emory.edu.

Learning Objectives

At the end of the case students will be able to:

1. Define Coulomb's Law and identify it as a description of a force that obeys the inverse square law.
2. Identify other phenomena that obey inverse square laws.
3. Relate Coulomb's Law to Newton's Third Law of motion
4. Calculate force using Coulomb's Law
5. Review and/or introduce concepts such as atomic theory, strong nuclear force and gravity.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

- a. Exhibit the above traits in their own scientific activities.
- b. Recognize that different explanations often can be given for the same evidence.
- c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh7. Students will analyze how scientific knowledge is developed. (NSES Content Standard A)

Students will recognize that:

- a. The universe is a vast single system in which the basic principles are the same everywhere.
- b. Universal principles are discovered through observation and experimental verification.
- c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

- d. Hypotheses often cause scientists to develop new experiments that produce additional data.
- e. Testing, revising, and occasionally rejecting new and old theories never ends.
- SP1.* Students will analyze the relationships between force, mass, gravity and the motion of objects (NSES Content Standard B)
- SP2.* Students will evaluate the significance of energy in understanding the structure of matter and the universe (NSES Content Standard B)
- SP5.* Students will evaluate relationships between electrical and magnetic forces (NSES Content Standard B)

Assessment

Each small group will be asked to write a “21st Century” encyclopedia article about Coulomb’s Law that would include hyperlinks to relevant websites with appropriate animations demonstrating the concepts described in Coulomb’s Law. Created encyclopedia entries will be combined to create an authoritative guide to Coulomb’s Law. Alternatively, if one wishes to be very ambitious, a real Wikipedia entry could be created. Individual answers to created learning issues can also be collected for assessment.

Implementation Strategy

This case can be implemented in three 50-minute class periods by following the schedule below:

	Day 1	Day 2	Day 3
Activity/Minutes	<i>15 min:</i> Read Scene 1, Break into small groups <i>35 min:</i> Create Box Chart, Develop and assign Learning Issues. If time remains, begin to research. Homework: Research assigned learning issues	<i>20 min:</i> Report learning issues to small group <i>30 min:</i> Read Scene 2, Create Box chart, Develop and assign Learning Issues Homework: Research assigned learning issues	<i>50 min:</i> Report answers to learning issues and prepare assigned encyclopedia entry
Materials	Box Charts	Box Charts	

Case Notes

The major objective behind this case was to both introduce Coulomb’s Law and begin to connect a variety of different topics that may seem unrelated to some students. This relatively short case can provide the framework for launching discussions about strong nuclear forces, gravity, inverse square laws, etc.

We would have liked to actually set up an email address the students could send their work to. To do this, you only need to change the email address in the dialogue.

Students responded really positively to the case. More and more, students communicate via text message or instant message. Each scene was a nice example of how effective PBL can be as it allows you to teach students using their own language.

In our opinion, one way to improve the case would be to stress the historical aspects of the case. For example, why would Coulomb know nothing about the atom? What was it like to be a scientist in the French Revolution? These things can be really interesting and, more importantly, they can get students thinking!

Facilitator Guide:

NOTE

Just to be clear, there are some serious historical problems with this entire scene. For starters, Charles Coulomb died in 1806. Ernest Rutherford, the “father of nuclear physics” wasn’t born until 1871. John Dalton didn’t even come up with the idea of an atom until the early 1800’s. While we’re on the subject, Mr. Worthingtonshire isn’t a real writer from Encyclopedia Britannica and it is doubtful that Charles Coulomb had access to the internet. These things can all become learning issues. For example...Why doesn’t Coulomb know about the atom yet?