

Name _____ Period _____

Fields and Energy - Fields and Forces 3 - NGSS Aligned

Learning Goals: Two like charges are placed close together. They gain kinetic energy as they fly apart. Where did the energy come from?

- A. Investigate why kinetic energy of an object changes when it is placed in a field.
- B. Connect conservation of energy concepts to change in the kinetic and potential energy of an object in a field.
- C. Use screenshots, drawings, and words to defend and communicate conclusions about the relationship between energy and fields.

Your ultimate task:

Answer the question **“What is the relationship between energy and fields?”** and document your answer, your rationale, and your evidence, using items from learning goal C above.

Part I. Investigate the relationship between energy and fields.

Here you will investigate to develop an understanding and come to consensus your answer to the question above. Learning goals A and B will be a part of this investigation.

A. Some suggestions to help you develop your understanding:

1. Create a scenario with an object in a field (electric, magnetic, or gravitational). Use this particular scenario as you investigate.
2. Investigate, using what you already know about fields. Here are some ideas:
 - a. Consider your experience with fields in everyday life.
 - b. Make drawings of field lines.
 - c. Work through answers to the guiding questions below.
 - d. Use the PhET simulations Electric Field Hockey and Magnets and Electromagnets.

B. Guiding questions

1. An object is placed in a field and released. Explore with either PhET simulation, your own drawing of field lines, or your every-day experience with masses in gravitational fields.
 - a. What energy changes are observable or measurable?
 - b. What does the conservation of energy principle imply about these energy changes?
2. Imagine that the field strength is doubled, for example by doubling the source charge or the mass of a planet. How does doubling the field strength affect the kinetic energy gained by an object placed in the field?
3. Create a field with two sources at some distance apart. If using charges or magnets, use charges or poles with the same sign (for example, both positive or both north).
 - a. What happens to the field as you move the two source objects closer together?
 - b. Did moving the sources closer together do (+), (-), or 0 work on the system?
 - c. Did the energy of the system change as you did work? If so, how?
 - d. If the energy of the system changed, is this change mainly a change in potential or kinetic energy or both? Consider only the starting and ending positions.

C. Develop an explanation.

1. Use your thoughts from part A to develop a group consensus about **the relationship between energy and fields.**
2. After you have come to consensus, write a draft statement that describes your answer. Keep a written record of your reasoning and evidence as well. Use your own paper.

D. Compare with another group

1. Join with another group to share and discuss your ideas. Bring your written explanation and reasoning with you.

Guidelines for sharing and discussing:

- Listen to one group's explanation and reasoning without speaking.
 - Ask clarifying questions, as needed, to understand their ideas.
 - Give warm (positive) feedback - what do you agree with, what do you find interesting (positive only), etc.
 - Give cool (constructive) feedback - what do you find confusing, conflicting, or perhaps disagree with.
2. Then, let the other group explain their ideas and reasoning. Follow the same guidelines.

E. Refine your own group's ideas.

1. After consulting with another group, meet again with your own group.
2. Discuss what you heard and come to consensus again if needed.
3. Rewrite your statement about the relationship between energy and fields below. Include your reasoning and evidence statements. Show your work to the teacher and get teacher initials in the official initial box (O.I.B).

Part II.

Make a large, neat, clearly labeled document, or poster, with words and drawings and/or screenshots, that you can use to present your conclusions, reasoning, and evidence to the class. (See learning goal C above.)