Navigate

Turn and Talk

What kinds of things would you like to see in a simulation that could help us figure out how energy transfers from a microwave oven's antenna into food?

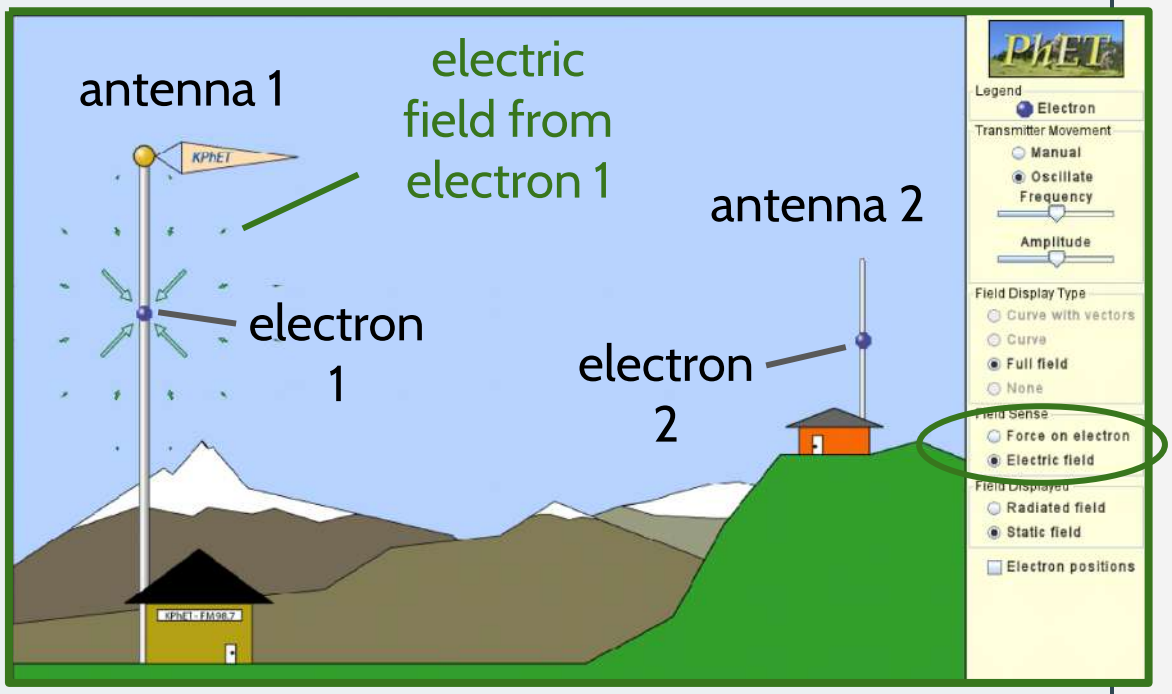
➔ Be ready to share with the class!

Explore Static Fields

With your class

- What do you notice?

- How does this compare to the microwave oven?
- What can we tell about the matter in the antenna from this image?



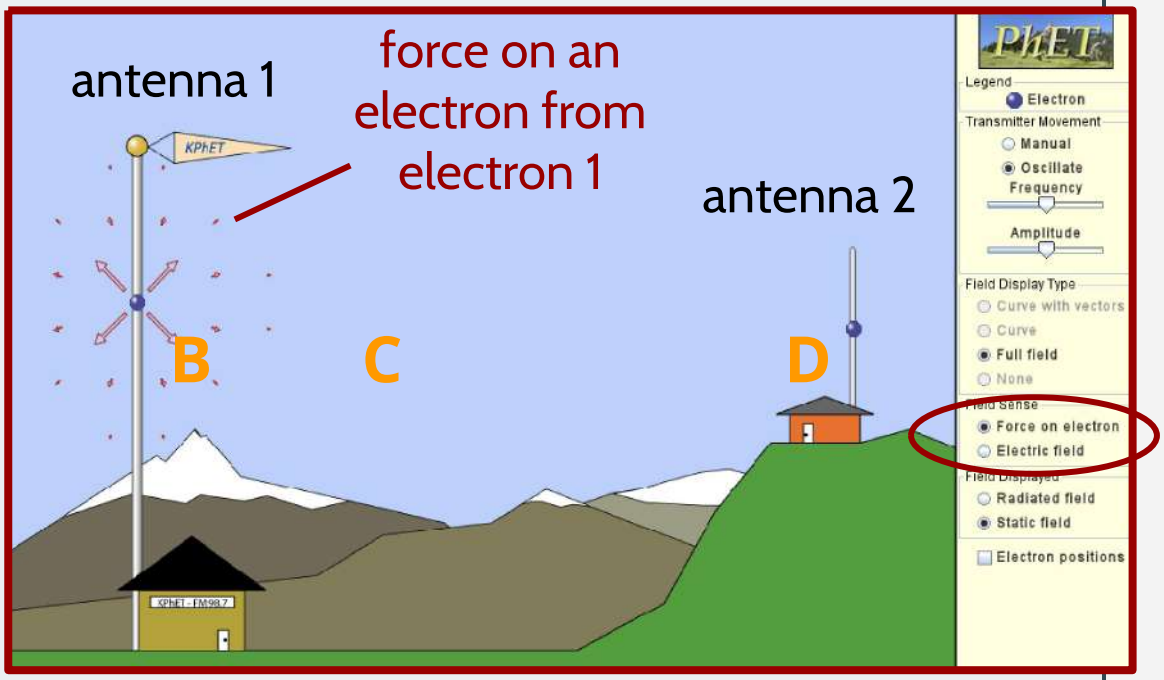
Adapted from: PhET Interactive Simulations

Explore Force on an Electron

With your class

- What do you notice?

- How close does electron 2 need to be to feel a force from electron 1?

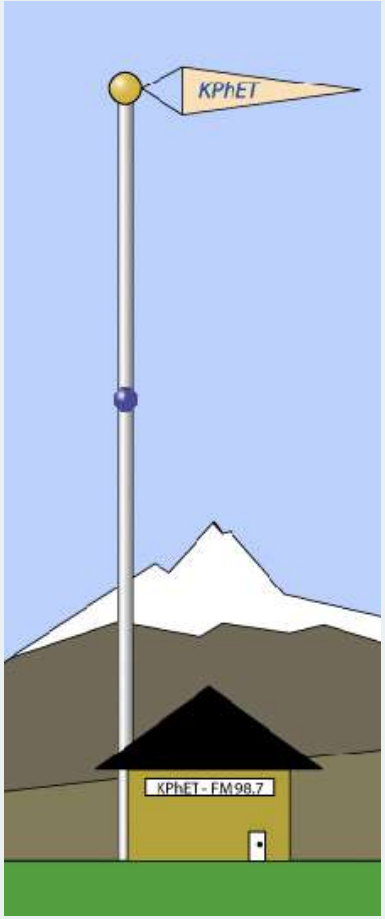


Adapted from: PhET Interactive Simulations

Consider Frequency and Amplitude

With your class

- Move your arm up and down to imitate the movement of the electron in the transmitting antenna.
- Show with your arm how the movement would change if we increased:
  - A. the frequency
  - B. the amplitude



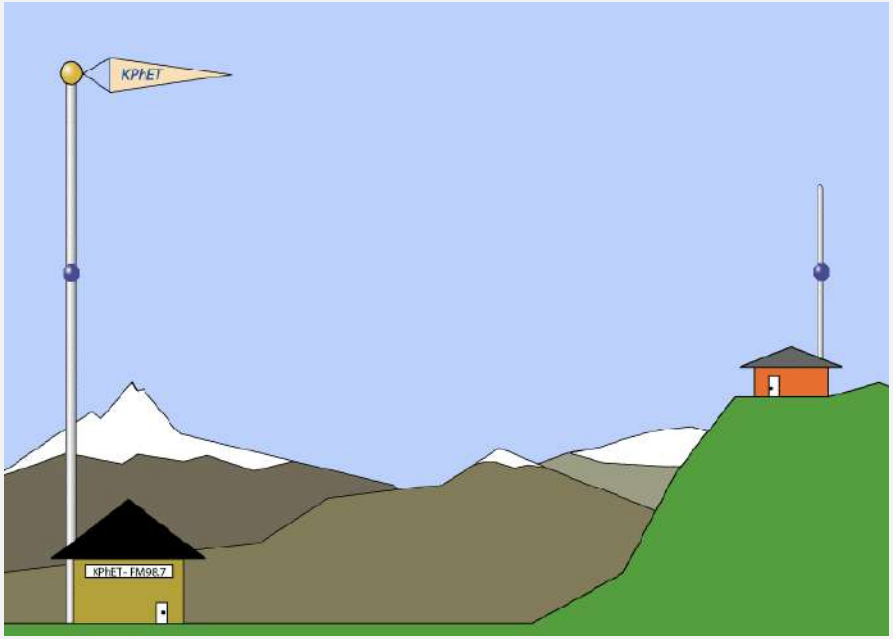
PhET Interactive Simulations

Slide E

Identify Evidence of Energy Transfer

Turn and Talk

- What evidence do we have of energy transfer?
- How would we start to model this?



PhET Interactive Simulations

With your class

Use boxes and arrows to develop an initial model of energy transfer in the system.

Identify Initial Patterns

On your own

1. Load the simulation.
2. Adjust it to the menu settings described in Part 1 of your handout.
3. Fill in Part 1 to describe the changes you notice in different parts of the system.
4. Consider what your visualization shows clearly and what seems unclear.

Do not go on to Part 2 without your Jigsaw group!

Slide G

Make Sense of Patterns Together

With your group

- Each person gets up to 1 minute to share answers to Questions 1-4 from their assigned field visualization.
- 1 person (or more) takes notes in the Summary Table: Question 5 in Part 2.
- Use your team's Summary Table to answer Questions 6-8 in the handout.

→ Be ready to share your ideas with the class!

Build Understanding about Fields

With your class

- What patterns did we see at B, C, D, and E?

- What can we conclude about *how much* energy transfers as the electric field radiates from left to right?
- What changes can we make to our consensus model of energy transfer?
- What are the limitations of the simulation for explaining how the antenna transfers energy to other parts?
- What questions did the simulation raise for you?

Read about Light

On your own

Read *Light as a Wave*.

- Part 1: As you read, draw a ⋆ next to:
  - a hypothesis that was tested
  - the result of that test
- Part 2: Underline all ideas that could help us explain **why the electric field *radiates* only when charged particles move**.

Slide J

Navigate

Exit Ticket

- Write your name at the top of the reading.
- Answer the questions in Part 1 of the reading.
- Turn in your reading to your teacher.

Navigate

Turn and Talk

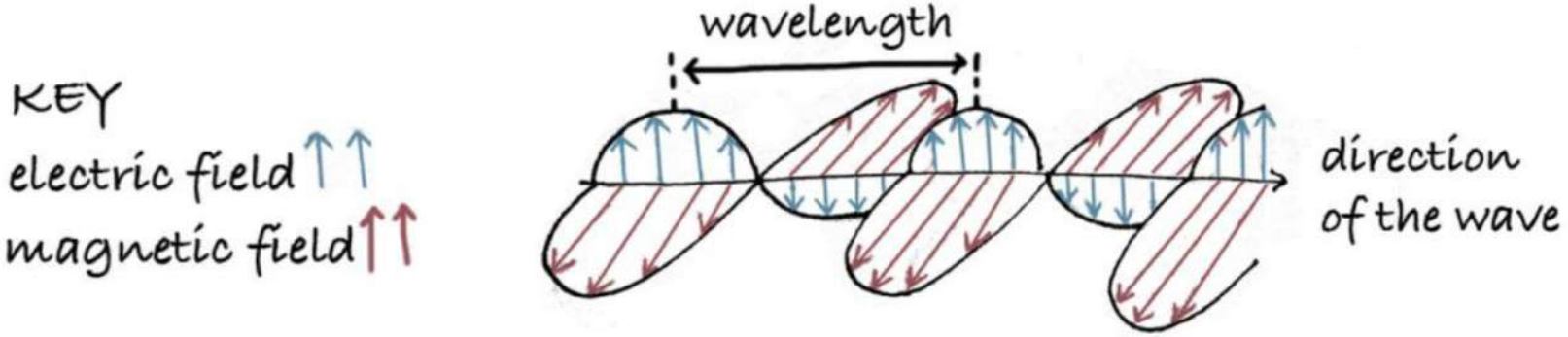
- What patterns from our work with radio waves did the reading help us explain?
- What new patterns did we see?

➔ Be ready to share your ideas with the class!

Make Sense of 2 Fields

Turn and Talk

- What do you notice in this diagram from the reading?
- What would change if you could animate the drawing?
- How would this animation look for just 1 arrow?

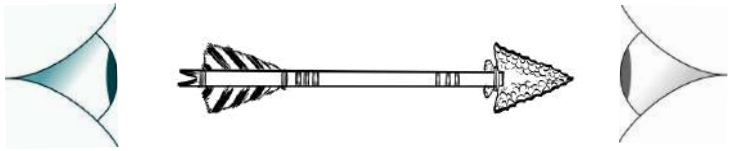


Arrows “Toward” and “Away”

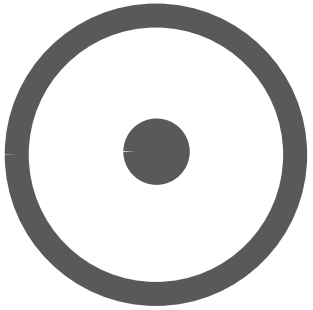
With your class

When physicists model fields, sometimes they need to show arrows pointing “toward” or “away”. Often they use the following notations:

away from you



“side view”



toward you

Adapted from: OpenClipart (PublicDomain)

Make Sense of Magnetic Field Changes

With your class

Let's focus on the magnetic field.

A. What do you notice at 1 point in space? What would we see from a "Top view"?

B. What do you notice at 2 points next to each other? What would we see at all points in space?

C. What do you see when we select "Total energy radiates in ALL directions?" What does this suggest?

Make Sense of 2 Fields Together

Turn and Talk

Study the field drawing in the reading and compare what you see to the simulation.

D. How do electric and magnetic fields change as the wave travels?
E. Is energy transferring through the electric fields, magnetic fields, or both? How do you know?
F. What are the limitations of this model? What doesn't it show or help explain?

➔ Be ready to share your ideas with the class!

Carry Out a Demonstration

Scientists Circle

How could we use physical equipment to investigate how changes in electric fields affect magnetic fields, or vice versa?

Available equipment:

hand-crank generator, wire coil, alligator clips, compasses, nail, magnets, LED

Carry Out a Demonstration

With a partner

Make predictions:

Generator, Wire Coil, Compasses: *If changing electric fields cause changes in magnetic fields, then cranking the generator back and forth should...*

Wire Coil, Magnets, LED: *If changing magnetic fields cause changes in electric fields, then moving the magnets inside the coil of wire should...*

Make Sense of Observations

Scientists Circle

- What happened when we used the generator to change the direction of the electric field in the wire?
- What happened when we used spinning magnets to change the direction of the magnetic field in the wire?
- How might this help us understand what is happening inside the cooking area of the microwave oven?

Revise the Energy Transfer Model

Turn and Talk

Study our consensus model in progress. Based on new evidence, what would you add to show:

- How do changes at one place cause changes at other places in the system?
- How does the vibrating electron at A cause energy to transfer?
- What do we call this system of changing electric and magnetic fields?

➔ Be ready to share your ideas with the class!

Update Your Personal Glossary

On your own

Use words and/or pictures to add your own definitions for *electromagnetic radiation* and *electromagnetic waves* to your Personal Glossary.

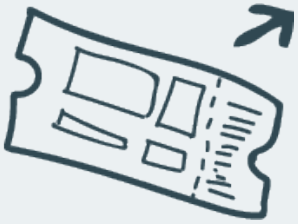
Set Up the Unit Progress Tracker

On your own

Make your first entry by filling in the 3 columns of the Progress Tracker handout:

- What patterns or results did we see or experience that helped us figure something out?
- What caused these patterns or results?
- How does this help us further our models or answer our questions on the DQB?

Navigate



Exit Ticket

- Use words and/or pictures to make a prediction about what microwave radiation would do when it encounters matter.

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