

Learning Cycle Planner

Electromagnet Lesson

Common Curriculum Goal:

Topics: Energy efficiency, alternative energy, electricity

Learning Objective: Students design experiments and make connections between magnets and electricity generation

Exploration Phase:

Hands-on Activity: Making an Electromagnet and testing magnetism

Exploration through Media: Virtual tour of a Wind Farm:

<http://www.midamericanenergy.com/html/aboutus3c.asp>

Concept Development Phase:

Concepts to be taught: Electricity and magnets, energy flow and conversion from one form to another, renewable and non-renewable energy, pollution, resource consumption

Procedures to be taught: Experimental design, inquiry

Activities: Video: <http://marshallbrain.com/science/electromagnets.htm>

Movie: Who Killed the Electric Car? With questions and discussion points.

More resources for the film:

<http://www.sonyclassics.com/whokilledtheelectriccar/electric.html?detectflash=false&>

(Paine, 2006).

Connections to other Lessons: Electricity audit, product disassembly, chemistry-metallic bonds

Teaching across the Curriculum: Politics involved with electricity industry regulation

Electromagnet Lesson (Adapted from Brain, 2008)

Show the video <http://marshallbrain.com/science/electromagnets.htm> as a demonstration. Allow two 45 minute class periods.

Material based on small groups:

4 or more assorted, non-rechargeable batteries, 3 feet of copper wire, six inch steel nail, electric tape, many paper clips.

Procedure:

Day 1

1. Demonstrate how wrapping copper wire around a nail and connecting it to a battery will cause the nail to become magnetic.
2. Provide the materials for each group and allow some time for preliminary exploration
3. Students work together to submit a proposal for their experiment and a hypothesis by the end of the first 45 minute class. The proposal and hypothesis follow the format on the handout below.

Day 2

1. Groups perform their experiments and record their results
2. Groups demonstrate their experiments for one another and for the teacher.
3. Each student records detailed observations of the experiment and the data regarding the paper clips. Students should including a statement of proving or disproving the hypothesis in the Analysis. If the hypothesis was disproved, students must include a detailed explanation why.

Helpful Information:

Tell students that they will be developing their own experiments and that no two groups should have the same experiment, so don't share ideas with other groups! Show the video of Marshall Brain making an electromagnet with the materials listed above and set the students to work collaboratively to design an experiment. Tell students that they must get their experiment approved in order to receive the materials and the deadline is the end of the class period. This is like meeting deadlines for grant applications to fund research before the experiments can be conducted. At the end of the class tell students that on the following day they will be working in the same groups, performing the experiments that they designed, recording data, and presenting their findings.

Handout

Electromagnets Proposal and Hypothesis

Names _____

Proposal must include:

1. the number of turns of copper wire around the nail
2. the number of batteries used and the arrangement of the batteries
3. Hypothesis: Predict the number of paper clips that the magnetized nail will be able to pick up and how long the magnetized nail will hold the paper clips.

**Electromagnets
Observations, Data, and Analysis**

Names _____

Observations:

Data:

Analysis:

Extension:

Show the movie “Who Killed the Electric Car?” and use the questions below to stimulate discussion and understanding.

Who Killed the Electric Car?

Name _____

Date _____

Take notes in the right hand column as the movie plays.

Answer the questions independently.

Questions with * may be done at the end or as the movie plays.

1.* Complete the timeline below with regard to vehicles that were available for sale in the USA. Write “**both electric and gasoline cars**” or “**gasoline cars only**” or “**hybrid cars**” above each date

1900's 1920's 1950's 1970's 1990's 2000 and beyond

2. The #1 flaw of non-electric cars:

Notes

3. In a 1989 study one out of four 15 to 25 year olds in Los Angeles had what kind of problems?

4. A gasoline powered car produces 19 lbs of _____
_____ per gallon of gasoline.

5. The **California Air Resource Board** took a “bold and unprecedented step” to stop smog. Provide a detail, theme, or fact about **CARB**'s plan.

6. The EV1 was the first modern electric production car in the USA in nearly how many years?

7. Name 3 car companies other than GM that produced electric cars after the EV1 came out.

8. *Name 2 celebrities that talk about electric cars.

9. Name one limitation to the electric car.

10. Who was the main source of funds and energy behind the campaign to stop the building of recharging stations?

11. What was one of their (from #10) arguments for their action?

12.* Write an observation about the advertisements (commercials) for electric cars.

13.* If you were in charge of marketing the electric car, what would you do?

14. Ralph Nader, veteran consumer advocate, worked to do what?
15. The auto manufacturers new, powerful ally was the _____
_____.
16. With \$1,000,000,000 “up for grabs” in what did the oil industry and car companies focus their energy?
17. Have you ever seen a fuel cell car or a hydrogen fueling station?
18. Explain where hydrogen fuel comes from.
19. Write observations about the hearing before the CARB (California Air Resources Board), for example, did the proceedings seem fair.
20. What was the result of the CARB hearing?
21. GM (General Motors) forced people to stop leasing their EV1 cars and took them all back?

True or False

22. What did GM do with the reclaimed EV1 fleet?

23. Why would GM crush and stack all the EV1's?

24. What was so significant about Stan Ovshinsky's battery invention and how did GM utilize their purchase of Stan's patent.

25. General Motors (GM) bought up the trolley systems and shut them down 40-50 years ago.

True or False

26. The combined profits of the 3 biggest oil companies jumped from \$33 Billion in 2003 to \$64 billion in 2005.

True or False

27. What are some of the associated parts (and therefore profits to dealerships) of the internal combustion engine?

28. Compare Japanese vs. American hybrid vehicles in miles per gallon.

29. What are some of the limitations of the Hydrogen fuel cell car?

30. How many gas stations are there in the U.S.?

31. What was GM's ultimate response to the vigil for the EV1?

32. Why do you think the vigilers/protesters were willing to stand outside in the rain and even get arrested for an electric car?

34. Who do YOU think killed the electric car???

35. List the guilty parties:

36. Stan Ovshinsky says you can change the world not with guns, but with
_____ and _____.

Discussion Points

Min 25: The Oil Industry “bought” editorials in national news papers?

What is a “Bait and Switch Strategy” re: H fuel vehicles???

Shredding autos and other materials = recycling

What kind of ads work, what kind of ads were made for electric vehicles?

Tax breaks for hummers: \$100,000 in 2003 vs. \$2,000 for electric cars in 2002.

OPEC oil embargo in the 1970’s re: CAFÉ standards.

Term: “Politically unattractive”

Ralph Nader for President

ANWR: predicted to have 1 year’s supply of oil, easily recovered in 15 yrs by raising fuel econ standards to 40 mpg.

References:

Brain, M. (2008). *Electromagnets – how can electricity create a magnet?* Retrieved July 26, 2009, from <http://marshallbrain.com/science/electromagnets.htm>

Paine, C. (Director) (2006). *Who killed the electric car?* [Motion Picture]. Sony Pictures Classics. U.S. (2007).