Superconductivity An Introductory E-book for High School Students

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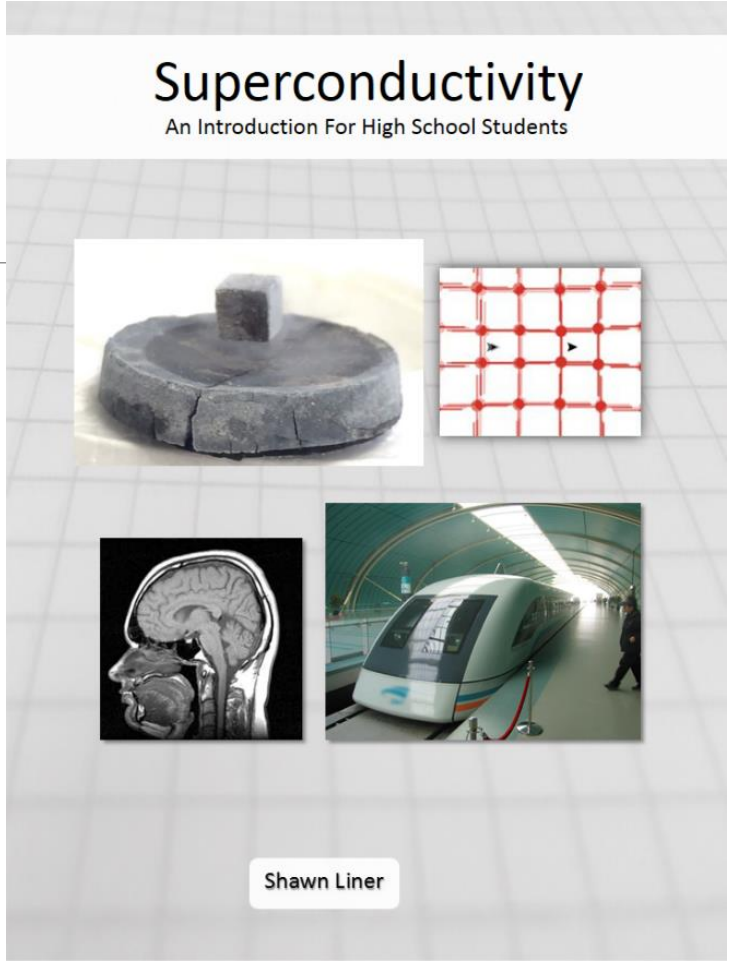
Goals

- **Cheap - We want it available to students and teachers**
- **Readily Available – easy to get and cross platform**
- **High School Level – our target audience**
- **Informative – teach them something**
- **Motivational – leave them with an interest in more**
- **Multimedia – hold their attention better with demos**
- **Interactive – allow them to touch and interact**
- **Editable – allow it to be updated in the future**
- **Structured – students have learned a healthy disrespect for websites**

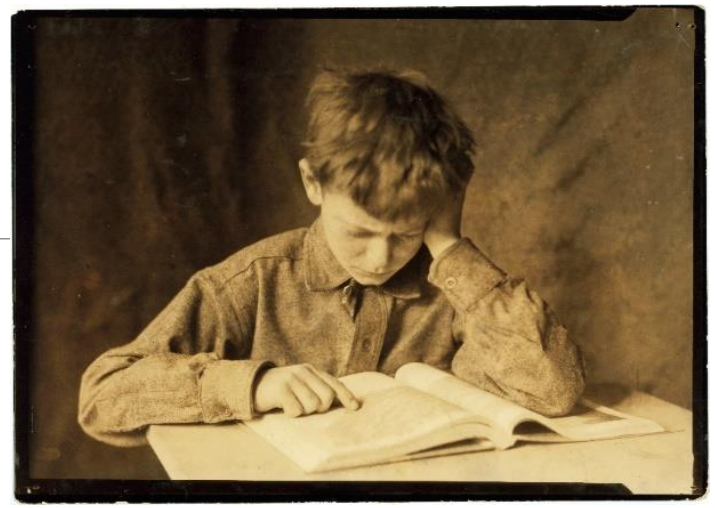


Proposed Solution

Publish an interactive multimedia e-book with Habitat on Inkling.com.

- **Inkling is available as a tablet app for apple, android and Microsoft products, as well as being available through web browser access.**
- **Epub versions can also be created for use on non-multimedia reading devices.**
- **The structure is maintained as a book and updates are pushed automatically.**
- **Inkling stores the files so they will be readily available and no new storage location has to be created.**
- **The Book can be “sold” for free and the hosting is free, so it will be readily available.**

Tasks



- Learn about superconductors
- Create an outline of the content.
  How much should we include to educate, but still keep them interested.
- Create Graphics, images, and videos.
  We wanted to own as much of the material as possible.
- Create and find demos to include in the material.

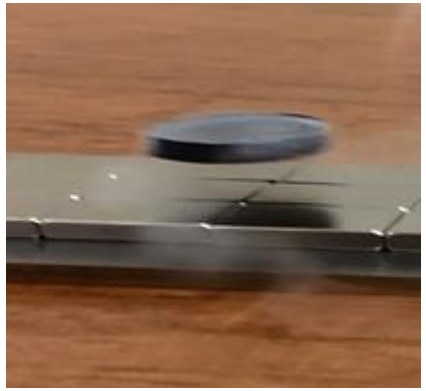
Topics for the Book

- **<u>Electrical and Magnetic properties of superconductors</u> along with some review of basic electrical and magnetic properties**
- **<u>A survey of superconducting limitations.</u> This helps prevent misinformation and promotes curiosity about overcoming those limitations**
- **<u>Superconducting technology.</u> A survey of where the technology is currently being used. Students are amazed that their life is impacted by these topics now.**
- **<u>Theory.</u> Placed last to maintain interest. Students who are genuinely curious will continue to read without chasing off the casual interest before they learn something.**

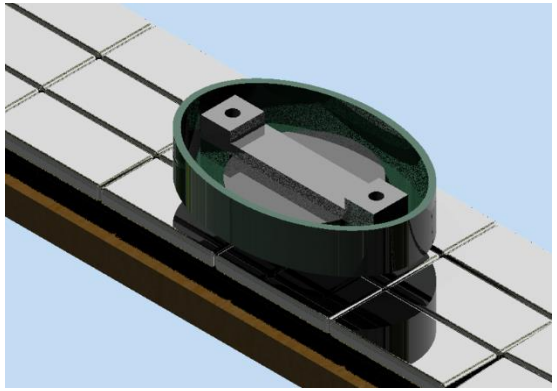
Demo Maglev Train Model

A track is created from rare earth magnets and a “train” is 3D printed to hold the superconductor and a reservoir of liquid nitrogen. This allows for a longer demo. Long term plan calls for an oval track to be built.

Levitating Disk on Track

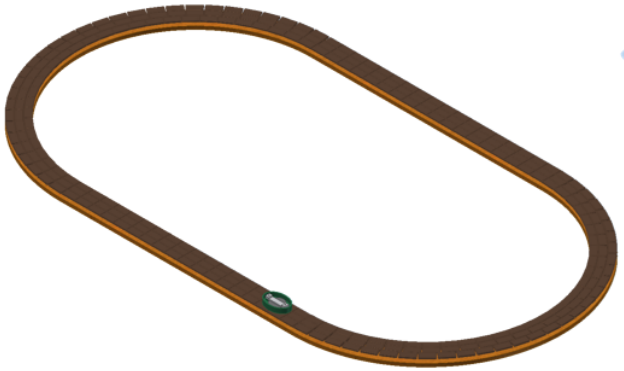


Design of “train”

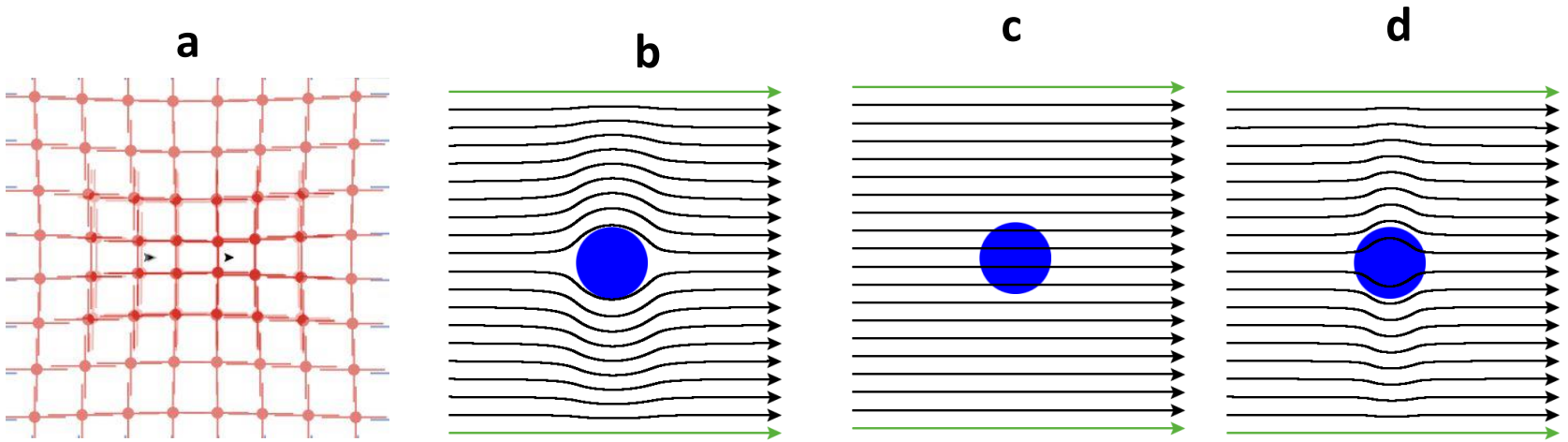


3D printed “Train”

Model of oval Track with “Train”



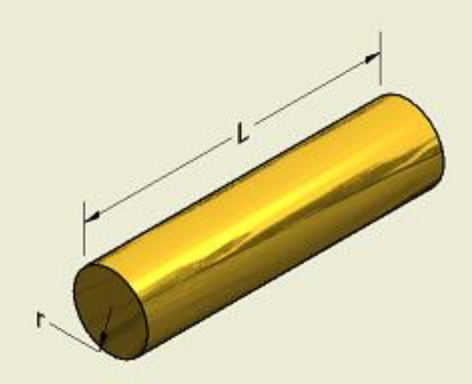
Graphics For Theory



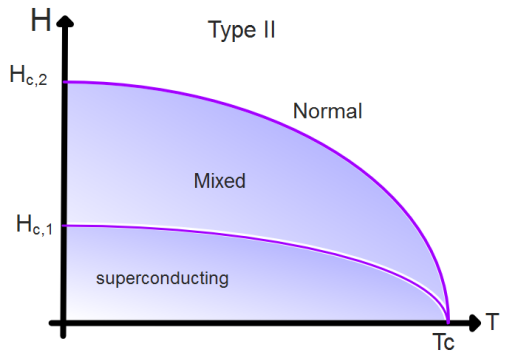
These four images were captured from simulations created in netlogo (a turtle based programing language.)
a) Two arrows represent electrons forming a Cooper Pair.
b) A superconductor expelling magnetic flux.
c) A non diamagnetic material allowing the
d) A Superconductor in a pinning state.

Graphics For Theory

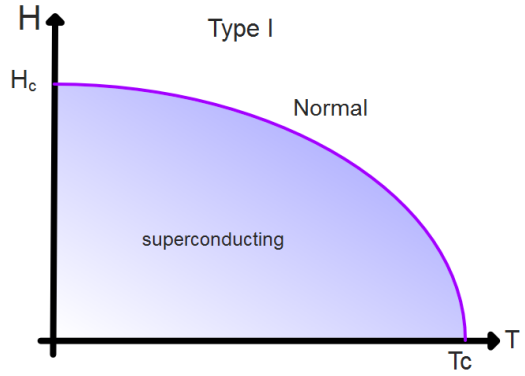
a



b



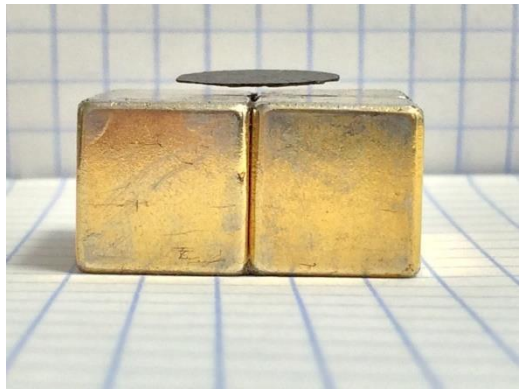
c



a) A simple diagram of a wire created to discuss causes of resistance
b) Type II critical magnetic field as a function of temperature.
c) Type I critical magnetic field as a function of temperature.

Demo Levitation

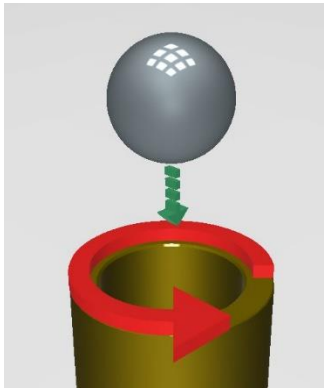
Video Demos are included of both a superconducting caused levitation and that of pyrolytic graphite. The latter was included to show that the property was not specific to superconductors.

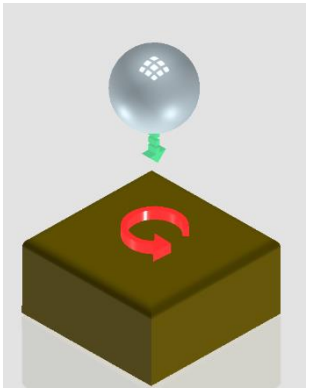


Freeze-frames of the two parts of a video demonstration.
The left shows pyrolytic graphite levitating above strong magnets.
The right shows the standard demo of a magnet levitating above a superconducting disk.

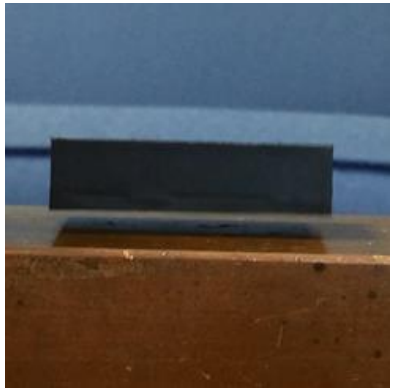
Demo Lenz Law

We included a demo of Lenz's law to help students understand levitation. The pictures include bubbles to explain the concept and the video includes a voice-over to help students see the important parts of the demo.





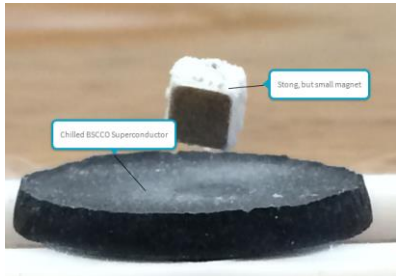
Illustrations created in Autodesk Inventor to show the current being created as the magnet falls.



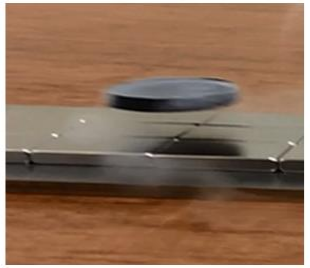
Freeze-frames of the two parts of a video demonstration. The spherical magnet is dropped through the copper pipe to show it falling slowly. Then a bar magnet is dropped onto a copper plate. It is visibly slowed by the induced magnetic field.

Features of the Book

Clickable table of contents, with images.



Pictures zoom and show clickable labels



VIDEO DEMO Maglev Demo Click the image above for a video demo of maglev model train. Shawn Liner

Full Screen "Video Demos"

thought of as a materials opposition to the flow

Insulator

a material with a high resistance to electrical current, like rubber.

materials are called **insulators** and are used to pr

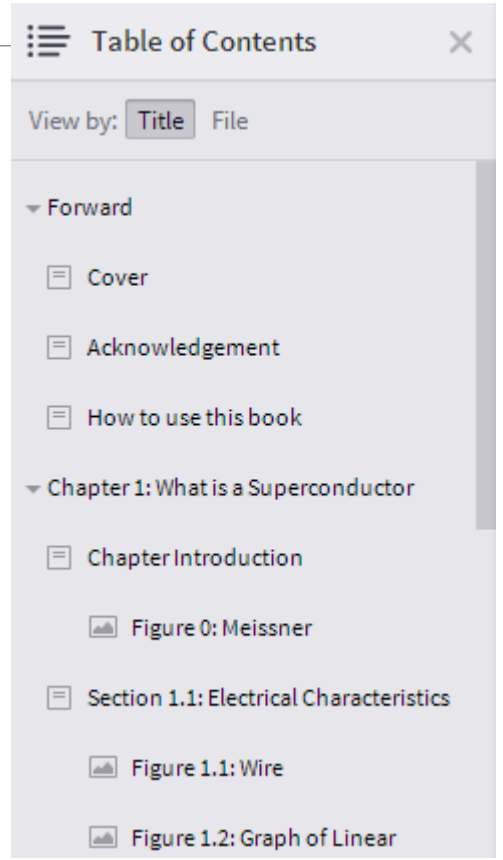
see an insulator on the outside of a wire that you use

Glossary with on page definitions

Links to some interesting maglev information.

- Shanghai maglev Train
  http://www.smtdc.com/en/index.html
- A French group invents a hoverboard.
  http://www.supraconductivite.fr/en/index.php#samuser-magsurf
- Maglev 2000, Organization pushing for trans-continental maglev trains in North America http://www.maglev2000.com/
- Antipodes Middle School Robotics Team build project on maglev
  http://www.theonerobot.com/maglevresearch

Links to interesting information



Questions