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Report and Recommendations on Available Multimedia Material for Electricity and Magnetism

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1. Introduction and Background

Multimedia resources are now commonly used for the teaching and learning of all areas of physics. These tools, including simulations of physical systems, virtual laboratories, video of real and animated experiments, and online tutorials, are being developed by educators and researchers around the world. Many publishers include this type of material as supplements to their textbooks. There are commercial enterprises where multimedia educational material is their sole product.

This report presents the results of a peer review of multimedia resources in electricity and magnetism. The use of animations, simulations, and computational resources is of particular importance for this topic because of the abstract nature of charges, currents, and fields. Many students have little previous experience with these concepts and need help in developing their understanding. In many cases, simulations are needed to directly demonstrate these abstract concepts. For example, a recent study has shown a greater gain in conceptual understanding of currents and circuits for students using a virtual lab than for students performing a standard circuit lab [1].

This review is the fifth annual review by an international group of physicists. The primary goal of this continuing effort is to identify multimedia resources that have the potential to significantly improve physics learning. Each year a broad topic is selected, a search for existing resources is made, and the high quality items are identified through peer review. These reports provide a broad view of the coverage of the topic, highlight the functionality of the resources, and, through independent evaluations, create a consensus regarding quality learning resources.

The reports of the review results have been presented at MPTL workshops since 2002. In Parma (2002), our members of the former EUPEN (European Physics Education Network) working group presented reviews and analysis of materials on Quantum Mechanics [2], and in Prague (2003) we focused on Optics [3]. In 2004 and 2005, this group collaborated on reviews of resources in Mechanics [4] and Thermodynamics and Statistical Physics [5] with the members of the MERLOT/Physics editorial board. MERLOT is based in the United States and has been performing reviews of multimedia resources in 15 different disciplines since 2000 [6].

2. Process

The process followed in these evaluations has been described in previous reports and publications [2-5]. Here we briefly outline the steps in current the review process. The steps are the discovery of materials, the initial selection of materials to be reviewed, the detailed evaluation of selected materials, and the final comparison and analysis of the results of the reviews.

a. Collection of Links

Researchers from the Technische Universität Kaiserslautern performed an extensive search using existing web archives and link collections [7]. They developed a list of more than 700 links to various learning resources in electricity and magnetism. This list was then compared with the NatSim search engine [8] to check its completeness. This comparison found that more than 90% of the materials discovered through NatSim were included in the Kaiserslautern list. An exact comparison between this list and NatSim was complicated by the number of mirrors and copies that exist for many applets. The electricity and magnetism resources from the MERLOT collection, approximately 300 items [9], were then compared to this list and items added that were not included.

Each of the resources is classified by topic. The topics used for the Kaiserslautern list are those found as the major E&M topics in any introductory physics textbook. The MERLOT classifications [9] are very similar. A list of the topics and numbers of resources in each is given in Table 1. The total number of resources is somewhat less than the sum of the numbers for the individual topics because some materials were listed under more than one category.

Topic	Number
Electrostatics	~220
Moving Charges	~120
DC Electric Circuits	~90
Magnetism	~100
Electromagnetic Induction	~70
AC-Circuits	~70
Electromagnetic Radiation	~130
Miscellaneous	~100
Tutorials	~50

Table 1: Resource numbers is each topical area.

Many of the resources listed are simulations or tutorial web pages that are part of a larger collection. The best of these collections provide a broad, consistent, and refined set of learning materials. Most of the multimedia was Java applets, with some Shockwave and Flash materials, and videos. Many resources used Physlets for their interactive media, indicating the power and wide-spread adoption of these freely available tools. Many of the tutorials reviewed are created by adding questions, activities, and pedagogical context to enhance the applet. Not included in the list were commercial products, computer experiment interface software, and general modeling software such as Dynasys and Stella. Only resources in English received full reviews because of the inability of some reviewers to perform competent reviews on materials in other languages.

b. Preliminary Reviews

The initial list of items was too long for careful review of each item, so quick preliminary reviews were performed to identify the high quality items. The complete list of resources was divided among members the group with one reviewer making an initial judgment for each item. Those items that passed this initial step received full reviews. MERLOT uses a similar preliminary review to remove unsuitable items and to create a list of high quality items for high-priority reviews.

The result of the preliminary review process was a list of 260 items. These are given in Appendix 1, sorted by topic and URL. This list includes some items that, upon detailed review, were rated as low quality. Similarly, a few items that did not make it through the initial preliminary review where brought back by the peer reviewers. Quick impressions are not sufficient for identifying high quality resources but it is an important step in an efficient review process.

c. Final Reviews

Each item in the list given in Appendix 1 was reviewed by one member of the EPS group and one member of the MERLOT group. These reviews were performed independently and used somewhat different rubrics to provide a test of the consistency and repeatability of review results. Agreement between reviews indicates that there are objective criteria for quality multimedia learning resources. There has been excellent agreement between the groups in past reviews.

The *EPS group* followed a review rubric that was accepted by participants at the MPTL workshops in Parma and Prague and has been published [10]. The review form (see Appendix 2) is used by reviewers to rate the best materials in the categories of **Motivation**, **Content**, and **Method**. A 5 level score (-2 to 2) is used for each question in the rubric, and an overall score is given.

The MERLOT reviews use three overall categories: **Quality of Content**, **Potential Effectiveness for Teaching and Learning**, and **Ease of Use.** These are defined by 4 or 5 questions used to rate the materials. Resources are scored on a 1 to 5 scale for each of the three categories and an overall score is given. Because these reviews are to help teachers and students discover learning resources and recognize the efforts of the authors, the completed MERLOT reviews are available online. Details of the MERLOT/Physics review process and the rubric are available [11].

Once completed, the EPS and MERLOT reviews were compared to identify high quality materials and common comments about the reviewed materials. The next section contains detailed information and recommendations for the highest quality resources. The final section gives general impressions of the reviewed Electricity and Magnetism resources, the review process, and the future direction of this effort.

3. Recommended Resources and Websites

The following are the recommendations and comments for the Excellent and Very Good resources identified in this review. We have also included two non-English resources that reviewers felt were of particular note.

Recommended Materials:

The following resources received excellent ratings from members of both groups and are recommended

TEAL E&M: John Blecher, MIT,
http://web.mit.edu/8.02t/www/802TEAL3D/index.html
http://ocw.mit.edu/OcwWeb/Physics/8-02TSpring-2005/CourseHome/index.htm (Complete course web site)

This web site contains resources for a complete introductory course in Electricity and Magnetism with extensive multimedia components. The multimedia materials include detailed 3D animations of physical systems showing important properties of electricity and magnetism and interactive shockwave and java simulations. The simulations are particularly useful for displaying the 3D vector nature of the topic. In some simulations, complex and realistic physical systems are modeled to present to students the richness of the topic beyond the standard, analytically solvable problems. Course notes with visualization resources integrated are available. In the Open Courseware web site (OCW), the complete MIT course materials are available including readings, lecture notes, labs, and problems.

Emanim: András Szilágyi, Institute of Enzymology, Hungarian Academy of Sciences
http://www.enzim.hu/~szia/emanim/emanim.htm
http://www.enzim.hu/~szia/cddemo/edemo0.htm (Tutorial)

This program displays several simulations of electromagnetic waves with different polarizations. These include plane-polarized waves, superposition of plane-polarized waves, circularly polarized waves, and the superposition of circularly polarized waves. The simulation displays E&M radiation in absorbing and refracting medium as well as the more complex properties of circular dichroism, circular birefringence, and both circular dichroism and circular birefringence combined. The program is easy to install, run, and understand. The tutorial listed above provides an online introduction to the physics presented in the simulation.

Hyper-Physics E&M: Rod Nave, Georgia State University
http://hyperphysics.phy-astr.gsu.edu/hbase/emcon.html

Hyper-physics Electromagnetism is massively hyperlinked collection of topic modules covering the fundamentals of electromagnetic theory. It is a subset of the full Hyper-physics site that covers most of physics. Hyperlinked graphical concept maps are used to show the overall relationships between topics. Interactive examples created with Javascript are extensively employed. There are also videos attached to some of the topics.

This section of Hyper-physics covers all of the standard topics in electricity and magnetism, and shows the relations between them. The presentation is clear, with simple diagrams used to help explain the content. The E&M concept map has fundamental topics at the top level and, for many of these top-level concepts, sub-maps showing relations between more specific information. The inclusion of materials on applications of the physics is a great benefit. A glossary and extensive set of references are also available.

Because of the outline nature of the content, the presentations tend to be very brief. The material is probably not sufficient to be the textbook for a class. In some places the navigation system is not consistent with the topical hierarchies.

Math & Physics Applets: Paul Falstad
http://www.falstad.com/emstatic/
http://www.falstad.com/vector2de/
http://www.falstad.com/vector/
http://www.falstad.com/vector3dm/

This set of applets displays, in two and three dimensions, the vector properties of electric and magnetic fields. A large number of different charge and current distributions can be selected and a wide range of physical properties displayed. Help for running the applets and some description of the physics is provided. The reviewers feel that students might be confused by some of the displays. There is no didactic material included with the applets so instructors will need to supplement the simulations when incorporating them in their courses. Several electrodynamics simulations from the same author (radiation and wave guides) were considered but did not receive as high a rating as these statics simulations.

Digital Circuits: Johns Hopkins Whiting School of Engineering
http://www.jhu.edu/~virtlab/logic-circuits/
http://www.jhu.edu/~virtlab/logic/logic.htm (Simulation)

This site presents a tutorial and simulation of binary logic and digital circuits. The introductory page contains background theory on digital logic and computers. There is also a series of increasingly difficult exercises to help students explore this topic. The circuit design is performed with a very easy to use circuit builder simulation. The user can select the number of inputs and outputs, up to four. Standard digital logic circuit elements (AND, OR, NOT, NAND, and NOR) are available to create the circuits. The simulator computes the logic table for the circuit when it is built.

Two other digital logic circuit simulators received positive reviews but do not have the tutorial material that distinguishes the materials from Johns Hopkins. These other simulations are somewhat more flexible than the one provided by Johns Hopkins, and could be used with the tutorial. These are:

Logic System Builder: Habib Hamam, University of Montreal
http://www.mapageweb.umontreal.ca/hamamh/Electro/LOGIC/logicSys.htm
This simulator has up to 6 inputs and outputs and a dynamically updated logic table. A drawback is that it makes noises.

Simcir: Kazuhiko Arase, D-project.com
http://www.d-project.com/simcir/
This simulator is open source and available for download and running locally. It has a larger selection of circuit elements, including switches.

The Semiconductor Applet Service: Prof. C.R. Wie, University at Buffalo, SUNY, http://jas.eng.buffalo.edu/ (also http://jas2.eng.buffalo.edu/applets/)

This web site covers the physics and design of semiconductor electronic devices, including a large number of simulations and illustrations of physical processes. Although the focus of this site is somewhat tangentially related to electricity and magnetism, there are several applets illustrating the electrical properties of devices. Included with these applets is reference material on the physics and mathematics of these systems and worksheets for students to use to explore the subject. This material is aimed at an upper level university semiconductor physics class.

Very Good materials:

These materials received very good ratings from reviewers, but were not rated as excellent.

Physlets at LTU: Scott Schneider, Lawrence Technological University
http://qbx6.ltu.edu/s_schneider/physlets/main/index.shtml

This is an example of the use of Physlets to create tutorial materials. The author has developed tutorial pages on a wide range of topics in introductory physics. These range from very simple illustrations, to interactive problems with questions. Although each tutorial would not be considered excellent by itself, as a collection this site is recommended.

Physlets at BU: Andrew Duffy, Boston University
http://physics.bu.edu/%7eduffy/semester2/

This is a collection of instructional web pages for electricity and magnetism, optics, and modern physics. Physlets are used to illustrate the concepts. There is not much interactivity in these programs; they mainly consist of selecting different prepared animations and changing views. A positive aspect of the material is how the text builds up sequences of questions and answers.

The student has to work with the animations in order to answer the questions. Similar to the previous collection, the individual items vary in quality but the collection as a whole is beneficial because of its breadth.

Modular Approach to Physics: David Austen, University of Alberta
http://canu.ucalgary.ca/
http://canu.ucalgary.ca/map/content/circuitbuilder/basic/simulate/practice/
http://canu.ucalgary.ca/map/content/energy/work_kinetic/simulate/elfield/applet.html
http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/electric_single_particle/applet.html
http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/exb_thomson/applet.html
http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/magnetic/applet.html

This set of applets includes both a circuit simulator and applets that show the motion of charged particles in electric and magnetic fields. The moving charge simulations show trajectories of the particles and the parameters in the problems such as charge, velocity, mass, and field strength can be adjusted. Thus these simulations can be used in a constructivist approach to learning about forces on charged particle through virtual experiments. Exercises and problems are not available but can be easily constructed. The circuit simulator has standard DC circuit elements available, batteries, resistors, light bulbs, and switches with their physical parameters all adjustable. These applets are designed to be accessed through the CANU content management interface, although development of this interface and the MAP materials seems to have stopped.

Physics Demonstrations: Saint Mary's University
http://www.ap.stmarys.ca/demos/navigation/navigation_frames.html (Select E&M)

This lecture-demonstration web site is an extensive collection of information on demonstrations and labs available for physics teachers. The web pages provide information about the setup and operation of the demonstration and the relevant physics. An important advantage of these pages is the inclusion of videos of the demonstrations. These can be used to give students access to the demonstrations outside of class.

Modern Physics Lab Demonstrations: University of Pennsylvania
http://mediamogul.seas.upenn.edu/physics_lab/modernphysics.html

This set of videos provides a pre-lab introduction for a number of modern physics labs. E&M labs include Electric Field, Electric Potential, Induced EMF, and E/M Ratio. The descriptions are very specific to the labs at the University of Pennsylvania, but can be used to help design labs or introduce similar activities in other universities. The streaming quality of the videos is excellent.

Non-English Materials:
Two non-English resources were recommended by reviewers, although they did not receive two full peer reviews.

Électricité: Jean-Jacques Rousseau, **Université du Maine**,**Le Mans**
http://www.univ-lemans.fr/enseignements/physique/02/electri/menuelec.html

This web site has approximately 60 simulation pages for E&M systems with explanations of the physics (in French).

El osciloscopio: Ángel Franco García, Universidad del País Vasco
http://www.sc.ehu.es/sbweb/fisica/elecmagnet/movimiento/osciloscopio/osciloscopio.htm

This web site provides an online introduction to the operation of oscilloscopes. It is part of a larger online textbook that includes a large section on E&M.

4. General comments & Conclusions

There were several common comments made by the reviewers about the Electricity and Magnetism materials reviewed. These are outlined below.

Comments regarding content:

There are many animations and simulations illustrating standard Electricity and Magnetism systems and problems. These include Coulomb's Law, the motion of charges, electric and magnetic fields, and circuits.

Most of the multimedia is Java applets, with some Shockwave and Flash materials, and videos. The applets generally work well. Many resources used Physlets for their interactive media, indicating the power and wide-spread adoption of these freely available tools. Many of the tutorials reviewed are created by adding questions, activities, and pedagogical context to enhance the Physlet.

Many of the resources are simulations or tutorial web pages that are part of a larger collection. These collections provide a broad, consistent, and refined set of learning materials that can be used throughout a standard class. Not included in our reviews are commercial products, computer experiment interface software, and general modeling software such as Dynasys and Stella.

Much of the material does not contain any explanation or didactic content. They are simple illustrations of specific physical phenomena. They do not challenge the learner to develop understanding or solve problems. In some cases it is not apparent that the multimedia is necessary or an improvement over a simple picture, graph, or data table. Many high quality resources include simulations of complex or applied systems that could not otherwise be presented, particularly at a conceptual level.

Comments regarding reviews:

Most highly rated items are from broad collections covering a range of topics. These broad collections are more useful for instruction because the material can be used over multiple topics. Also these larger collections tend to have more text and learning content. The authors who create these larger resources do so with a didactic goal in mind.

It is difficult to review some of the simulations with very specific and limited content. There is no obvious way to judge the educational impact of these materials without the context of how the item will be used. The MERLOT review process handles this issue by having reviewers consider materials in terms of what they consider to be the best possible use of the resource. The reviews indicate the educational context in which the item is reviewed. However, materials with clear learning goals and text that provides more learning support receive the highest ratings.

Materials from the Davidson Physlets website and the National Taiwan Normal University Virtual Physic Laboratory are not listed above. These are well known and highly regarded resources and should be considered in any comprehensive list of quality resource collections. The reviewers spent time reviewing materials that are not as well known.

There were more diverging recommendations between the EPS and MERLOT reviewers for the Electricity and Magnetism materials than for past topics. In several cases, one reviewer gave a relatively high score while the other reviewer considered the material average. It is not clear why this occurred; whether it was due to the subject matter, the larger number of items reviewed, or a difference in the review rubrics.

The materials with this disagreement between reviewers included:

- **Textbook Companion Websites:**
  http://cwx.prenhall.com/bookbind/pubbooks/giancoli3/chapter30/deluxe.html
  http://www3.interscience.wiley.com:8100/legacy/college/halliday/0471320005/simulations6e/index.htm
  These two web sites are companion web sites to two of the standard introductory textbooks in the United States. They received a good review from the EPS reviewer, but were considered average by the MERLOT reviewer. The lower MERLOT review seemed to be due to the fact that they are older and the reviewer felt that they had not been updated for some time.
- **Physics 2000:**
  http://www.colorado.edu/physics/2000/
  Two of the web pages from the Physics 2000 web site were recommended by an EPS reviewer. While the Physics 2000 material has been highly rated by MERLOT reviews, the MERLOT reviewer felt that these individual items were too limited for a high review.
- **Hysteresis-loop:** :
  http://www.student.uni-kl.de/~mewes/magnet.e.html
  This illustration of the physics of ferromagnetic materials and hysterisis was recommended as small but well-construction element for an electrodynamics

course by an EPS reviewer. The MERLOT reviewer felt that the level and construction of this page made it more suitable for reference than as a learning resource.

- **E&M Tutorials:**
  http://paer.rutgers.edu/PT3/cycleindex.php?topicid=10
  http://people.clarkson.edu/~svoboda/eta/index.html
  http://schools.matter.org.uk/a-level.html
  These items were recognized by MERLOT reviewers as useful tutorial collections using multimedia, the first site using video and the other two using simulations. The first site illustrates some very basic E&M experiments, the second has tutorial material at somewhat more of an electrical engineering approach. The third site has tutorials on a range of topics including capacitors, magnetic fields from currents, and series and parallel circuits. They all provide conceptual and/or numerical questions for students. These were not recommended by the EPS reviewer.
- **PhET Circuit Simulator:**
  http://www.colorado.edu/physics/phet/simulations/cck/cck.jnlp
  This realistic circuit simulator is one of the top rated items in MERLOT, but was not recommended by the EPS reviewer. This may be because it does not include tutorial or didactic materials. The MERLOT reviewers of this material felt that it can be used in any curriculum that uses DC circuit labs. Research by the group that authored the simulation supports this view.
- **EduMedia:**
  http://www.edumedia.fr
  This extensive collection contains a wide assortment of small Flash animations. Each includes a summary and a learning goal. Although each animation is very limited, this material was noted by the MERLOT reviewer for its breadth. This is a commercial site that requires registration for the full versions of the materials.
- **iPES-EMFields:**
  http://www.ipes.ethz.ch/ipes/2002Feldlinien/felder.html
  This set of simulations illustrates relatively complex E&M systems. It does not, however, include didactic content other than brief introductions to the simulation.

5. Future Efforts

The review efforts described above will be continued next year with a review of resources in two topical areas, Solid State/Condensed Matter Physics and Particle and Nuclear Physics. The current plan is then to re-visit the topical areas previously reviewed, one topic each year: quantum physics, optics, classical mechanics, thermal and statistical physics, and electricity and magnetism.

The review process will remain unchanged, except for the use of online resource catalogs (digital libraries) to organize and present the resources being reviewed and to help simplify the review workflow. Materials considered for review will need to reside in the online catalog; authors wishing to have their materials reviewed will load their resources into the library with the help of the librarians. The review process can then be organized and monitored online. This will encourage the re-use and dissemination of the high quality resources identified.

References

[1] N.D. Finkelstein, W.K. Adams, C.J. Keller, P.B. Kohl, K.K. Perkins, N.S.Podolefsky, S. Reid, "When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment", Phys. Rev. ST Phys. Educ. Res. 1 (2005)

[2] M. Benedict, E. Debowska, H. J. Jodl, L. Mathelitsch, R. Sporken, "Reccomendations (for material on quantum mechanics and for evaluation criteria)", 7th Workshop on Multimedia in Physics Teaching and Learning of the European Physical Society – Proceedings, (Parma, Italy 2002), available online http://informando.infm.it/MPTL/proceedings/WG5_rec1.PDF

[3] M. Benedict, E. Debowska, H. J. Jodl, L. Mathelitsch, R. Sporken, "Report and Recommendations on Available Multimedia Material for Teaching Optics at School and at University Level", 8th Workshop on Multimedia in Physics Teaching and Learning of the European Physical Society – Proceedings, (Prague, Czech Republic 2003) http://lucy.troja.mff.cuni.cz/~tichy/MPTL/contributions/jodl/report_and_recommendations_for_teaching_optics_prag03.pdf

[4] M. Benedict, E. Debowska, H. J. Jodl, L. Mathelitsch, R. Sporken, T. Bradfield, T. Colbert, L. Keiner, B. Mason, T. Meldor, S. Sen, J. Rauber, "Report and Recommendations on Available Multimedia Material for Teaching Mechanics at School and at University Level", 9th Workshop on Multimedia in Physics Teaching and Learning of the European Physical Society – Proceedings, (Graz, Austria 2004) http://physik.uni-graz.at/MPTL9/proceedings/ProcSporkenMason.pdf

[5] L. Mathelitsch, B. Mason, H.J. Jodl, et. al, "Report and Recommendations on Available Multimedia Material for Statistical and Thermal Physics", 10th Workshop on Multimedia in Physics Teaching and Learning fo the European Physical Society – Proceedings, (Berlin, Germany 2005) http://pen.physik.uni-kl.de/w_jodl/MPTL/MPTL10/contributions/mathelitsch/Rep_Recom_Thermodyn_2005.pdf

[6] MERLOT is available online at http://www.merlot.org. More information about the MERLOT Project is available online at http://taste.merlot.org, and the portal page for MERLOT/Physics is http://portals.merlot.org/physics/

[7] The web collections and databases used in this search that were most useful were:
AKLEON - (http://www.akleon.de/Welcome_JS),
Leonardo: Interactive Virtual Science Museum - (http://www.ba.infn.it/www/didattica.html),
FiPS-Medienserver - (http://vernstudium-physik.de/medienserver),
Physlet Resources - (http://webphysics.davidson.edu/applets/applets.html and http://pen.physik.uni-kl.de/physlets/index.html),
Multimedia Physik - (http://www.schulphysik.de),
Physics Web - (http://physicsweb.org/resources/Eduation/Interactive_experiements/Electromagnetism),

CoLoS - (http://www.colos.org)

[8] F.F. Schweickert, “NatSim.net – an open teacher’s platform for web-based homework on simulatin programs”, http://natsim.net/download/doc/natsim.pdf. NatSim search is available at http://natsim.net/cgi-bin/ps/search.pl

[9] The MERLOT/Physics E&M collection is available online at http://www.merlot.org/merlot/materials.htm?category=2749

[10] S. Altherr, A. Wagner, B. Eckert, H. J. Jodl, “Multimedia material for teaching physics (search, evaluation and examples)", European Journal of Physics 25 (2004)

[11] MERLOT/Physics peer review outline and rubrics are online at http://portals.merlot.org/physics/PeerReviewOverview.html

Appendix 1:

Items recommended by a preliminary review

	URL	Topic
1	http://cwx.prenhall.com/bookbind/pubbooks/giancoli3/chapter30/deluxe.html	AC Circuits
2	http://fernstudium-physik.de/medienserver/mediafiles/realvideo/free/hoch_und_tiefpassfilter.rm (in German, log in required user: medien, password: uni-kl)	AC Circuits
3	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter02/free/rc_c.html (in German)	AC Circuits
4	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter02/free/rc_f.html (in German)	AC Circuits
5	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter04/free/induktion.html (in German)	AC Circuits
6	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter05/free/komplexer_widerstand.html (in German)	AC Circuits
7	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter05/free/lineare_netzwerke.html (in German)	AC Circuits
8	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter05/free/rl_f.html (in German)	AC Circuits
9	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter05/free/rl_l.html (in German)	AC Circuits
10	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter06/free/lc_erzwungen.html (in German)	AC Circuits
11	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter06/free/lc_gedaempft.html (in German)	AC Circuits
12	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter06/free/lc_ungedaempft.html (in German)	AC Circuits
13	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter06/free/reihenschwingkreis.html (in German)	AC Circuits
14	http://www.mapageweb.umontreal.ca/hamamh/Electro/Circuit/Circuit.htm	AC Circuits
15	http://www3.interscience.wiley.com:8100/legacy/college/halliday/0471320005/simulations6e/index.htm	AC Circuits
16	http://phys23p.sl.psu.edu/phys_anim/EM/indexer_EM.html	Collections
17	http://web.mit.edu/8.02t/www/802TEAL3D/teal_tour.htm	Collections
18	http://www.ap.stmarys.ca/demos/navigation/navigation_frames.html (see E&M)	Collections
19	http://btpdx1.phy.uni-bayreuth.de/VirtuelleExperimente/elek/quickstart.html (several virtual experiments on measurements of simple circuits, in German)	DC Circuits

20	http://canu.ucalgary.ca/map/content/circuitbuilder/basic/simulate/practice/	DC Circuits
21	http://physics.bu.edu/%7eduffy/semester2/ (many Physlets)	DC Circuits
22	http://schulen.eduhi.at/riedgym/physik/10/elektrizitaet/ue_stromkreis/sim_gluehbirnen/bsp_parallel.htm#applet (assignments in German) original applet no longer available (?)	DC Circuits
23	http://schulen.eduhi.at/riedgym/physik/10/elektrizitaet/ue_stromkreis/sim_gluehbirnen/bsp_serie.htm#applet (assignments in German) original applet no longer available (?)	DC Circuits
24	http://www.udel.edu/ghw/circuit-simulator/	DC Circuits
25	http://www.univ-lemans.fr/enseignements/physique/02/electri/coderesi.html (in French, color code of resistor only)	DC Circuits
26	http://www.univ-lemans.fr/enseignements/physique/02/electri/condo2.html (in French)	DC Circuits
27	http://www.univ-lemans.fr/enseignements/physique/02/electri/kirchhoff.html (in French)	DC Circuits
28	http://www.univ-lemans.fr/enseignements/physique/02/electri/loijoule.html (in French)	DC Circuits
29	http://www.univ-lemans.fr/enseignements/physique/02/electri/superpos.html (in French)	DC Circuits
30	http://cwx.prenhall.com/giancoli/chapter22/deluxe.html	E&M Radiation
31	http://hyperphysics.phy-astr.gsu.edu/hbase/ems1.html#c1	E&M Radiation
32	http://ocw.mit.edu/OcwWeb/Physics/8-02TSpring-2005/Visualizations/detail/light.htm (several visualizations)	E&M Radiation
33	http://www.colorado.edu/physics/phet/simulations/emf/emf.jnlp	E&M Radiation
34	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=418	E&M Radiation
35	http://physics.bu.edu/%7eduffy/semester2/ (many Physlets), for example:	Electrostatics
36	http://physics.bu.edu/%7eduffy/semester2/c01_charge_conservation.html	Electrostatics
37	http://physics.bu.edu/%7eduffy/semester2/c01_charging.html	Electrostatics
38	http://physics.bu.edu/%7eduffy/semester2/c01_electroscope.html	Electrostatics
39	http://physics.bu.edu/%7eduffy/semester2/c01_time_evolution.html	Electrostatics
40	http://physics.bu.edu/%7eduffy/semester2/c02_line1.html	Electrostatics
41	http://physics.bu.edu/%7eduffy/semester2/c02_testcharge_motion.html	Electrostatics
42	http://physics.bu.edu/%7eduffy/semester2/c02_testcharge_questions.html	Electrostatics
43	http://physics.bu.edu/%7eduffy/semester2/c02_vectors.html	Electrostatics
44	http://physics.bu.edu/%7eduffy/semester2/c02_visualize.html	Electrostatics
45	http://qbx6.ltu.edu/~s_schneider/physlets/main/coulomb.shtml	Electrostatics
46	http://qbx6.ltu.edu/~s_schneider/physlets/main/dipole_torque.shtml	Electrostatics
47	http://qbx6.ltu.edu/~s_schneider/physlets/main/efield.shtml	Electrostatics
48	http://qbx6.ltu.edu/~s_schneider/physlets/main/efield_arc.shtml	Electrostatics
49	http://qbx6.ltu.edu/~s_schneider/physlets/main/eforcex.shtml	Electrostatics
50	http://qbx6.ltu.edu/~s_schneider/physlets/main/eforcex3.shtml	Electrostatics
51	http://qbx6.ltu.edu/~s_schneider/physlets/main/electroscope.shtml	Electrostatics
52	http://qbx6.ltu.edu/~s_schneider/physlets/main/eline.shtml	Electrostatics
53	http://qbx6.ltu.edu/~s_schneider/physlets/main/equipotentials.shtml	Electrostatics
54	http://qbx6.ltu.edu/~s_schneider/physlets/main/erings.shtml	Electrostatics
55	http://qbx6.ltu.edu/~s_schneider/physlets/main/es_01.shtml	Electrostatics
56	http://qbx6.ltu.edu/~s_schneider/physlets/main/es_02.shtml	Electrostatics

57	http://qbx6.ltu.edu/~s_schneider/physlets/main/es_03.shtml	Electrostatics
58	http://qbx6.ltu.edu/~s_schneider/physlets/main/gauss_rings.shtml	Electrostatics
59	http://qbx6.ltu.edu/~s_schneider/physlets/main/index.shtml (several physlets)	Electrostatics
60	http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/electrostatics/index.htm	Electrostatics
61	http://www.edumedia.fr/a101-action-reaction.html	Electrostatics
62	http://www.edumedia.fr/a103-gravitational-analogy.html	Electrostatics
63	http://www.edumedia.fr/a104-electric-force.html	Electrostatics
64	http://www.edumedia.fr/a113-2-electric-point-charges.html	Electrostatics
65	http://www.edumedia.fr/a114-negative-point-charge.html	Electrostatics
66	http://www.edumedia.fr/a115-positive-point-charge.html	Electrostatics
67	http://www.edumedia.fr/a116-dipole-field-lines.html	Electrostatics
68	http://www.edumedia.fr/a117-2-positive-point-charges.html	Electrostatics
69	http://www.edumedia.fr/a118-line-integral.html	Electrostatics
70	http://www.edumedia.fr/a120-coulomb-law.html	Electrostatics
71	http://www.edumedia.fr/a124-positive-single-charge-3d.html	Electrostatics
72	http://www.edumedia.fr/a125-negative-single-charge.html	Electrostatics
73	http://www.edumedia.fr/a126-infinite-line-positively-charged-3d.html	Electrostatics
74	http://www.edumedia.fr/a127-infinite-line-negatively-charged3d.html	Electrostatics
75	http://www.edumedia.fr/a128-infinite-line-e.html	Electrostatics
76	http://www.edumedia.fr/a129-equipotential-1.html	Electrostatics
77	http://www.edumedia.fr/a130-equipotentials-2.html	Electrostatics
78	http://www.edumedia.fr/a133-flux.html	Electrostatics
79	http://www.edumedia.fr/a134-attractive-force.html	Electrostatics
80	http://www.edumedia.fr/a135-attractive-force-field.html	Electrostatics
81	http://www.edumedia.fr/a136-force-and-potential.html	Electrostatics
82	http://www.edumedia.fr/a169-repulsive-force.html	Electrostatics
83	http://www.edumedia.fr/a170-repulsive-force-field.html	Electrostatics
84	http://www.edumedia.fr/a171-gauss-theorem.html	Electrostatics
85	http://www.edumedia.fr/a172-gauss-theorem-sphere.html	Electrostatics
86	http://www.edumedia.fr/a173-gauss-theorem-line.html	Electrostatics
87	http://www.edumedia.fr/a175-gradient.html	Electrostatics
88	http://www.edumedia.fr/a177-electrostatic-influence.html	Electrostatics
89	http://www.edumedia.fr/a193-superposition-principle.html	Electrostatics
90	http://www.edumedia.fr/a194-principle-superposition.html	Electrostatics
91	http://www.edumedia.fr/a195-principle-superposition.html	Electrostatics
92	http://www.edumedia.fr/a196-principle-superposition.html	Electrostatics
93	http://www.edumedia.fr/a200-electrostatic-laws.html	Electrostatics
94	http://www.falstad.com/emstatic/	Electrostatics
95	http://www.falstad.com/vector/	Electrostatics
96	http://www.falstad.com/vector2de/	Electrostatics
97	http://www.falstad.com/vector3de/	Electrostatics
98	http://www.ibiblio.org/links/devmodules/electricpotential/index.html	Electrostatics
99	http://www.tufts.edu/as/wright_center/fellows/bob_morse_04/	Electrostatics
100	http://cwx.prenhall.com/bookbind/pubbooks/giancoli3/chapter29/deluxe.html	Induction
101	http://cwx.prenhall.com/giancoli/chapter21/	Induction
102	http://fernstudium-physik.de/medienserver/mediapages/experimentalphysics2/chapter04/free/faraday.html (in German)	Induction

103	http://ocw.mit.edu/OcwWeb/Physics/8-02TSpring-2005/Visualizations/detail/faraday.htm (several visualizations)	Induction
104	http://physics.bu.edu/%7eduffy/semester2/ (several Physlets)	Induction
105	http://scitec.uwichill.edu.bb/cmp/online/p10D/sodha/lecture16/lect16.htm	Induction
106	http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/faraday/index.htm	Induction
107	http://webphysics.davidson.edu/physlet_resources/bu_semester2/c18_generators.html	Induction
108	http://webphysics.davidson.edu/physletprob/ch7_in_class/in_class7_2/enm7_2_8.html	Induction
109	http://webphysics.davidson.edu/physletprob/ch9_problems/ch9_7_faraday/default.html	Induction
110	http://www.k-wz.de/elektro/threephasegenerator.html	Induction
111	http://www.ngsir.netfirms.com/englishhtm/Transformer.htm	Induction
112	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/fem/fem.htm	Induction
113	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/induccion/caida/caida.htm (in Spanish, parts of tutorial on electromagnetism: http://www.sc.ehu.es/sbweb/fisica/elecmagnet/elecmagnet.htm)	Induction
114	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/induccion/faraday/faraday.htm	Induction
115	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/induccion/mAngular/mAngular.htm (part of tutorial, in Spanish)	Induction
116	http://www.schule-bw.de/unterricht/faecher/physik/online_material/e_lehre_1/induktion/trafo1.htm (in German)	Induction
117	http://www.univ-lemans.fr/enseignements/physique/02/electri/lenz.html (in French)	Induction
118	http://www.univ-lemans.fr/enseignements/physique/02/electri/mutuelle.html (in French)	Induction
119	http://www.walter-fendt.de/ph11e/generator_e.htm	Induction
120	http://www.walter-fendt.de/ph14e/generator_e.htm	Induction
121	http://www.wfu.edu/physics/demolabs/demos/avimov/launcher.html	Induction
122	http://cwx.prenhall.com/bookbind/pubbooks/giancoli3/chapter27/deluxe.html	Magnetism
123	http://ocw.mit.edu/OcwWeb/Physics/8-02TSpring-2005/Visualizations/detail/magnetostatics.htm (several visualizations)	Magnetism
124	http://qbx6.ltu.edu/~s_schneider/physlets/main/index.shtml (several physlets)	Magnetism
125	http://socrates.berkeley.edu/~cywon/Vortex.html	Magnetism
126	http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/magnetostatics/index.htm	Magnetism
127	http://web.mit.edu/jbelcher/www/java/part_biot/part_biot.html	Magnetism
128	http://www.angelfire.com/wa/hurben/swaves.html	Magnetism
129	http://www.falstad.com/vector3dm/	Magnetism
130	http://www.honeylocust.com/hysteresis/	Magnetism
131	http://www.ipes.ethz.ch/ipes/2002FelderFEM1/fem_quad.html	Magnetism
132	http://www.ipes.ethz.ch/ipes/2002FelderFEM1/fem_quadfluss.html	Magnetism
133	http://www.ipes.ethz.ch/ipes/2002FelderFEM1/fem_shield.html	Magnetism
134	http://www.ipes.ethz.ch/ipes/2002Feldlinien/feld_magstat.html	Magnetism
135	http://www.kw.igs.net/~jackord/bp/g5a.html	Magnetism
136	http://www.lassp.cornell.edu/sethna/hysteresis/hysteresis.html	Magnetism

137	http://www.ngdc.noaa.gov/seg/geomag/jsp/IGRF.jsp (part of tutorial on Geomagnetism http://www.ngdc.noaa.gov/seg/geomag/geomag.shtml)	Magnetism
138	http://www.nhn.ou.edu/~walkup/demonstrations/WebAssignments/Magnetism001.htm	Magnetism
139	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=276	Magnetism
140	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=49	Magnetism
141	http://www.student.uni-kl.de/~mewes/magnet.e.html	Magnetism
142	http://www.univ-lemans.fr/enseignements/physique/02/electri/bobines.html (in French)	Magnetism
143	http://www.univ-lemans.fr/enseignements/physique/02/electri/champterre.html (in French)	Magnetism
144	http://www.univ-lemans.fr/enseignements/physique/02/electri/cyclehys.html (in French)	Magnetism
145	http://www.univ-lemans.fr/enseignements/physique/02/electri/filverti.html (in French)	Magnetism
146	http://www.univ-lemans.fr/enseignements/physique/02/electri/helmoltz.html (in French)	Magnetism
147	http://www.univ-lemans.fr/enseignements/physique/02/electri/mommagne.html (in French)	Magnetism
148	http://www.univ-lemans.fr/enseignements/physique/02/electri/solenoid.html (in French)	Magnetism
149	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava32.html (in French)	Magnetism
150	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava49.html (in French)	Magnetism
151	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava50.html (in French)	Magnetism
152	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava52.html (in French)	Magnetism
153	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava53.html (in French)	Magnetism
154	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava63.html (in French)	Magnetism
155	http://www.up.univ-mrs.fr/~laugierj/CabriJava/0pjava65.html (in French)	Magnetism
156	http://www2.truman.edu/~velasco/ising.html	Magnetism
157	http://www3.interscience.wiley.com:8100/legacy/college/halliday/0471320005/simulations6e/index.htm	Magnetism
158	http://canu.ucalgary.ca/map/content/energy/work_kinetic/simulate/elfield/applet.html	Moving Charges
159	http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/electric/applet.html	Moving Charges
160	http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/electric_single_particle/applet.html	Moving Charges
161	http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/exb_thomson/applet.html	Moving Charges
162	http://canu.ucalgary.ca/map/content/force/elcrmagn/simulate/magnetic/applet.html	Moving Charges
163	http://colos1.fri.uni-lj.si/~colos/COLOS/EXAMPLES/XDJ/PARTICLES/Particles.html (caused breakdown of IE)	Moving Charges
164	http://dept.physics.upenn.edu/courses/gladney/mathphys/java/sect5/section5_1.html	Moving Charges
165	http://home.in.tum.de/~vogelj/index.php?url=physics/magnetism/field/index.xml	Moving Charges
166	http://home.in.tum.de/~vogelj/index.php?url=physics/magnetism/halleffect/index.xml	Moving Charges

167	http://home.in.tum.de/~vogelj/index.php?url=physics/magnetism/wienfilter/index.xml	Moving Charges
168	http://home.in.tum.de/~vogelj/index.php?url=physics/statics/field/index.xml	Moving Charges
169	http://lectureonline.cl.msu.edu/~mmp/applist/coulomb/orbit.htm	Moving Charges
170	http://lectureonline.cl.msu.edu/~mmp/kap18/RR4460app.htm	Moving Charges
171	http://lectureonline.cl.msu.edu/~mmp/kap21/cd533capp.htm	Moving Charges
172	http://mediamogul.seas.upenn.edu/physics_lab/modernphysics.html	Moving Charges
173	http://micro.magnet.fsu.edu/electromag/java/crookestube/index.html	Moving Charges
174	http://micro.magnet.fsu.edu/electromag/java/electrophoresis/index.html	Moving Charges
175	http://microcosm.web.cern.ch/microcosm/RF_cavity/ex.html	Moving Charges
176	http://natsim.net/physlets/BField4/bfield_1.html	Moving Charges
177	http://natsim.net/physlets/BField4/enm7_2_7.html	Moving Charges
178	http://natsim.net/physlets/EField/fadenstrahl_b.html	Moving Charges
179	http://natsim.net/physlets/EField/fadenstrahl_e.html (in German)	Moving Charges
180	http://natsim.net/physlets/EField/Velocity_Selector.html	Moving Charges
181	http://natsim.net/physlets/EField4/electrostatics9_1_6.html	Moving Charges
182	http://natsim.net/physlets/EField4/electrostatics9_1_8.html	Moving Charges
183	http://natsim.net/physlets/EField4/enm7_2_1.html	Moving Charges
184	http://pen.physik.uni-kl.de/medien/MM_Videos/index_eng.html choose « Ionic Migration » in navigation bar left, video available under « Download »	Moving Charges
185	http://physics.bu.edu/%7eduffy/semester2/ (several Physlets)	Moving Charges
186	http://surendranath.tripod.com/Applets/Electricity/MovChgEleMag/MovChgEleMagApplet.html	Moving Charges
187	http://surendranath.tripod.com/Applets/Electricity/MovChgMag/MovChgMagApplet.html	Moving Charges
188	http://web.mit.edu/jbelcher/www/java/attLec/attPot.html	Moving Charges
189	http://web.mit.edu/jbelcher/www/java/rep_pot/repPot.html	Moving Charges
190	http://webphysics.davidson.edu/applets/ibe/default.html	Moving Charges
191	http://webphysics.davidson.edu/course_material/py230l_wc/demo/ex27_2.html	Moving Charges
192	http://webphysics.davidson.edu/course_material/py230l_wc/demo/prob27_9.html	Moving Charges
193	http://www.cco.caltech.edu/%7Ephys1/java/phys1/MovingCharge/MovingCharge.html	Moving Charges
194	http://www.colorado.edu/physics/2000/waves_particles/wavpart2.html	Moving Charges
195	http://www.colorado.edu/physics/2000/waves_particles/wavpart3.html	Moving Charges
196	http://www.didaktik.physik.uni-erlangen.de/download/applets/magnet.htm (in German)	Moving Charges
197	http://www.geneva-link.ch/jdesiebenthal/physique/simulations/jacob/Mvtcharges.html	Moving Charges
198	http://www.k-wz.de/elektro/vakuumdiode.html (in German)	Moving Charges
199	http://www.ngsir.netfirms.com/englishhtm/Lissajous.htm (belongs also to AC oscillations…)	Moving Charges
200	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?p=147 (maybe already quoted, above)	Moving Charges
201	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=257	Moving Charges
202	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=274	Moving Charges
203	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=277	Moving Charges
204	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=295	Moving Charges

205	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=43	Moving Charges
206	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=50	Moving Charges
207	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=53	Moving Charges
208	http://www.physics.brocku.ca/faculty/sternin/120/applets/MassSpectrometer/	Moving Charges
209	http://www.physik.uni-muenchen.de/leifiphysik/web_ph10/versuche/10_fadenstrahl/versuch/fadenstrahl.htm (in German)	Moving Charges
210	http://www.pk-applets.de/phy/ashton/ashton.html (in German)	Moving Charges
211	http://www.pk-applets.de/phy/thomson/thomson.html (in German)	Moving Charges
212	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/espectrometro/espectro.html (in Spanish, part of tutorial)	Moving Charges
213	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/movimiento/cicloide/cicloide.htm (in Spanish, part of tutorial)	Moving Charges
214	http://www.sfu.ca/physics/funstuff/java/	Moving Charges
215	http://www.upscale.utoronto.ca/PVB/Harrison/SternGerlach/Flash/SGClassicalCharge.html (Spin of charge, Stern-Gerlach)	Moving Charges
216	http://www.walter-fendt.de/ph14e/electricmotor.htm	Moving Charges
217	http://www.walter-fendt.de/ph14e/lorentzforce.htm	Moving Charges
218	http://www3.interscience.wiley.com:8100/legacy/college/halliday/0471320005/simulations6e/index.htm choose “Motion of a charge in Electric and Magnetic Fields“ in navigation bar left	Moving Charges
219	http://btpdx1.phy.uni-bayreuth.de/VirtuelleExperimente/elek/quickstart.html (several virtual experiments on how to use multimeter etc., in German)	Other/Misc
220	http://cripe03.rug.ac.be/circuit/circuitbuilder.html (original)	Other/Misc
221	http://fem.um.es/Ejs/Ejs_en/index.html (powerful simulation tool)	Other/Misc
222	http://fem.um.es/Ejs/EjsExamples3.3/Simulations/EMwave.html	Other/Misc
223	http://fem.um.es/Ejs/EjsExamples3.3/Simulations/ParticlesAndWalls.html	Other/Misc
224	http://home3.netcarrier.com/~chan/MATERIAL/BANDS/carrieraction.html	Other/Misc
225	http://home3.netcarrier.com/~chan/MATERIAL/DIFFUSION/	Other/Misc
226	http://home3.netcarrier.com/~chan/MATERIAL/MOS/MOS.html	Other/Misc
227	http://home3.netcarrier.com/~chan/MATERIAL/PNJUNCTION/	Other/Misc
228	http://jacob.fe.uni-lj.si/eng/index.html (covers several topics on electricity and magnetism)	Other/Misc
229	http://jas.eng.buffalo.edu/	Other/Misc
230	http://mediamogul.seas.upenn.edu/physics_lab/modernphysics.html	Other/Misc
231	http://micro.magnet.fsu.edu/primer/java/electronmicroscopy/magnify1/index.html	Other/Misc
232	http://www.colorado.edu/physics/2000/bec/mag_trap.html	Other/Misc
233	http://www.colorado.edu/physics/2000/laptops/calculator2.html (part of tutorial)	Other/Misc
234	http://www.colorado.edu/physics/phet/simulations/cck/cck.jnlp	Other/Misc
235	http://www.d-project.com/simcir/	Other/Misc
236	http://www.jhu.edu/~virtlab/logic/log_cir.htm	Other/Misc
237	http://www.jhu.edu/~virtlab/logic/logic.htm	Other/Misc
238	http://www.mapageweb.umontreal.ca/hamamh/Electro/LOGIC/logicSys.htm	Other/Misc

239	http://www.mos.org/sln/toe/toe.html	Other/Misc
240	http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=51	Other/Misc
241	http://www.physik.uni-muenchen.de/leifiphysik/web_ph10/umwelt-technik/15planar/planar.htm (in German)	Other/Misc
242	http://www.quantum-physics.polytechnique.fr/physics/index.html	Other/Misc
243	http://www.sc.ehu.es/sbweb/fisica/elecmagnet/movimiento/osciloscopio/osciloscopio.htm (in Spanish)	Other/Misc
244	http://www.schulphysik.de/ntnujava/electronics/multimeter.html	Other/Misc
245	http://www.schulphysik.de/ntnujava/oscilloscope/oscilloscope.html (original from NTNU Java, Hwang, Taiwan)	Other/Misc
246	http://www.virtual-oscilloscope.com/	Other/Misc
247	http://hyperphysics.phy-astr.gsu.edu/hbase/emcon.html	Tutorials
248	http://maxwell.ucdavis.edu/~electro/	Tutorials
249	http://micro.magnet.fsu.edu/electromag/index.html	Tutorials
250	http://paer.rutgers.edu/PT3/cycleindex.php?topicid=10	Tutorials
251	http://people.clarkson.edu/~svoboda/eta/Circuit_Design_Lab/circuit_design_lab.html	Tutorials
252	http://people.clarkson.edu/~svoboda/eta/index.html	Tutorials
253	http://schools.matter.org.uk/a-level.html	Tutorials
254	http://www.colorado.edu/physics/2000/waves_particles/index.html	Tutorials
255	http://www.enzim.hu/~szia/cddemo/edemo0.htm	Tutorials
256	http://www.glenbrook.k12.il.us/gbssci/phys/Class/estatics/estaticstoc.html	Tutorials
257	http://www.ibiblio.org/links/devmodules/electricpotential/index.html	Tutorials
258	http://www.pbs.org/transistor/	Tutorials
259	http://www.slcc.edu/schools/hum_sci/physics/tutor/2220/index.html	Tutorials

Appendix 2: EPS Review Sheet

URL
Comment:
Recommendation:

User-friendliness:	**Rating**	**Comments**
Is it easy to start using the MM?		
Are the design comprehensible and the image quality satisfactory?		
Is the function of control elements evident?		
Are the software requirements clear and of adequate proportion?		
Attractiveness:		
Is the layout appealing?		
Is there a motivating introduction?		
Are there interactive components?		
Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?		
Is the MM up-to-date / innovative?		
Clear description of purpose and work assignment:		
Is the intention of the MM evident?		
Does the user know what is expected from him?		
Is there a problem to solve or a context to understand?		
Relevance:		
Is the topic important?		
Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?		
Scope:		
Is there a profoundness of content?		
Is there a broadness of content (special case, general overview)?		
Correctness:		
Is the content of the MM correct?		
Are simplifications indicated?		
Flexibility:		
Is the MM appropriate for a broad target group (incl. self-learning)?		
Is it possible to use the MM in different teaching and learning situations?		
Does the MM allow for the same topic to be approached in different ways?		

Matching to target group:		
Is a reasonable didactical reduction implemented?		
Are technical terms explained?		
Are the objectives appropriate?		
Realization:		
Is the general approach suitable to present the subject and realize aims of the given MM?		
Is the type of MM chosen reasonable (video, simulation, animation)?		
Documentation:		
Is the operation obvious or explained?		
Is the material self-evident or explained by additional text?		
Is there a reference to material for further studies?		
Are there any suggestions for implementation into the teaching process?		