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TEACHING PHYSICS CORE IDEAS TO CONTENT GENERALISTS

HAUPTMAN, JOHN

DEPARTMENT OF PHYSICS AND ASTRONOMY

IOWA STATE UNIVERSITY

IOWA

BAHNG, EUNJIN

SCHOOL OF EDUCATION

IOWA STATE UNIVERSITY

IOWA

Prof. John Hauptman
Department of Physics and Astronomy
Iowa State University
Iowa.

Prof. EunJin Bahng
School of Education
Iowa State University
Iowa.

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Synopsis:

We describe the physics content course for future elementary teachers at Iowa State University and our textbook for this course, "Children Doing Physics: How to Foster the Natural Scientific Instincts in Children." The course consists mainly of teachers performing the same experiments their future elementary students will be doing: measuring masses and length, making clocks to measure time, making electroscopes to measure charge, building a solar powered car, etc.

Mostly, all of the building and measuring in the lab are done with simply made instruments, using duct tape and common materials. This enables these pre-service teachers and their future students to understand completely what it is they are doing. There are plenty of excellent physics instruments and experiments that can be bought, but these are effectively ‘black boxes’ to students.

Figure 3: The first figure of the text illustrating the “hands-on” style of the course.

Individual teaching assistants have their own styles of teaching and varying degrees of rapport with their laboratory classes.

5 Web resources

The Khan Academy[2] (www.khanacademy.org) is a treasure of simple 10-12 minute recordings of Salman Khan explaining math, physics, and chemistry, in addition to economics, art, and history.

The amount of good material on the web is extensive and impressive, from national professional societies, to personal and professional youtube videos, to do-it-yourself home videos.

If an elementary teacher is unsure what to do in science the next week, just google ‘Bill Nye [any physics term]’ and you will likely get an interesting video to start off a science discussion. (www.sophia.org/billnye)

1. The Institute of Physics (UK) has a vast resource of educational material on their website www.iop.org/education/index.html. A well-hidden link on this IoP site is for international education and the following link has ninety experiments, some very easy and clever, for teaching physics with minimal resources: www.iop.org/about/international/development/resources/page_43501.html
2. The Vega Project (<http://www.vega.org.uk/>) has a collection of videos, including interviews and lectures by famous scientists and experiments and instruments to build.

Several other useful websites about elementary education are

- cse.ssl.berkeley.edu
- fi.edu/guide/hughes/energyconservation.html
- nobelprize.org/educational
- ocw.mit.edu/courses/physics - university physics lectures (MIT)

- petpset.iat.com/htm/pset2.htm
- physicsclassroom.com/class
- school.discoveryeducation.com
- school-for-champions.com/science
- sciencenetlinks.com
- web.mit.edu/jbelcher/www/anim.html
- wisegeek.com

The fourth website is the MIT OpenCourseWare physics lectures, consisting of fifty-minute regular university undergraduate physics lectures delivered in a lively way and interesting for the future elementary teacher who wants to understand physics deeper. The websites listed here are not exhaustive, and there is much more if you are patient to look.

People who understand nature and how it works are able to form a movie in their mind. Being able to just watch how a system develops, e.g., a pendulum, a mass on a spring, etc., is very valuable. One site developed by Walter Fendt has dozens of applets showing simulations of many things in physics:

walter-fendt.de/ph14e/index.html

Teaching techniques, support information, and science standards and content are available at the following sites:

educateiowa.gov/pk-12/iowa-core/iowa-core-science (Iowa Core Science content)

nextgenscience.org/next-generation-science-standards (Next Generation Science Standards)

nsta.org/preservice/ (Professional development)

tools4teachingscience.org/ (Teaching techniques)

Small equipment and parts are available at the following sites: amazon.com (Good for many items for this course; probably the best go-to site.)

digikey.com (All you need in electronics.)

scientificsonline.com (All optics.)

surplussed.com (Some optics and some mechanics; surplus.)

This course has been relatively well received by students[3], with the usual proviso that most students do not like physics. These students take a more formal course in science methods in their fourth year in the School of Education.

References

- [1] *Children Doing Physics: How to Foster the Natural Scientific Instincts in Children*, John Hauptman and EunJin Bahng, Cognella Academic Publishing, First Edition, 2016.

- [2] The Khan Academy, khanacademy.org, is a collection of invaluable 10-12 minute discussions of topics in physics, chemistry, mathematics, history and art, computing and economics. It is a go-to website for a free and easy lecture on many science topics for students, teachers and parents.
- [3] An interview of the authors and comments from a student:
<https://www.hs.iastate.edu/news/2015/09/21/children-doing-physics/>