The most important video course on-line: Physics C10/LS C70V at Berkeley

Posted on 24 February 2011 by **cjf**

As citizens aboard SpaceShip Earth, we need to understand the principles of science and technology that shape our world. We need this knowledge to become effective co-designers of the world that Humanity is collectively building for today and tomorrow. We need to conceptually apprehend and comprehend how the Universe actually operates so we can better contribute to steering the forces that continually reshape our worlds. What are the most important concepts needed to proficiently build, use, steward, and re-generate the infrastructure of civilization on an on-going basis? Where can we get the information needed in terms that is easy to understand, easy to relate to, easy to use, and relevant to the problems we all face today and into the future?

Although Berkeley's free video course Physics C10/LS C70V: Physics for future Presidents AKA Descriptive Introduction to Physics is not the answer to all of these questions, it **will explain the basic physics** that is necessary to critically evaluate much of the information that inundates us each day. This course will significantly increase your ability to think more confidently about the heady questions above. It is a first step.

Is there an on-line video course that does a better job than Physics C10/LS C70V of explaining the broadly relevant principles needed to understand the big issues of the day?

In 2000, when Richard Muller started teaching a new course, Physics C10/LS C70V: Physics for future Presidents AKA Descriptive Introduction to Physics, at Berkelely he asked himself what are the principles and facts from physics that a student should understand to be able to make effective decisions on the Big issues of the day should they become President of the United States? From this ambitious question, a course was designed that is eminently useful. Even though it is oriented to the non-scientist, Physics majors at Berkeley can take the course for credit toward their degree, meaning it is even useful for scientists!

In an introductory post on the OER (Open Educational Resources) Movement, I explained that the Internet now offers illions of educational resources many with free video lectures. I've spent several years searching for and enjoying on-line video courses and Physics C10 is the most broadly relevant course with the most critical information for understanding how the world works that I have found. **Everyone should watch, enjoy and think about this most enriching class of some 35 hours of free on-line video lectures!**

What resources do you use to get comprehensively educated about the principles of science and technology and how they are changing our civilization so rapidly? What is the most important or broadly useful OER course that you have found on the Internet?

A Review of Physics C10: Physics for Future Presidents

Note: this review focuses on *the Spring 2008 version of the course* that I watched [As of 1 July 2011 Berkeley has removed the Spring 2008 videos and they are no longer on-line. Although I have not watched them, the Spring 2010 videos look like a good alternative.]. Berkeley has released full sets of videos from both older and newer editions of the course. I looked at the listings for several other versions and only the Spring 2008 videos have descriptive text for the content of each video. I speculated that more effort was dedicated to the Spring 2008 videos which is also the year that the popular edition of Muller's book came out and it was during the last USA Presidential election. I assume that the other editions (semesters) will be as good as the Spring 2008 videos. Of course different explanations will be given in different versions (some better, some worse) and an evolution of content will ensue as current events and the knowledge and interests of the lecturer change. It would be interesting to know which parts of which lectures of the various versions of the course have especially good explanations or special content. But I know of no easy way to collect such intelligence (perhaps, you could share any insights in the comments). In particular, in recent editions of the course the lectures are given by Bob Jacobsen with Muller guest lecturing. Let me know in the comments of your impressions on any of the videos you watch.

Richard Muller's choice of content, approach, and exquisite skill in explaining complicated physics in conceptual terms so that ordinary people can use and apply it in their lives make this course unusually engaging and informative. During the first five to ten minutes of each lecture, Muller invites questions from the class on any subject. Some of those questions and Muller's spontaneous responses are very interesting. As with most courses, sometimes there is time spent on administrative details such as quizzes (see below for my way to download the videos so I can skip over these parts). Then a 70 minute lecture often including demonstrations follows. This repeats for 27 lectures ranging from energy, to global warming, nukes, holograms, radioactivity, spy satellites, relativity, quantum physics, and astrophysics.

> It's not ignorance does so much damage; it's knowing so darned much that ain't so. — Josh Billings

The course starts with the concept of energy. Muller keeps it simple and uses the concept of energy density to illustrate the relative capabilities of substances to power our civilization (so simple, yet I had never thought so concretely about energy capacity per pound). The demonstrations of the concepts help us remember them so we can apply them later.

Muller's demonstrations are a significant part of the course. They are not as dramatic as Walter Lewin's in MIT OCW's Physics I: Classical Mechanics. But Muller's physics is more accessible and more relevant to the needs of everyday citizens. If you want to learn physics in more depth, then I suggest watching Berkeley's Physics C10 followed by MIT's Physics I which I have also watched and thoroughly recommend.

Muller's ability to illustrate his points in concrete terms but without "dumbing down" is impressive. His stories will stick with you. Like his observation that we currently have plentiful, great food whereas our ancestors were continually hungry. Our body's almost constant urging for food is now sadly out of touch with our needs. Muller suggests that we can simply accept that it is OK to be hungry much of the time (like our ancestors always were) and thereby bolster our "won't" power. I doubt that (I suspect it is better to focus on our will power: actively doing something so that we "forget" our built-in hunger reflex), but his explanation is satisfying, memorable and motivational.

Another great story is the explanation of the 1947 Roswell UFO incident. The US discovered during WWII military uses of the ocean's sound channel (where alternating temperatures in the ocean and the Huygens-Fresnel principle combine to send sound waves thousands of miles without significant diminution of the signal). Project Mogul applied the same physics principle to the sound channel in the atmosphere to detect atom bomb tests. When the detection apparatus crashed in 1947, the cover-up of the classified military program led ufologists to let their imagination run wild. Muller's explanation of waves and how they work and how they explain the mystery at Roswell is typically incisive.

I do not agree with everything that Muller says in the course. For example, Muller repeatedly tells the story of how he quit the Sierra Club when they opposed nuclear power. Muller thinks that the threat of global warming is so urgent that we need to use every option including nuclear power to reduce the risk of disaster. Whereas I think we should not burn our capital reserves for everyday needs (moreover, nuclear power appears to be too expensive and to take too long to bring to market to compete without huge government subsidies). I think it is imperative that our daily energy should come from renewable resources not finite ones (like Uranium, Plutonium, or oil). But Muller is very fair in his presentation. He makes clear that reasonable people can and do disagree. And he gave a big plug for Amory Lovins who strongly argues that nuclear power is not feasible. I must say that I valued Muller's course all the way through even when I disagreed with some of his assessments.

Here are some of the facts that made it into my notes from the course ("~" means "is approximately"):

- Power is the rate of energy flow. 1 W = 1 watt = 1 joule / second = 1 J/s
- 1 Wh (watt-hour) ~ 1 flashlight bulb ~ 1 Calorie (the food type) = 1 Cal
- 1 human ~ 100 Wh ~ 100 Cal (heavy exercise is only about 350 Cal)
- 1 house ~ 1 kWh = 1000 Wh ~ 1 horsepower ~ 10 ¢
- 1,000 houses ~ 1 MWh ~ a neighborhood ~ local power plant ~ $1 million to build (coal)
- 1,000,000 houses ~ 1 GWh ~ a city ~ 1 large power plant ~ $1 billion to build
- The solar capacity of 1 km^2 (about the size of a nuclear power plant) could generate about 1 GWh of electricity
- The energy density is an important comparison of fuels: 1 g of TNT has about 1 Cal whereas 1 g of gasoline has about 10 Cal (10 times the energy density!).
- 1 m^3 of air ~ 1 million g = 1000 kg ~ 1 metric ton
- IPCC consensus is that it is 90% likely that a 1° F rise in temperature over the past 50 years is due to humans
- In relativity, time dilation, mass increase and length contraction are all the same phenomena
- Light travels ~ 1 foot in a nanosecond (1 billionth = 10^{-9} seconds) which is about 1 clock cycle in a modern computer
- A hologram is a mirror with film that "memorizes" the image and "plays" it back
- There are about 40 billion galaxies with about 1 billion stars in each
- The velocity of Earth in Universe is about 1 million miles per hour

Let me know if I got any of these facts or figures bungled from my notes.

In conclusion *Physics for Future Presidents AKA Descriptive Introduction to Physics* is a great video course: great ideas, great illustrations, great demonstrations, great stories. And very relevant

to any citizen interested in critically evaluating the information that pervades us every day. I strongly recommend it to anyone.

How we watched Descriptive Introduction to Physics

Jeannie and I watched each of the 29 videos in the Spring 2008 edition of the course including two review lectures (they were less good than Muller's lectures). We watched each video once and waited several days before watching the next one (on the theory that retention is enhanced if the material is spread out over a longer period of time). We did follow-up some topics with Wikipedia lookups and I took two pages of notes. We did not explore all of the supplementary material on the web site nor did we do any homework, tests or essays (unless you count this blog post!). We did not read the textbook nor the popular book. I endeavor to be a comprehensivist, so the idea is to learn what we can from the videos, get an overview … build intuitions and dawning awareness, maybe follow-up with a few questions of interest by searching on-line, but then move on (we can always go back and study parts in more depth if and when mastering the material becomes important).

What is your style or approach to studying OER courses? Are you using them as part of a comprehensive self-education program (as we are) or with a more focused objective? What are your self-educational objectives?

There are some parts of all on-line video lectures that deal with administrative details for the class including quizzes which are, frankly, uninteresting. For me watching videos requires focused attention. When the phone rings or the tea kettle starts boiling, etc. I need to pause the video, back it up by at least 10 seconds and resume when I can again give it my attention. I recommend downloading the videos to your harddisk (each one is only about 145M) so that it is easier to pause, seek, skip over boring parts, and back up a little to rewatch important parts (or parts that you "missed"). In the next section I describe how I did that.

Some technical details on watching RTSP video

I have found Mplayer to be the most versatile media player software to deal with on-line video courses. I programmed Mplayer to work with my remote control giving me fine grained handling of rewind, pause & play from the comfort of the couch. I used it to download each of the Physics C10 videos with the command:

```
mplayer -cache 65535 -dumpfile 2008.$MM.$DD.dump -dumpstream
rtsp://169.229.131.16:554/classes/s2008/phys10/2008$MM$DD.rm
```

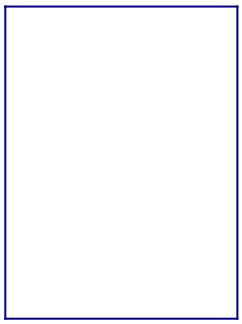
where $MM and $DD refer to the two-digit month and date of each video which I read (meaning eyeballed) from the appropriate column in the Spring 2008 webcast listing page. For example, the first video was on "Tue 1/22", so I substitute $MM=01 and $DD=22 in the command above. Mplayer was able to playback the dump files (in Debian Lenny neither vlc nor xine could play the dumped videos, but in Squeeze all three could playback the files). A friend using Windows, found that the (free) RealPlayer client allowed him to also download the videos for playback later.

Rant: Streaming video is absolutely awful for long videos and worse if you are trying to study the content of a video. To pause the video and rewind it by 10 seconds or to return to the video after a few days and resume it at a specified time (or even just quickly scanning through it to find where you left off) are essential features for viewing video. I have not yet found a streaming video client that can do much more than Pause and that often proves troublesome. It is unfortunate and for me intolerable. By downloading videos one can use a flexible client like Mplayer or VLC (a comprehensive list of video player software is available here so you can look for options that will meet your needs). I have found them to be essential to fully enjoy Internet videos. Video producers: please give us easy access to video files so we can better enjoy them!

Please watch Physics C10 and let me know what you think of it

Whether your background in science and math is weak or you earned a degree in the physical sciences, this course will enlighten you on the physics behind many of the important issues in the daily news. Watch the lectures and let me know what you think of the course!

Resources Related to Physics C10/LS C70V



Bob Jacobsen: Spring 2010

- Spring 2010 edition of Physics C10/LS C70V lectures by Richard Muller and Bob Jacobsen.
- Spring 2008 Berkeley Webcasts for Physics C10/LS C70V lectures by Richard Muller. [These are the videos that Jeannie and I watched. Since 1 July 2011, they are no longer available on-line.]
- Spring 2006 Videos on YouTube for Physics C10/LS C70V lectures by Richard Muller.
- Interview with Richard A. Muller: Physics for Future Presidents.
- Official home page for Physics 10/LS C70V.
- Muller's (old) home page for Physics 10/LS C70V.
- The textbook for Physics 10/LS C70V: Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know by Richard A. Muller.
- The "popular" book: Physics for Future Presidents: The Science Behind the Headlines by Richard Muller, 2008.
- In 2008, Berkeley students selected Physics for Future Presidents as the best class on campus.
- The course description: The most interesting and important topics in physics, stressing conceptual understanding rather than math, with applications to current events. Topics covered may vary and may include energy and conservation, radioactivity, nuclear physics,

the Theory of Relativity, lasers, explosions, earthquakes, superconductors, and quantum physics.

- Berkeley's webcasts homepage where you can find more video and audio lectures.
- Berkeley's YouTube channel with more videos.

[Berkeley has added another version of the course which I have not had a chance to review: Fall 2011: Physics for Future Presidents with Steven Boggs.]

Please let me know what you think.

Share |

Tags: astrophysics, Berkeley, Bob Jacobsen, Descriptive Introduction to Physics, Education, Energy, Global Warming, Mplayer, nuclear power, Nukes, OCW, OER, on-line video, Online Courses, Physics, Physics for Future Presidents, President, quantum physics, relativity, Richard A. Muller, Roswell, Science, spy satellites, UFO, Video Courses, Walter Lewin

Posted in Education, Reviews, Science, Video Course Review | Print

Related Posts:

- **23 August 2011**: A Big Picture, Conceptual Introduction to Biology: EEB 122 (1 comment)
- **10 April 2019**: Robert Sapolsky's Edutaining "Human Behavioral Biology" (1 comment)
- **12 December 2012**: My Two Presentations at 2012 Buckminster Fuller Legacy Conference (2 comments)
- **15 April 2011**: Study Linear Algebra at MIT with Gilbert Strang (3 comments)
- **26 October 2010**: Buckminster Fuller and the Open Educational Resources Movement (25 comments)

Author: cjf

- Full Name: **CJ Fearnley**
- Web: http://www.CJFearnley.com

Recent Posts:

- **1 November 2020**: "Comprehensively Commanded Automation" (1 comment)
- **31 December 2019**: Addenda to My Second 2019 Conversation with Harold Channer (0 comments)
- **21 November 2019**: A Synopsis of "Operating Manual for Spaceship Earth" by Buckminster Fuller (0 comments)
- **20 August 2019**: Addenda to My First 2019 Conversation with Harold Channer (2 comments)
- **10 April 2019**: Robert Sapolsky's Edutaining "Human Behavioral Biology" (1 comment)

9 Responses to "The most important video course on-line: Physics C10/LS C70V at Berkeley"

1. **Dick Fischbeck** on 24 February 2011 at 10:52 pm

   Whoa. That's a lot to digest. Can I get back to you……..?!

   Reply

2. **cjf** on 25 February 2011 at 7:20 pm

Dick, no need to digest it all at once. But start watching either the Spring 2008 videos of Muller or the Spring 2010 videos of Jacobsen and let us know what you think of them. What I wrote is mainly to give details about why the course is so important and how I used the videos in the hopes that others will watch them.

Kirby, Muller himself (with two colleagues whose names were inaudible) measured the velocity of Earth with respect to the cosmic microwave background radiation as about 1 million miles per hour. Most of the speed is due to the speed of the Milky Way galaxy. Muller discusses the issue at about 30 minutes and 30 seconds into the Thu 5/1 video from Spring 2008 webcasts. At about 21 and a half minutes into the Tue 5/6 video, Muller acknowledges that the work was done with colleagues. There is a discussion of the issue in Wikipedia's article on the Milky Way.

Reply

3. **cjf** on 26 February 2011 at 3:29 pm

There are also Fall 2010 videos with Bob Jacobsen but a couple of minutes are edited out due to mic problems in one video.

Reply

4. **cjf** on 2 March 2011 at 11:58 am

I started an OpenStudy study group for Physics 10 / LS C70V on OpenStudy (link searches for the study group).

If you want to discuss the course there, we can.

Reply

5. **cjf** on 3 July 2011 at 5:43 pm

Berkeley restructured their webcasts site a few days ago and my links into their site no longer work. I submitted a help request. Until I see how to redo the links, let me know if you need help finding a video set to watch.

Reply

6. **cjf** on 3 July 2011 at 6:37 pm

With the new Berkeley structure, it could be that Spring 2010 videos with Bob Jacobsen and Richard Muller (it is a team taught course) may be more complete.

Reply

7. **cjf** on 4 December 2011 at 8:55 pm

The Fall 2011 version of Physics C10/LS C70V Physics for Future Presidents with a new instructor Steven Boggs is available as a playlist from Berkeley's YouTube channel. There are 26 videos in the playlist (the last one was published on Dec 1),

so I think the course is complete. Unfortunately, I don't have time to check it out. Let me know if Boggs is good.

Reply

8. **cjf** on 4 December 2011 at 8:55 pm

The Fall 2011 version of Physics C10/LS C70V Physics for Future Presidents with a new instructor Steven Boggs is available as a playlist from Berkeley's YouTube channel. There are 26 videos in the playlist (the last one was published on Dec 1), so I think the course is complete. Unfortunately, I don't have time to check it out. Let me know if Boggs is good.

Reply

9. **K. Foster** on 4 August 2012 at 6:15 pm

I watched the Fall 2011 version of Physics C10 with Steven Boggs. To me his lectures were better organized than Mueller's. He uses a lot of demos as he explains the major concepts of physics. He does not use Mueller's book. Instead he uses the textbook "How Things Work" by Louis Bloomfield. You can purchase older editions of this book on amazon.com; I think it is an excellent book for learning the concepts of physics and how those concepts appear in everyday life.

Reply

10.