

## Cellular Solids on OCW



A model of an elephant's skull made with a 3-D printer by students in Professor Lorna Gibson's *3.054 Cellular Solids: Structure, Properties and Applications*.

### Solid, Cellular, and Surrounding Us

Pop quiz!

1. What does a polystyrene coffee cup have in common with a slice of bread?
2. How is a woodpecker skull like a iris leaf?
3. How is a porcupine quill like a milkweed stem?\*

On the face of it, these questions might seem like set-up lines for jokes, but they evoke serious science for anyone taking *3.054 Cellular Solids: Structure, Properties and Applications*, a course recently published on OCW with lecture notes, lecture slides, and more.

The course investigates porous cellular materials, which occur abundantly in nature and have synthetic counterparts with myriad applications in engineering. Having the structures of honeycombs and foams, the materials range over an astonishing variety of things, from wood, bone, and leaves to the padding in football helmets and the scaffolds used in tissue engineering.

The course is taught by [Professor Lorna Gibson](#), who was recently named a [MacVicar fellow](#) for her distinguished ability as a teacher. She places special emphasis on student projects, where students can apply what they have learned to create models of different kinds of materials. Her students see at firsthand what gives these materials their characteristic properties: their ability to undergo large strains, their light weight, their flexibility, their ability to provide thermal insulation, their large surface area. The students also discover under what conditions the materials fail or break, what purpose suits the use of one material over another, and how synthetic materials can be refined for superior performance.

So, as Professor Gibson observes on her [This Course at MIT](#) page, students learn both how the natural

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Erik, we hope you learned something new or refreshed your memory on a topic you've previously studied.

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world can be seen through the eyes of an engineer and how engineers can design materials inspired by the natural world.

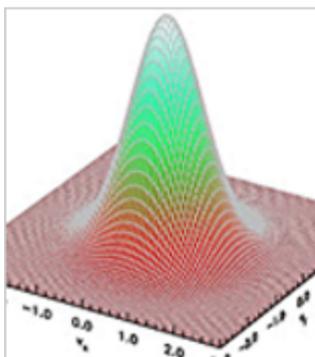
\*Quiz answers: 1. Both are foams. 2. Both are sandwich structures. 3. Both have a cylindrical shell and compliant core.



## New Courses



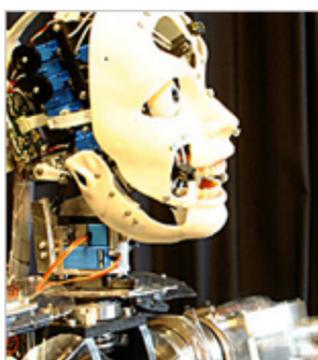
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## OCW Educator



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**Delve into the minds of MIT professors.**

**>Explore OCW Educator**



Graduate student, Lyubo Panchev, gives a lecture in the Fall 2014 Kan seminar. (Photo courtesy of MIT OpenCourseWare.)

### **Mathematics as Literature**

Normally when you think of a literature seminar, you think of a bunch of students sitting around a table talking about Kafka or George Eliot.

OCW has just published a literature seminar of a different stripe—in mathematics. The course is [18.915 Graduate Topology Seminar: Kan Seminar](#). It is named after its founder, [Daniel Kan](#), an MIT Professor known for his unconventional, conversational style of teaching. Lectures simply did not suit him. He developed an alternative style of instruction more reminiscent of the humanities than the traditional chalkboard session in mathematics. Professor Kan passed away in 2013, but his legacy has been carried on at MIT, most recently by [Professor Haynes Miller](#), who led the published version.

The course serves as a sequel to a first year graduate course in algebraic topology. It introduces graduate students and occasional undergraduates to a broad range of more advanced algebraic topology by requiring them to read some of the classic papers in the field. The idea is “to push students through the transition from someone who takes courses to someone who thinks more actively about mathematics,” as 18.915 alumnus (and Kan PhD student) Philip Hirschhorn puts it.

It’s a process: Students give practice talks to their classmates (no instructor present). These are typically “fractious,” full of interruptions, questions, and criticism. After that, it’s on to formal presentations, with the instructor attending and attentive. In his office after delivery, Professor Miller then “debriefs” students individually on the effectiveness of their presentations and on the mathematics involved.

According to Professor Miller, a second course objective is to help students learn “to scan an article quickly, to glean the essential points and relate them to the rest of their evolving intellectual infrastructures, and to express this understanding.” So seminar participants must write “reading responses” to all of the papers they are not presenting. Professor Miller responds to the responses. The course site has a [full list of readings](#) and some [sample student reading responses](#), along with Professor Miller’s replies.

There must be something contagious about this approach to teaching mathematics, because the OCW site has [links to Kan seminars taught at other](#)

[institutions](#). As Professor Miller sees it, instructors shouldn't be put off by the list of long and difficult papers that have been used in the course. "You're not there to teach the material to the students; you're there to help students learn the material."

18.915 is second project-based course by Professor Miller published as part of [OCW's Educator initiative](#). The first was [18.821 Project Laboratory in Mathematics](#), in which students acquire a taste of what it's like to do mathematical research.

>See more [This Course at MIT pages](#)

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### Highlights for High School



A photo of Grace Hopper at the UNIVAC keyboard in 1960. Image courtesy of the [Smithsonian Institution](#). Licence: CC BY.

You've probably heard of Marie Curie, but have you heard of Grace Hopper? Not only was she one of the earliest computer programmers, but she also was a Rear Admiral in the United States Navy! Have you ever had to debug a computer program you've written? Well, Grace Hopper helped popularize the term "debugging" when an actual bug, a moth, got trapped in some equipment and caused technical problems.

As a child she was quite curious, and one day her mother came home to find Grace, then seven years old, disassembling her alarm clock to see how it worked. Her curiosity paid off; she earned her bachelor's degree in physics and mathematics from Vassar College in 1928 and went on to get both her Master's and her Ph.D. at Yale.

During WWII, she became one of the first programmers of the Mark I computer. Also, Grace invented the first compiler for a computer programming language, and contributed to the creation of one of the first programming languages, COBOL.

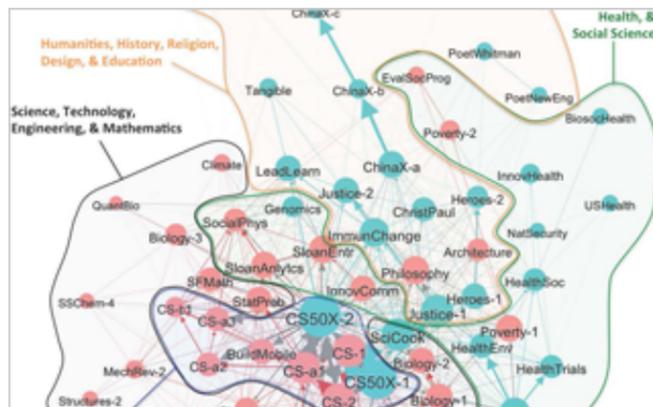
Grace Hopper is remembered for her decade's long career in the Navy and her accomplishments in the world of computer science. She has a naval ship, the USS Hopper named after her, one of the few vessels named after a woman. In addition, there are a plethora of awards and structures named after this incredible woman, everything from a bridge over a

creek to a group of women at Microsoft who call themselves the “Hoppers.”

We hope this has piqued your interest. Check out the [computer science materials](#) at Highlights for High School!

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## MITx News



Four curricular content areas visualized across the full participation network for HarvardX (blue nodes) and MITx (red nodes).

### What Two Years of MOOCs Can Tell Us

Researchers at Harvard and MIT have just published a study of user behavior in 68 MOOCs offered by [HarvardX](#) and [MITx](#) on the edX platform from Fall 2012 through Summer 2014.

*[HarvardX and MITx: Two Years of Open Online Courses](#)* runs to 37 pages and analyzes massive amounts of data: 1.7 million participants, 10 million participant hours, and 1.1 billion participant logged events. But don't be intimidated. The study opens with a convenient executive summary, and all terms (like *participant* and *logged event*) are clearly defined in a brief glossary.

Harvard's [Andrew Ho](#) and MIT's [Isaac Chuang](#) are the lead authors of the report, which identifies trends and patterns in demographics and outcomes, reveals the top five courses in a variety of categories (like female participation and participation by people without Bachelor's degrees), and visualizes the emerging MOOC curriculum by participation in multiple courses in sequence.

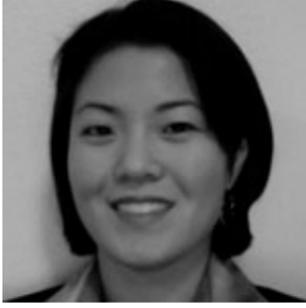
The report reveals a dynamic and subtly changing situation, in which the numbers both of total participants and of unique participants are steadily rising, and the make-up of the population is becoming slightly older and more female.

Perhaps the most interesting finding from surveys of MOOC participants is that as many as 39% are teachers, and some 21% of them are taking courses in their areas of expertise, suggesting that there be a substantial multiplier effect in classrooms around the world.

>[Explore MITx on edX courses](#)

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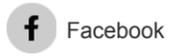


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