

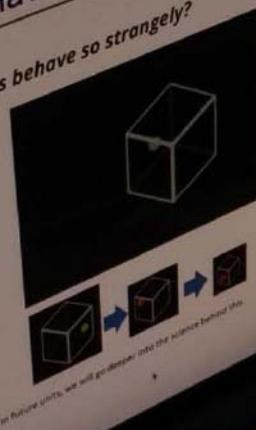
## Size-Dependent Behavior

The question is...

Why do nanomaterials behave so strangely?

The answer:

- Electrons are squeezed into a space smaller than they prefer
- a phenomena known as quantum confinement



In future units, we will go deeper into the science behind this.

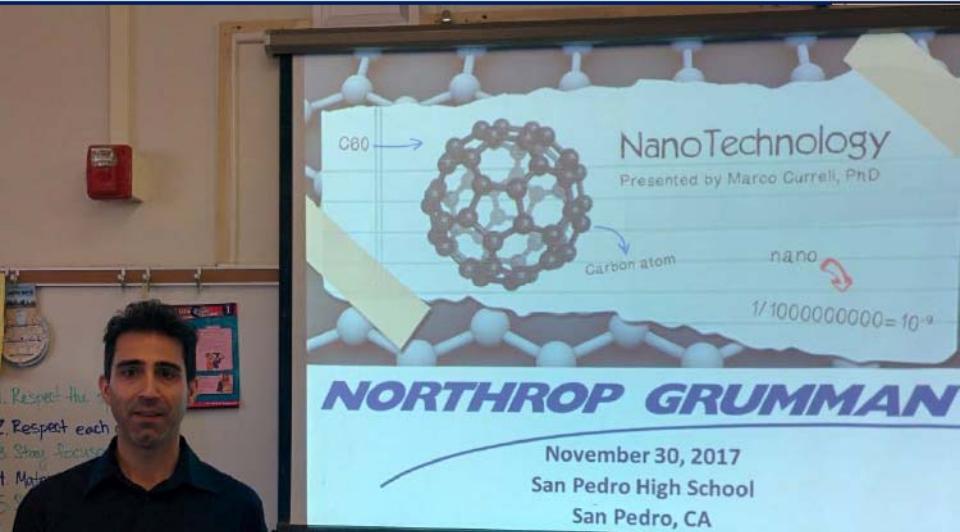
OMNI  
NANO  
Presentation by  
*Dr. Marco Curreli*

SDNI-NNCI Annual Educational Symposium 2020  
2020 - Copyrights Omni Nano.

Permission granted to local schools to use without modification.

# A Digital Curriculum for Global Nanotechnology Education

# What does Omni Nano do?



We teach students the science skills they need for the jobs of the future.



# About us

- Omni Nano is in the education technology (“**EdTech**”) space.
- Not-for-profit, 501(c)(3) organization.
- Developing **digital educational resources** to teach **nanotechnology** at the high school and college levels.



Today's students

Omni  
Nano's  
Programs &  
Resources



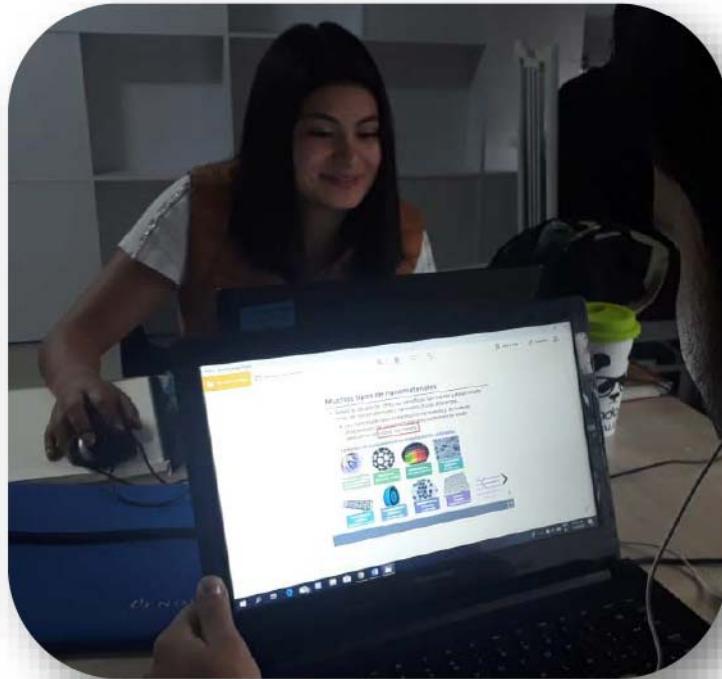
Tomorrow's STEM workforce

A photograph of a smartphone displaying a mobile application. The app interface includes a header with the Schoology logo, a title "Module #39(b) - Imaging at the nanoscale", and several sections of text and images related to nanotechnology, such as "Ultra-high-resolution probe tips" and "Overview". The bottom of the screen shows standard smartphone navigation icons.

Today's students can  
become tomorrow's STEM  
workforce with Omni Nano's  
programs and resources.

# Mission and vision

**OUR MISSION** is to inspire today's students to become tomorrow's scientists, engineers, and entrepreneurs.



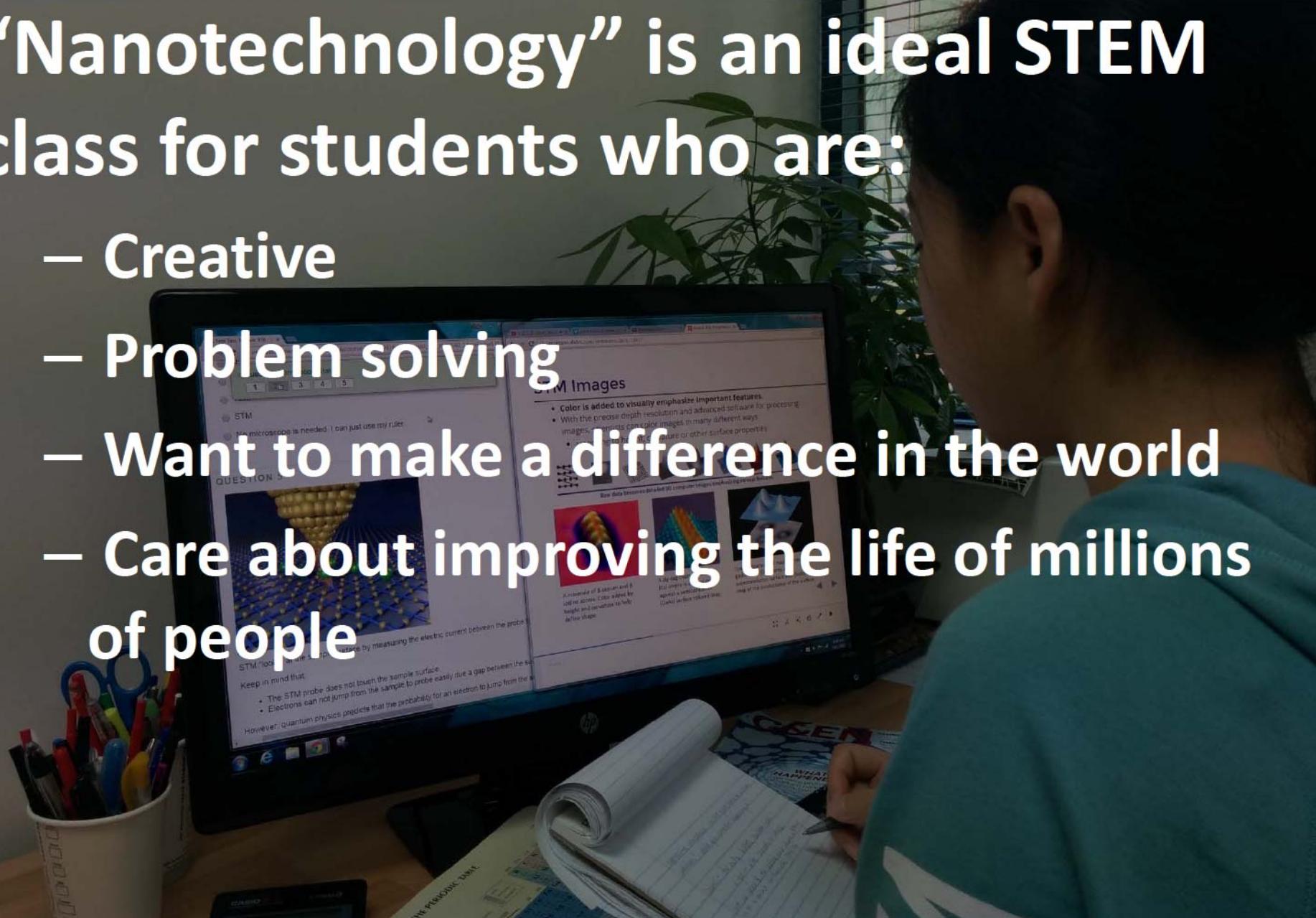
**WE ENVISION** giving every student in the world the opportunity to learn nanotechnology with a high-quality, curriculum.



# Ideal STEM class

“Nanotechnology” is an ideal STEM class for students who are:

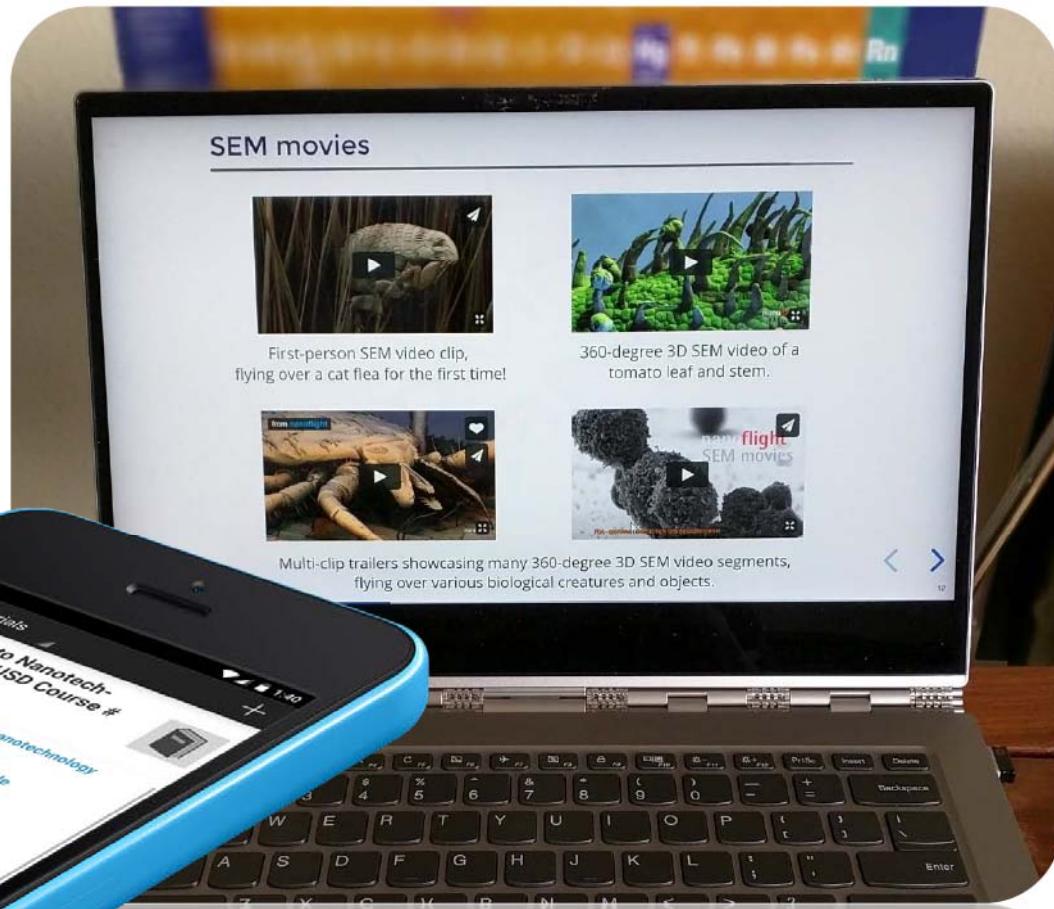
- Creative
- Problem solving
- Want to make a difference in the world
- Care about improving the life of millions of people



# Curricula for teachers & students

## NEEDED A NANOTECHNOLOGY CURRICULUM THAT IS:

- Comprehensive
- Student-centered
- Teacher-approved
- Fully digital
- Mobile-friendly
- User-friendly



*Designed for worldwide  
distribution*

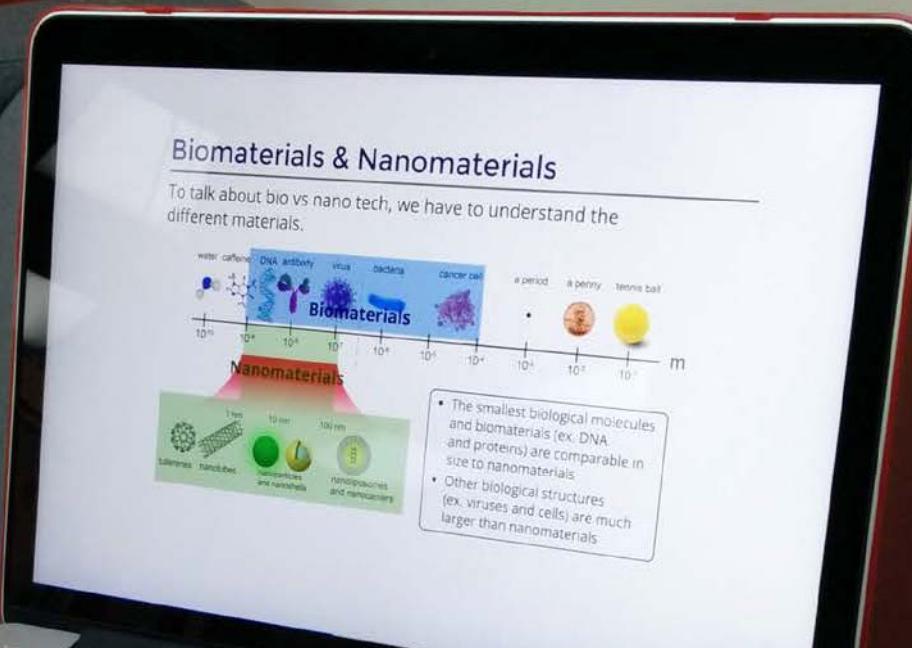
# Versatile uses

- A digital curriculum can be used in:
  - In traditional classrooms
  - Hybrid education
  - Virtual classrooms
  - Self-learning mode
- Mobile-friendly content:
  - Students can learn at their own pace, anytime, anywhere.

# Preview of the digital textbook?

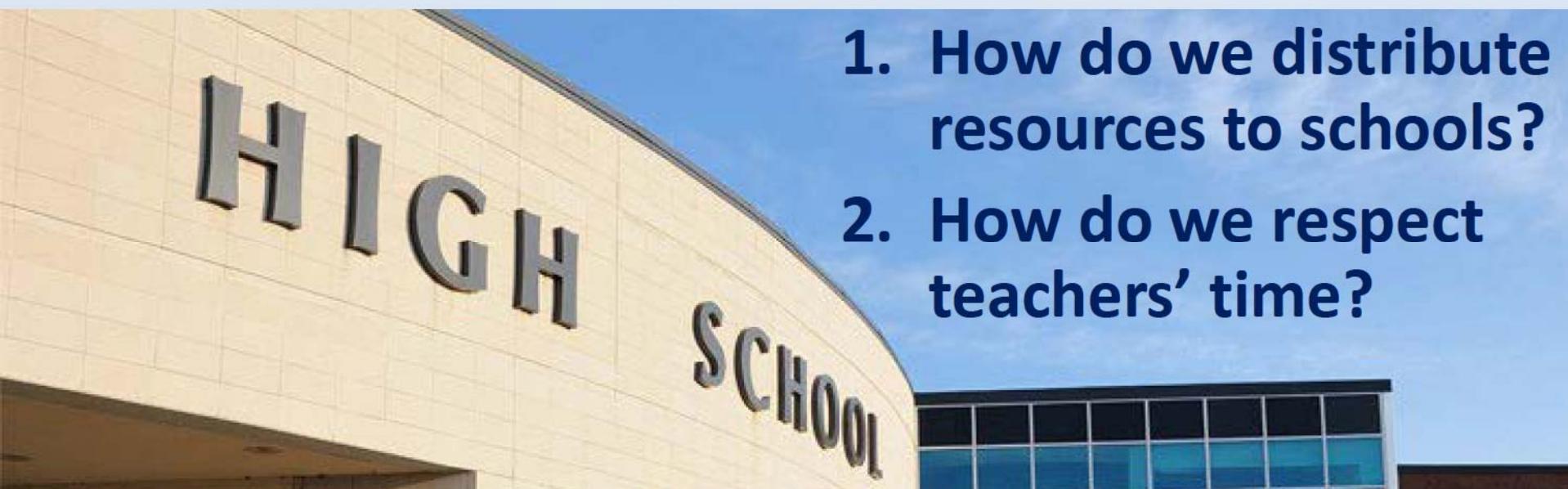
Email me and I'll send  
you a link to self-enroll

[info@omninano.org](mailto:info@omninano.org)



# Questions that came up

1. How do we distribute resources to schools?
2. How do we respect teachers' time?



Climate change could push bumblebees to extinction

The future is looking over more time for bees

By Helen James | Updated: 10/10/2019 10:57 AM

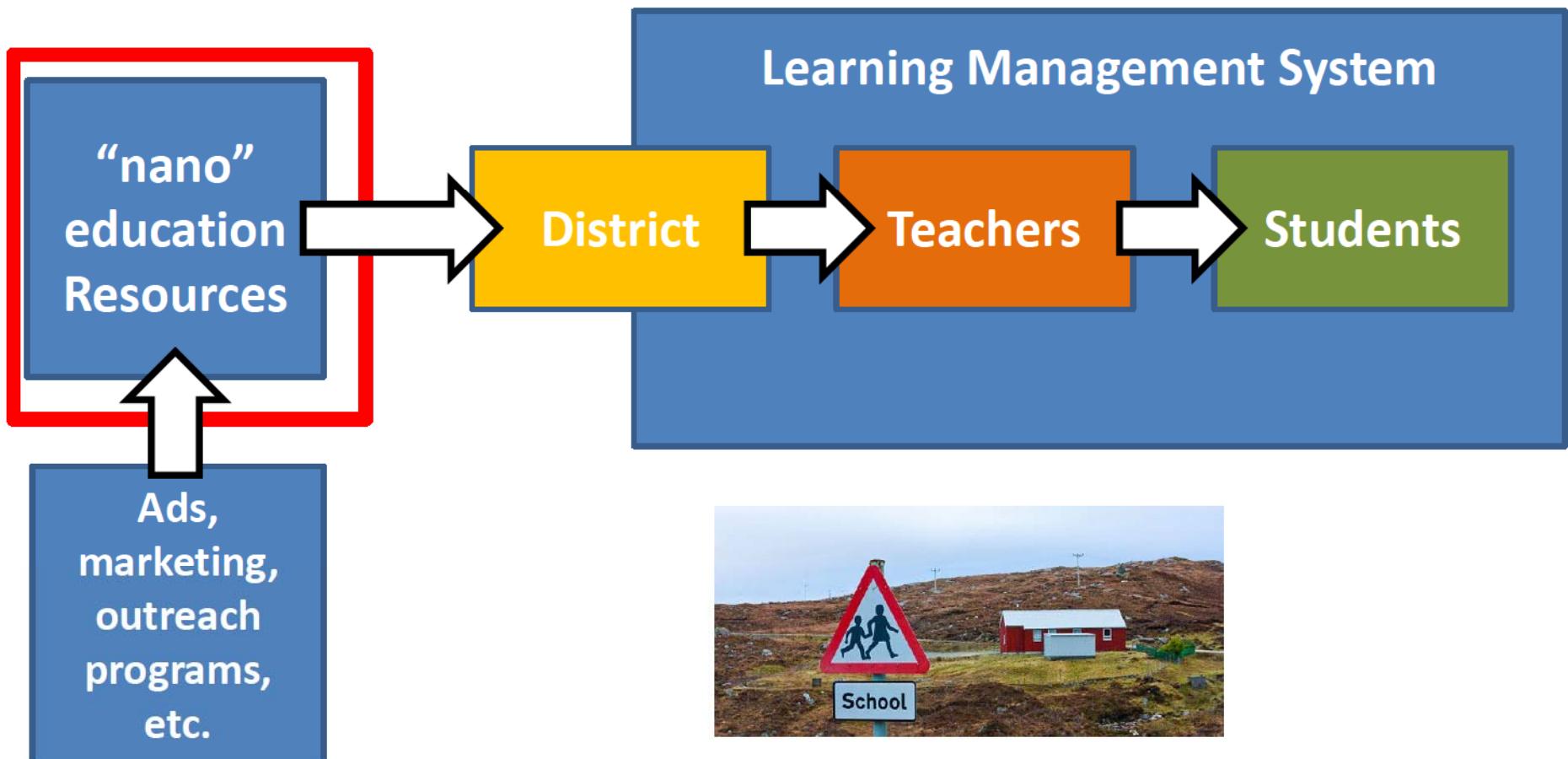
Facebook Twitter Email



# Distribution

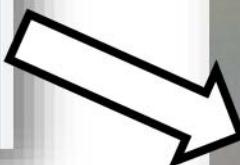
# Solving the distribution problem

- How can we have “nano” activities or classes in 10,000 schools?

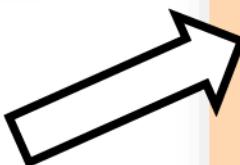


# Google Ads & landing page

A smartphone screen showing a Google search result for "Free Online STEM Activity | LMS compatible | All Digital, Mobile Friendly". The ad is from [www.omninanano.org/STEM/Activity](http://www.omninanano.org/STEM/Activity). The text in the ad reads: "Free, fun, and inspiring STEM activity for high school students. Discover the tiny world of nanotechnology while having fun! Donate Online. Become A Volunteer. Sign Up For Newsletters. Need a customized image? Types: Carb...". Below the ad are links to "About our organization" and "About Omni Nano".



The landing page title is "STEM Activity How Mark Became a Nanotechnologist". It features a large image of a person looking at a computer screen displaying an STM (Scanning Tunneling Microscopy) image of a surface. To the right of the image is a sidebar titled "STM Images" with text and small images illustrating the technology.



A Google search results page for the query "stem courses online nanotechnology". The top result is a link to a website with the following snippet: "International Students: Extend Your HB1 Visa With STEM-certified Program. New Jan. Intake. Paid Internship Opportunities With Established Local & National Companies. Emerge Better. AACSB Accredited. SAS Approved. Curriculum · Business Analytics Master · GMAT waivers available · Expert Faculty".

Ad · [www.omninanano.org/](http://www.omninanano.org/)

## Nanotechnology is the Future - A Growing STEM Field

What is nanotechnology? How will it affect your life in the near future? Find out here. Journey into Nanotech with our collection of quizzes, free courses, or TED talks. Learn About a New Career. Test your Knowledge. Learn STEM Today. Watch Videos.

[About Us](#) · [Past Testimonials](#) · [Workshops](#) · [Course](#)

Students and teachers love it!



"Now, we're looking into introducing a year-long course in nanotechnology!"

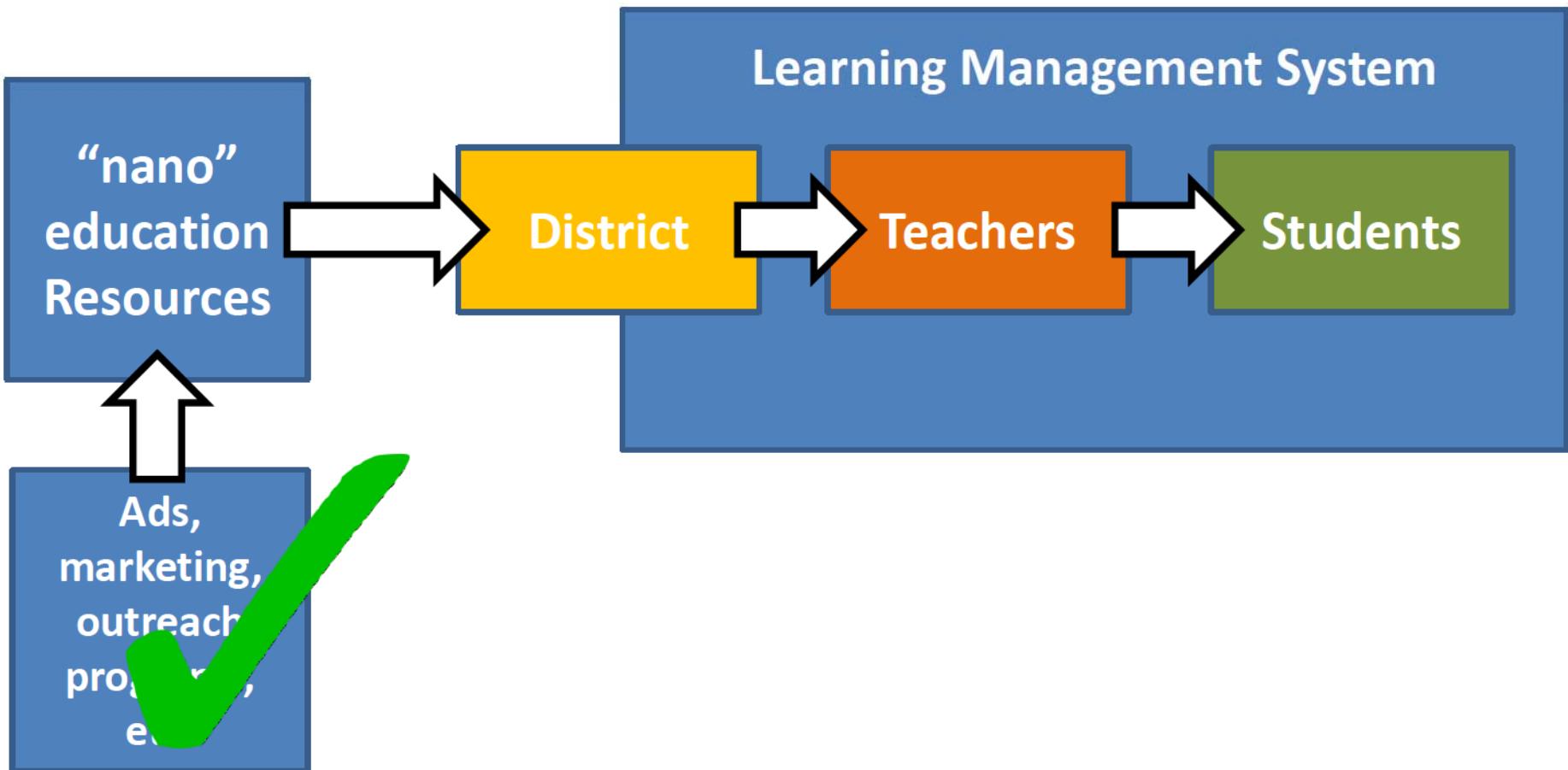
**Request your course package here:**

You will receive an email with a link to download the course package, as Thin Common Cartridge, and import instruction.

Full name\*

Email\*

# Solving the distribution problem



# Request form

## Request your course package here:

You will receive an email with a link to download the course package, as *Thin Common Cartridge*, and import instruction.

Full name\*

Email\*

".edu" or "business" emails only

Alternative email\*

Do you have a "gmail" or a "yahoo" or another address?

What subject do you mainly teach and where?\*

Do you teach chemistry or biology or...? -- What is the name of your institution?

Anything you want to tell us?

protected by reCAPTCHA

[Privacy](#) · [Terms](#)



**Request your course package (check your Spam Folder!)**

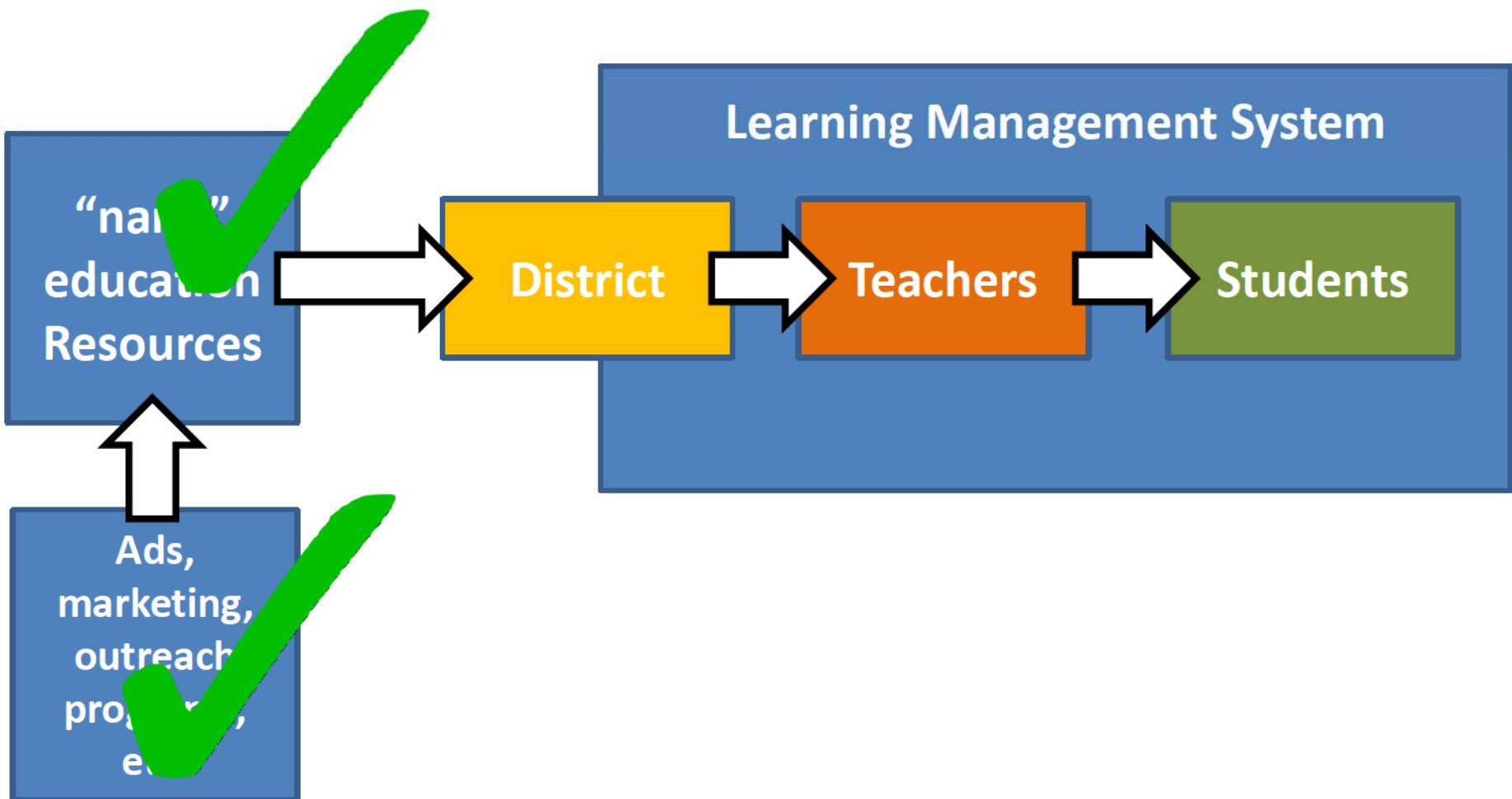
# Course package – LMS compatible

My Drive > STEM-Activity-Package---Published ▾

Name ↑

-  1) START HERE (Includes Course Package LTI Accreditation) 
-  2a) Canvas-Import-Instructions---STEM-Activity-01---How-Mark-Became-a-Nanotechnologist.pdf 
-  2b) Canvas-Optimized---STEM-Activity---How-Mark-Became-a-Nanotechnologist-003-092020 imscc 
-  3a) Schoology-Import-Instructions---STEM-Activity-01---How-Mark-Became-a-Nanotechnologist.pdf 
-  3b) Other-LMSS---STEM-Activity---How-Mark-Became-a-Nanotechnologist-003-092020 imscc 

# Solving the distribution problem



# Import into the LMS

- Typically handled by the District LMS specialist

The screenshot shows the 'Import Content' dialog box. The process is guided by red arrows and numbers:

- (4) Content Type: Common Cartridge 1.x Package
- (5) Source: Choose File (No file chosen)
- (6) Default Question bank: -- Create new question bank --
- (7) Content: All content (radio button selected)
- (8) Options:
  - Overwrite assessment content with matching IDs
  - Adjust events and due dates
- (9) Import button

Below the dialog box, the 'Current Jobs' section shows:

Common Cartridge	...-Nanotech_ThinCC imscc	Aug 28, 2019 at 7:07pm	Completed	1 issues
------------------	---------------------------	------------------------	-----------	----------

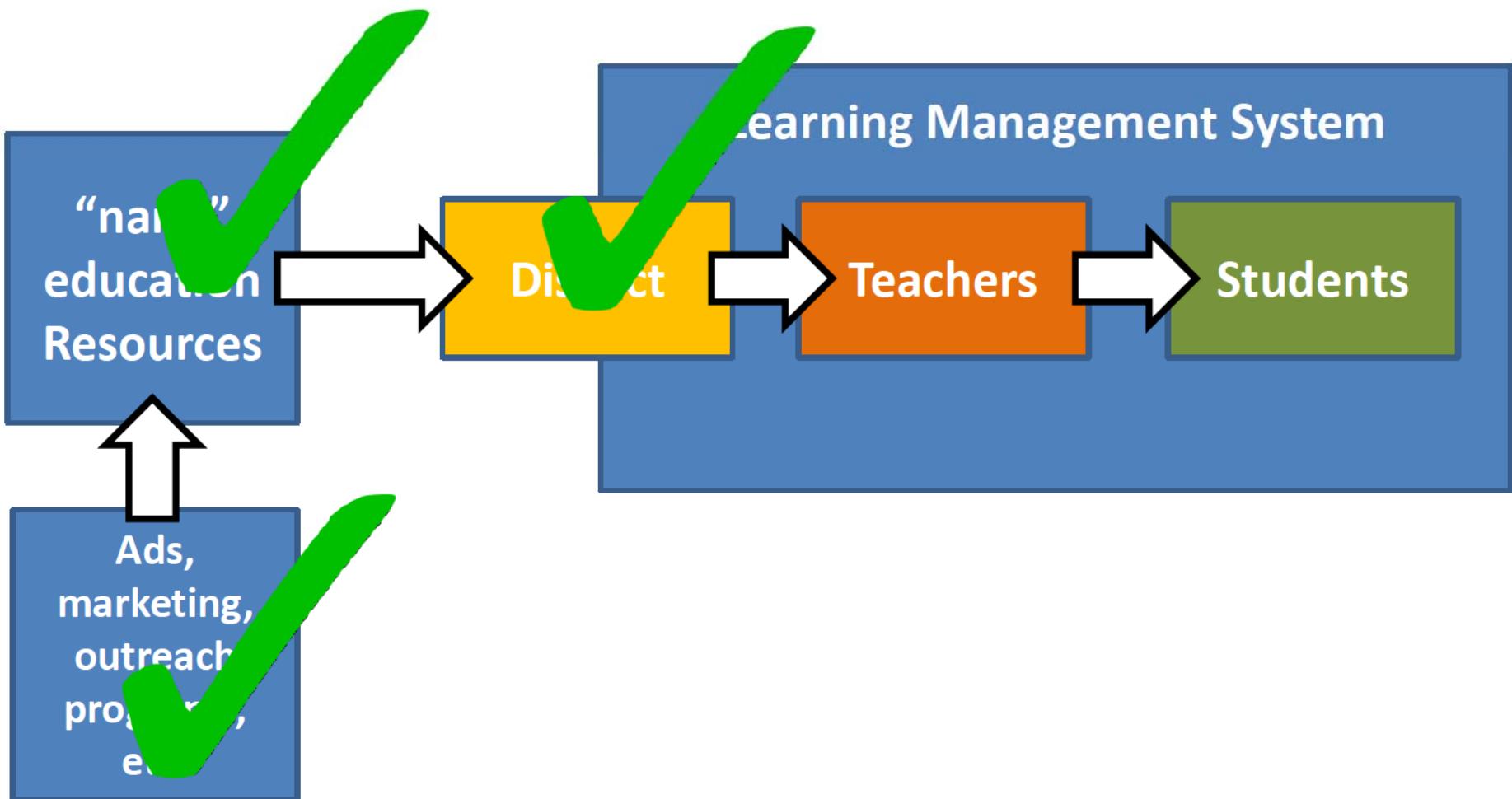
A red arrow labeled (9) points from the 'Completed' status back to the 'Import' button.

# LAUSD & Schoology

---

<https://lausd.wistia.com/medias/tgiasfvvab>

# Solving the distribution problem



# Imported & ready



Dashboard

Courses

Calendar

Inbox

Commons

Help

Dashboard

## Introduction to Nanotechnology

Introduction to Nanotechnology  
Torrance HS Denisiu 19-20



## Introduction to Nanotechnology

Introduction to Nanotechnology  
Valencia HS Nanochemistry 1...



纳米技术基础 (PREVIEW: Introduction to Nanotechnology)  
Chinese PREVIEW



How-Mark-Became-a-Nanotechnologist...  
Nano-Activity-01

## Introduction to Nanotechnology

PREVIEW: Introduction to Nanotechnology  
OmniCoLab PREVIEW

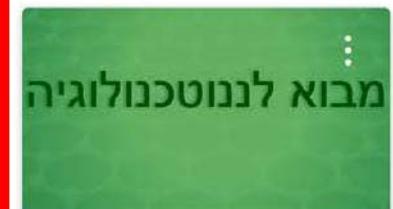


PREVIEW: Introduction to Nanotechnology  
Nazarbayev Uralsk PREVIEW



## Introduction to Nanotechnology

Granada Hills Charter  
GHC-Nano-01



Introduction to Nanotechnology  
Nano-01 - ISRAEL SCI-TECH

## Introduction to Nanotechnology

Introduction to Nanotechnology --...  
MOOC-001

## 나노 기술 소개

Introduction to Nanotechnology ...  
MOOC-Korean

## Introduction to Nanotechnology

Nano @ BASE 11  
Nano@Base11

## Introducción a la nanotecnología

Nanotecnología MOOC en español  
MOOC-002



# Instructions for teachers

## ⋮ ▾ Instructor Resources

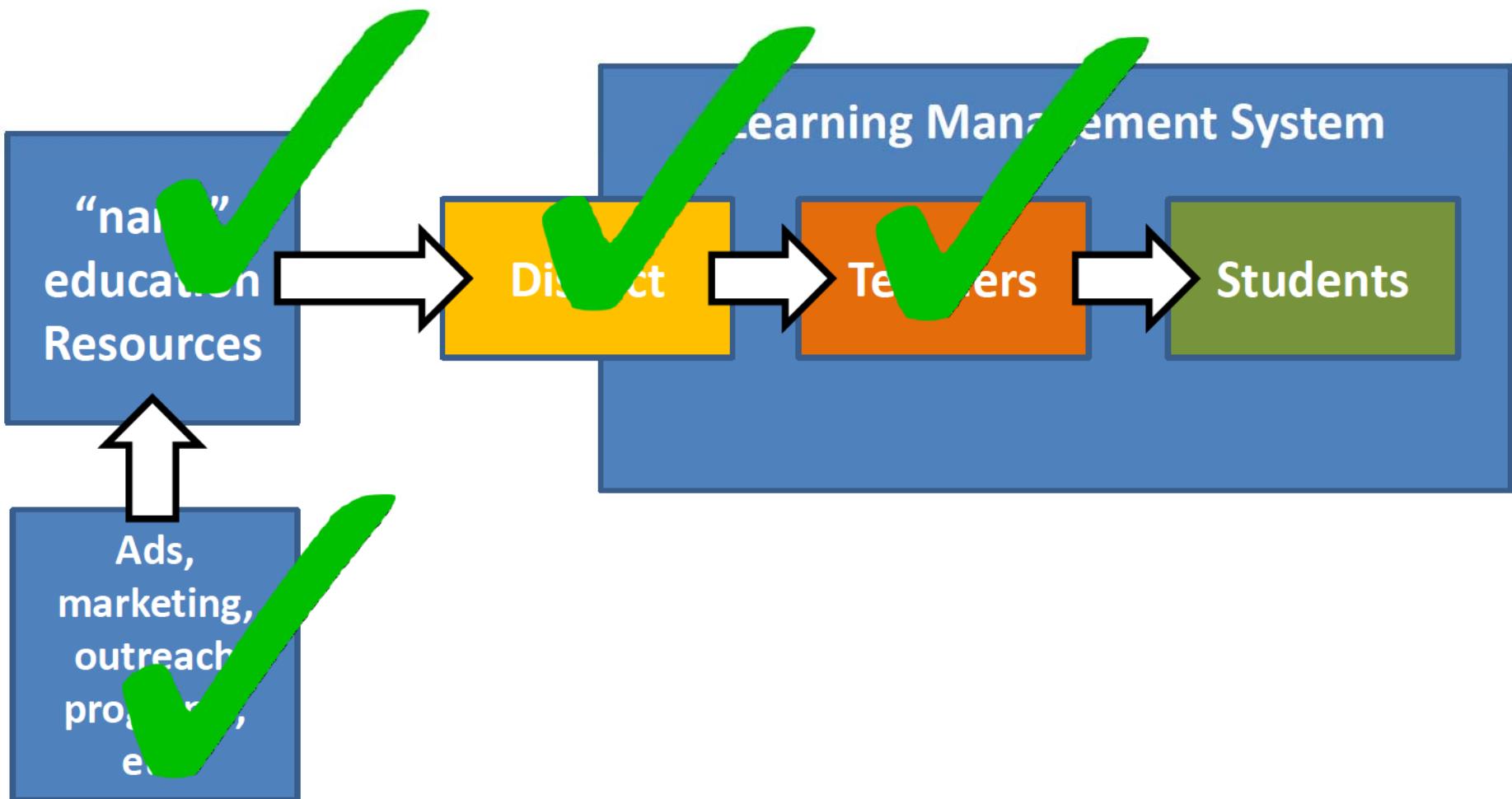
- ⋮  i) NGSS - Next Generation Science Standards information
- ⋮  ii) Notes for instructors using Canvas
- ⋮  iii) Notes for instructors using Schoology
- ⋮  iv) Notes for instructors using other LMSs
- ⋮  v) Suggested # of points per activity
- ⋮  vi) Other notes

# All students are enrolled

Gradebook ▾ View ▾ Actions ▾

Student Name	#11 - Assignment Out of 43	#12 - Assignment Out of 25	#13 - Assignment Out of 38	#14 - Assignment Out of 44	#15 - Assignment Out of 24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	-	-	-
[REDACTED]	43	25	38	44	-
[REDACTED]	43	25	38	44	-
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	38	44	24
[REDACTED]	43	-	-	-	-
[REDACTED]	43	25	27.33	-	-
[REDACTED]	43	25	38	44	24
[REDACTED]	43	25	33.33	-	-
[REDACTED]	43	25	38	44	-
[REDACTED]	43	25	38	44	24

# Solving the distribution problem



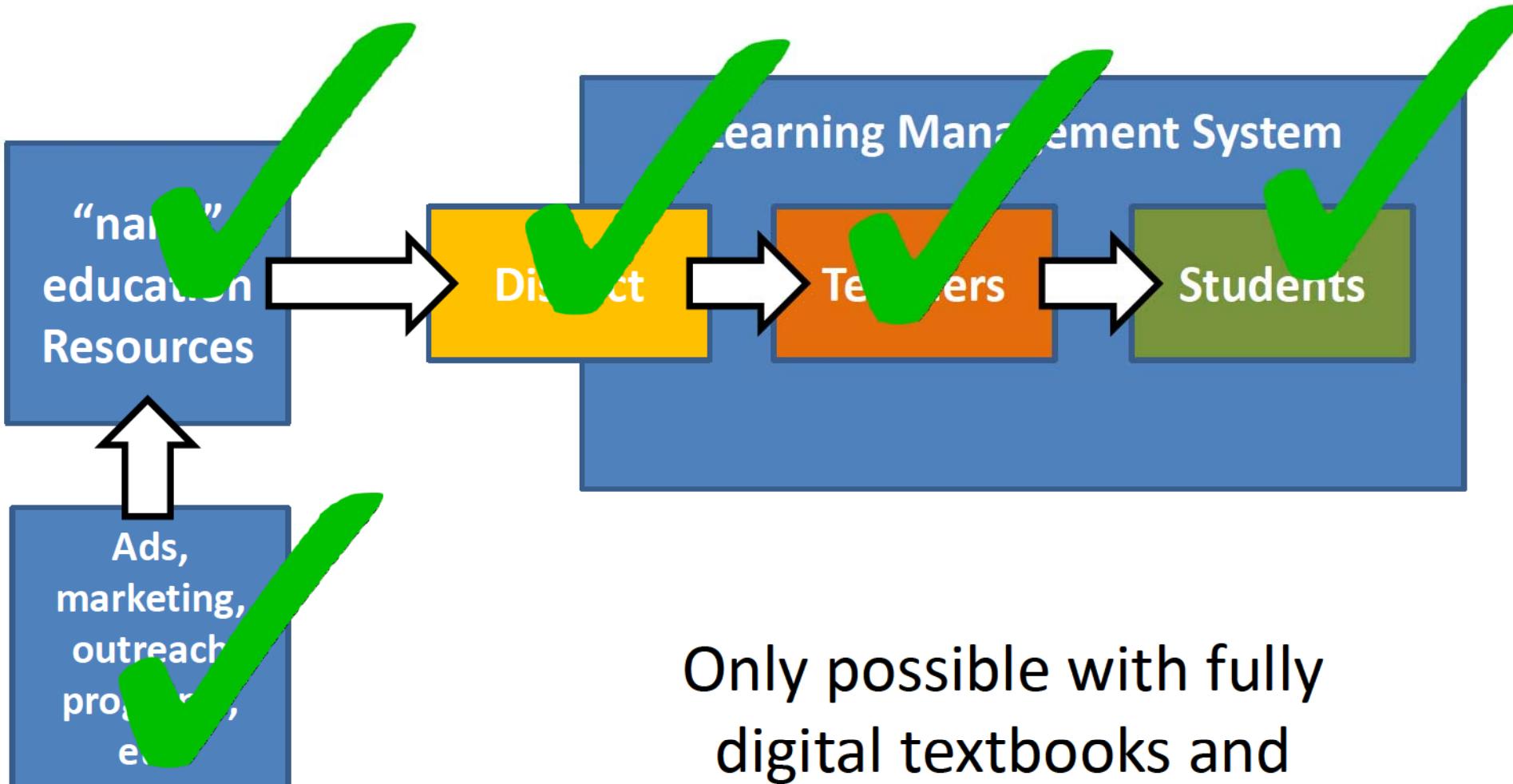
# Accessible to students

The screenshot shows a user interface for a learning management system. On the left is a dark sidebar with icons and labels: Account (Dashboard), Modules, Grades, Courses, Calendar, Inbox, and Help. The main area has tabs for Modules and Grades. The Modules tab is active, displaying a list of resources and activities. A red box highlights the 'Student Resources' section, which contains a link 'a) Student instructions'. Another red box highlights a section titled 'STEM Activities: How Mark Became a Nanotechnologist', which lists six numbered activities with icons and points: 1) Meet Mark! (16 pts), 2) What is nanotechnology? (35 pts), 3) Mark taking classes in a cleanroom (37 pts), 4) What is nanofabrication? (56 pts), 5) Nanotechnology is the future! (33 pts), and 6) Where can I study nanotechnology?

- ▼ Student Resources
- a) Student instructions

- ▼ STEM Activities: How Mark Became a Nanotechnologist
- 1) Meet Mark!  
16 pts
- 2) What is nanotechnology?  
35 pts
- 3) Mark taking classes in a cleanroom  
37 pts
- 4) What is nanofabrication?  
56 pts
- 5) Nanotechnology is the future!  
33 pts
- 6) Where can I study nanotechnology?

# Solving the distribution problem



Only possible with fully  
digital textbooks and  
curricula!

# **Some Requirements of Digital Textbooks**

# Requirements: “508” compliance



- **Accessibility requirements** for information and communication technology (ICT)
- Section **508** of the Rehabilitation Act
- Section 255 of the Communications Act.



# LAUSD students with disabilities

• **14%**

LAUSD students have a disability (or 85k/600k)

- Primary Disability Categories:

- Intellectual Disability (ID)
- Hard of Hearing (HH)
- Deafness (DEAF)
- Speech or Language Impairment (SLI)
- Visual Impairment (VI)
- Emotional Disturbance (ED)
- Orthopedic Impairment (OI)
- Other Health Impairment (OHI)
- Specific Learning Disability (SLD)
- Autism (AUT)
- Traumatic Brain Injury (TBI)



Need a “508”  
compliant course

# LACCD just lost a lawsuit

Los Angeles Community College District (LACCD)

- **Complaint filed by:** National Federation of the Blind and two students who are blind
- **Year:** March 3, 2107
- **Complaint:** Violation of the ADA and Section 508

## Federal Court Rules in Favor of Blind Students

August 21, 2019 | Source: National Federation of the Blind

The National Federation of the Blind, its California affiliate, and two blind students, Roy Payan and Portia Mason, have won their disability discrimination lawsuit against the Los Angeles Community College District (LACCD). The Federal District Court for the Central District of California Found that LACCD violated the students' rights under Title II of the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973 by, among other things, failing to provide them with accessible documents and course materials, failing to provide equal access to library resources...

# Ally accessibility report



Modules

Conferences

NetTutor

Canvas Tutorials

Chat

Office 365

Library Resources

Zoom

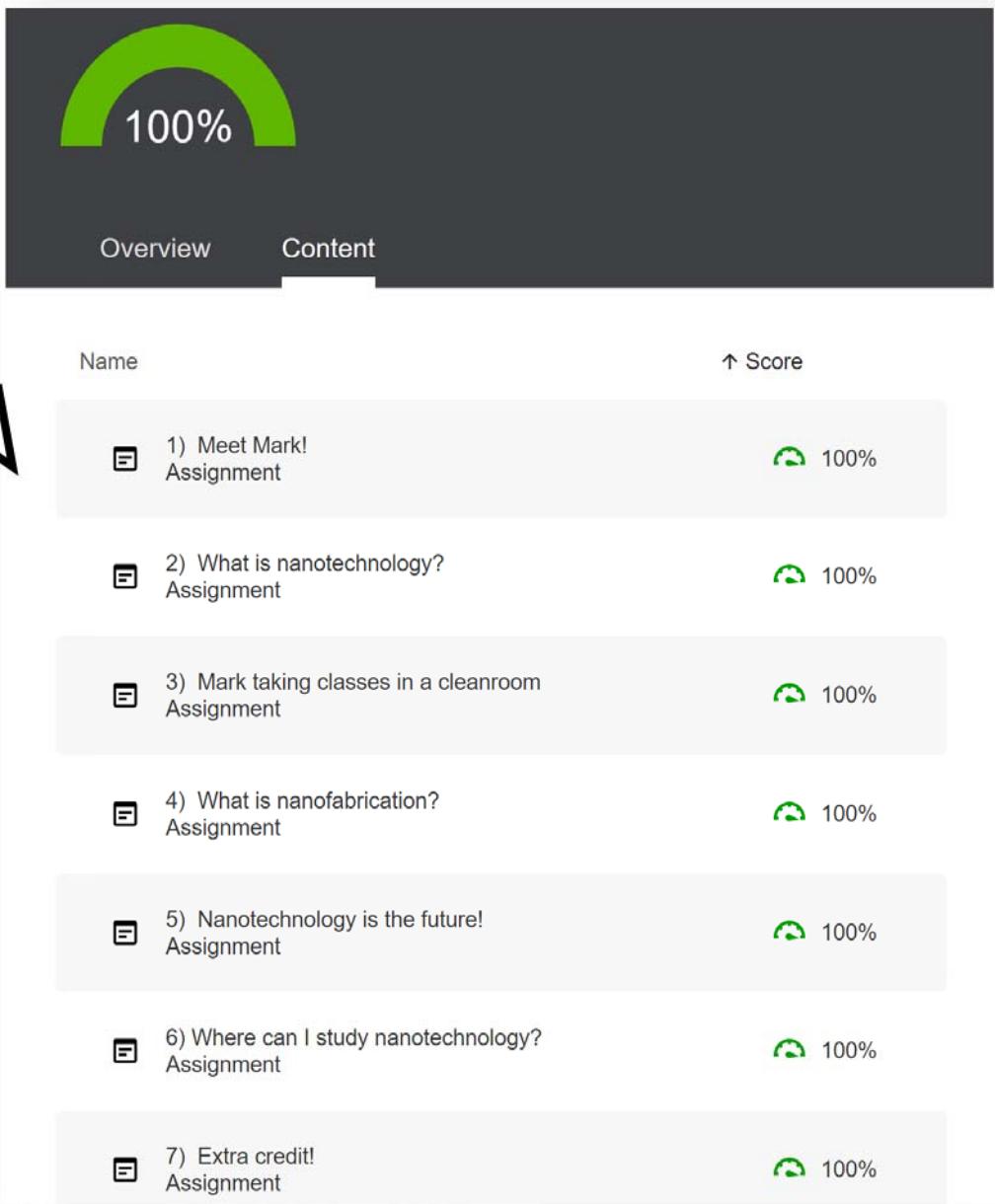
Ally Accessibility Report

Adjust-All HQ

Collaborations

Studio

Settings

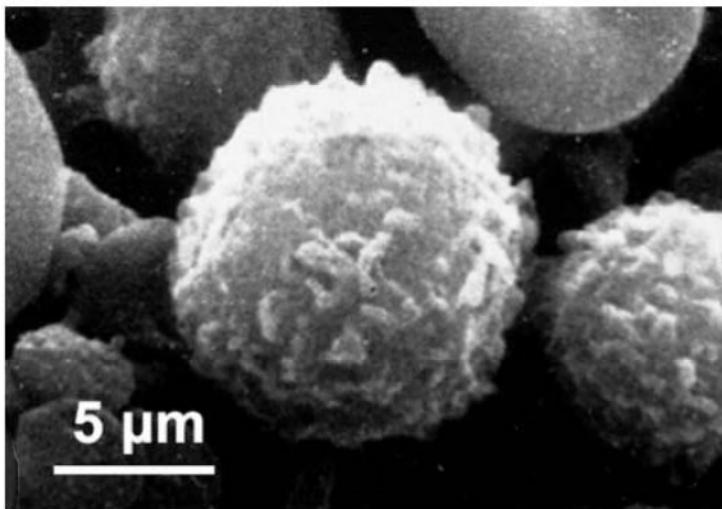


# How did we pass the accessibility check?

# “Alt text”

3) **Beyond the video** – The microscopy image below shows a human white blood cell. What is its approximate diameter?

- Hint: Use the scale bar at the bottom.



- 10-11 micrometers
- 7-8 micrometers
- 10-11 nanometers
- 4-5 micrometers
- 0.05 millimeters
- 50-100 nanometers

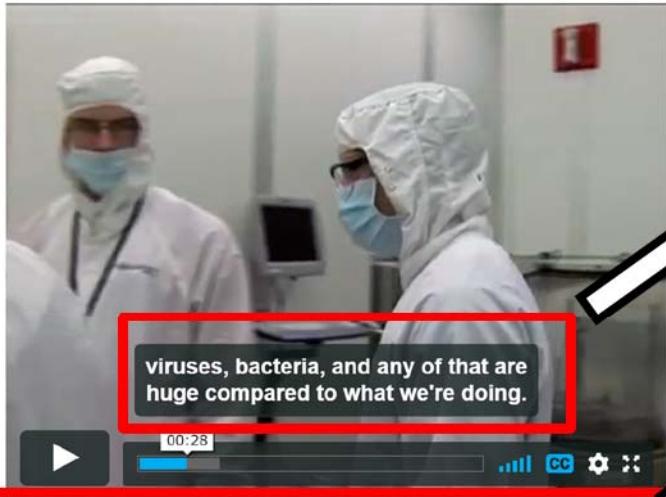
“alt text” describe images  
for students with visual  
impairments.

Type: MC  
Score: 3, Partial  
3) [HTML]<div style="font-size:1.5em; color:#1E1658;"><span style="color:#0080ff;"><em><strong>Beyond the video</strong></em></span> – The microscopy image below shows a human white blood cell. What is its approximate diameter? <span style="font-size:0.75em;"><ul><li><em><span style="text-decoration:underline;">Hint:</span></em> Use the scale bar at the bottom.</li></ul></span></div>[/HTML]  
@[Always] The scale bar reads 5 micrometers, and the white blood cell shown here appears to be roughly twice that of the scale bar. Thus, we can deduce that the diameter of this white blood cell is approximately 10-11 micrometers.  
[1]a. 10-11 micrometers  
b. 7-8 micrometers  
c. 10-11 nanometers  
d. 4-5 micrometers  
e. 0.05 millimeters  
f. 50-100 nanometers

Screen reader software  
reads HTML code

# Video caption and description

1. Which of the following statements about the video below seem correct? Select all that apply.



**Captions for students with hearing impairments.**

**Description for students with visual impairments.**

- The reason why Mark's class requires a bunny suit is to prevent people from introducing contaminants into the ultra-clean working environment of the Nanofabrication Lab.
- Mark and the other students get trained to operate the same type of equipment used in the semiconductor industry to make the electronics that power your smartphone.
- Fabricating nanoscale devices and systems requires an understanding of design, chemistry, physics, biology, and engineering. Nanotechnology is truly STEM!
- Nowadays, students like Mark might have multiple careers in very different fields. A strong background in nanotechnology prepares these students for rewarding professional careers.
- Learning nanofabrication gave Mark superpowers, similar to the superheroes in Marvel movies. Mark is now unstoppable.

# NGSS & other standars

## **STEM ACTIVITY** **“How Mark Became a Nanotechnologist”** **Next Generation Science Standards (NGSS)**

### **Grade Levels:**

- 9th - 12th (but also OK for grades 8-16)

### **Duration:**

1-2 class periods

### **Topic/Theme:**

This STEM activity introduces the subject of nanotechnology, a new field of science and engineering, through the story of a college student named **Mark**. This story shows that many students like him are willing to undergo rigorous training to acquire the skills needed to develop transformative technologies at high-tech companies. In fact, nanotechnology applications promise to find solutions to many real-world concerns affecting human lives and the environment at large – such as water purification, clean energy production, energy storage, effective medical treatments, accurate disease diagnostics, and safe food storage, just to name a few. By learning more about nanotechnology, today's high school students will become tomorrow's STEM workforce for the greater good of the world.

## NGSS Performance Expectations

### Glossary:

- PE = Performance Expectation
- SPE = Science and Engineering Practices
- DCI = Disciplinary Core Ideas
- CCC = CrossCutting Concepts

### **HS-PS2 Motion and Stability: Forces and Interactions**

#### **HS-PS2-6**

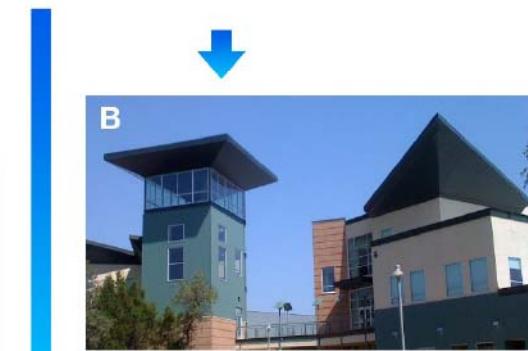
##### **HS-PS2-6 -- General Statement:**

- **PE:** Students who demonstrate understanding can communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
  - NGSS Document Link:  
[https://www.nextgenscience.org/sites/default/files/evidence\\_statement/black\\_white/HS-PS2-6%20Evidence%20Statements%20June%202015%20asterisks\\_0.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-6%20Evidence%20Statements%20June%202015%20asterisks_0.pdf)

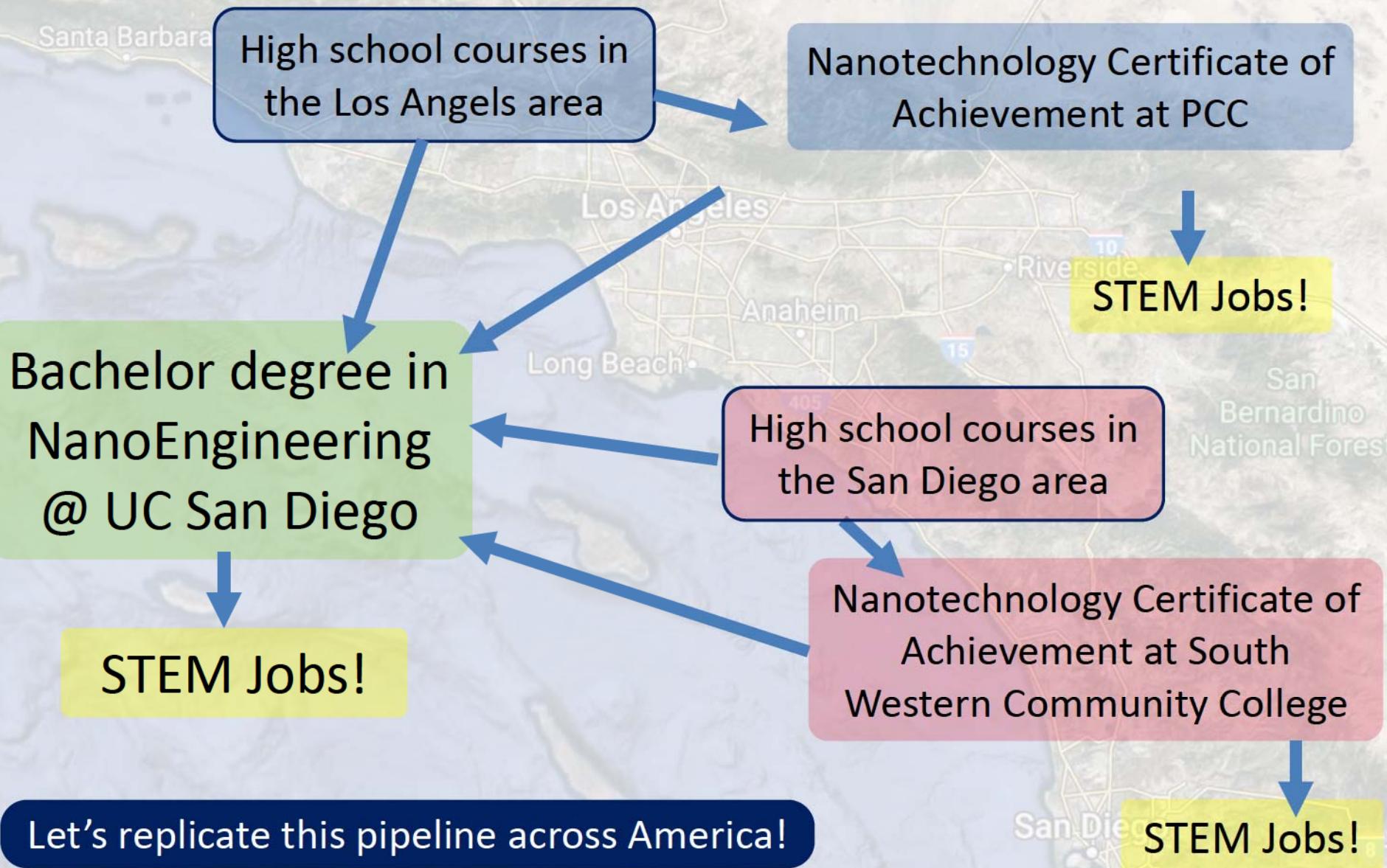
##### **HS-PS2-6 -- Specific to this Activity:**

- **PE:** Students who demonstrate understanding can communicate the development of this new field of science and engineering, nanotechnology, wherein a unique arrangement of atoms constrained to nanoscale dimensions results in novel material properties, which can be utilized to design and manufacture new technological devices and systems.
- **SPE:** To show proficiency, students must be able to communicate scientific and technical information about novel materials and structures with nanoscale dimensions. These materials/structures, even if have the same formula/composition, behave completely differently than bulk forms. This discovery brought on changes and enabled this new field of science and engineering known as nanotechnology, which ultimately is leading towards new products, processes, and industries. Students must also be able to communicate scientific and technical information about how nanotechnology is expected to bloom in a new Industrial Revolution by changing the way objects and materials are manufactured, resulting in significant social and economic changes.
- **DCI:** The structure and dimension of materials are important for their properties and function. In fact, (PS1.A) scientists and engineers can design, create, and study materials and structures with precise nanoscale dimensions (less than 100 nm). The unique properties of nanoscale materials are derived from their tiny size. Moreover, (PS2.B) nanoscale materials and structures display novel chemical and physical properties, unachievable with the corresponding bulk material, enabling applications previously unimaginable.
- **CCC:** Nanoscale materials and structures can be manufactured with precise dimensions so they display certain desired properties. There are two main manufacturing methods: “top-down” and “bottom-up” manufacturing. At the research level, these materials/structures must be investigated to gain a full understanding of their properties. At the production level, they must be examined to ensure proper quality control. Special instrumentation has been developed to study matter at these tiny dimensions.

# Show students the path!



# “Nano” education pathway in SoCal

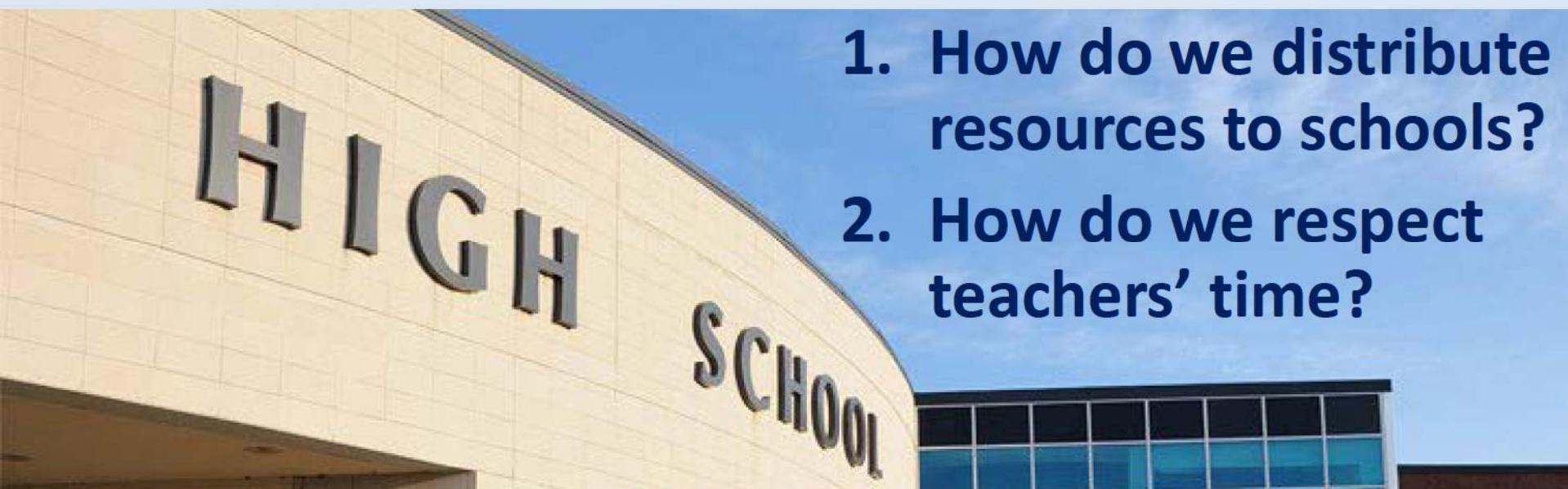


# Nanotech classes across America

- There is an unprecedented opportunity to offer nanotechnology classes all over the United States.
  - The U.S. is home to **over 13,000 school districts**.
  - Over **4 million students move through the U.S. education system each year**.
- Our long-term vision is to prepare today's students all across the country for the careers of the future.

# Questions that came up

1. How do we distribute resources to schools?
2. How do we respect teachers' time?



Climate change could push bumblebees to extinction

The future is looking over more time for bees

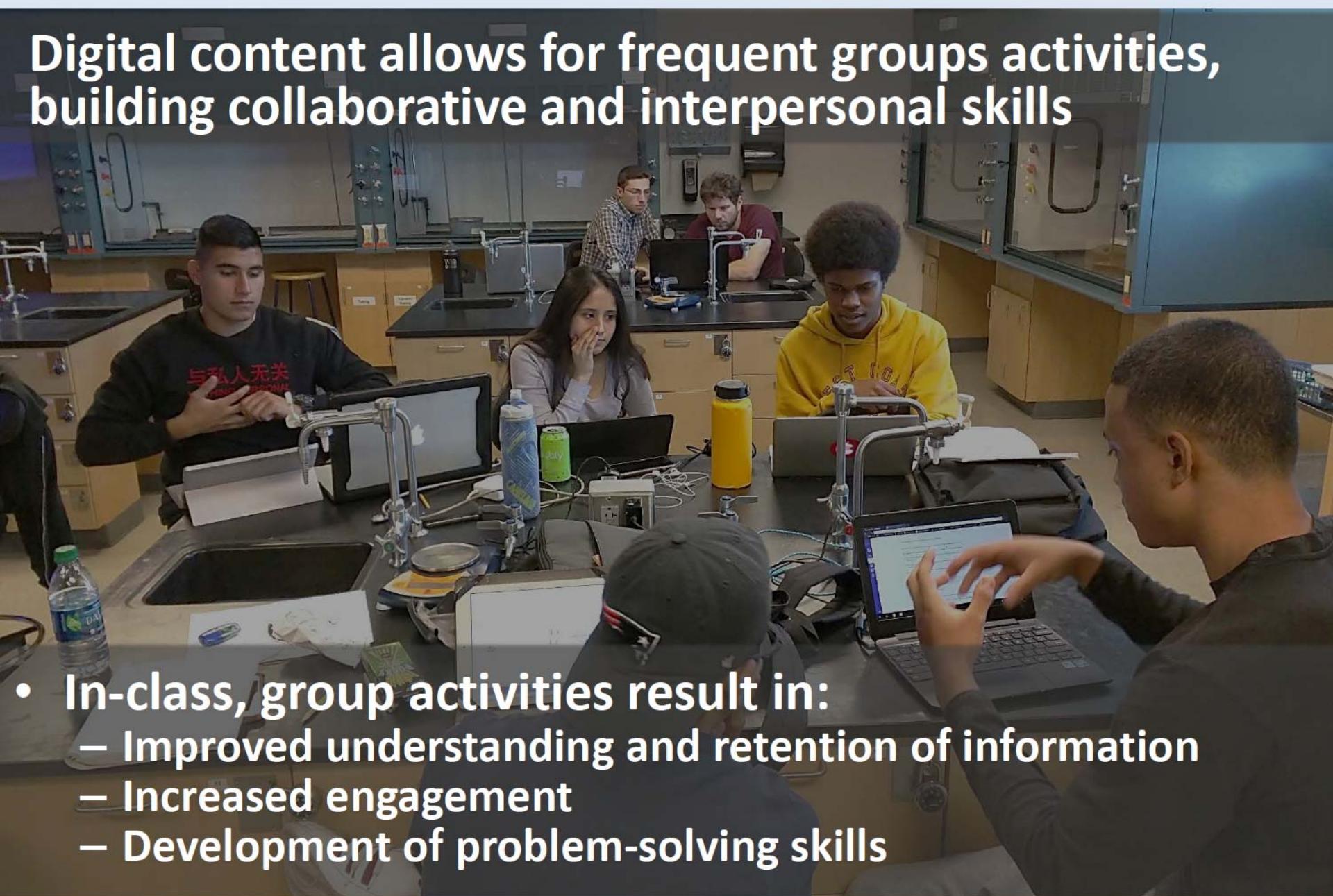
By Helen James | Updated: 10/10/2019 10:55 AM

Facebook Twitter Email



# Promote collaborative learning

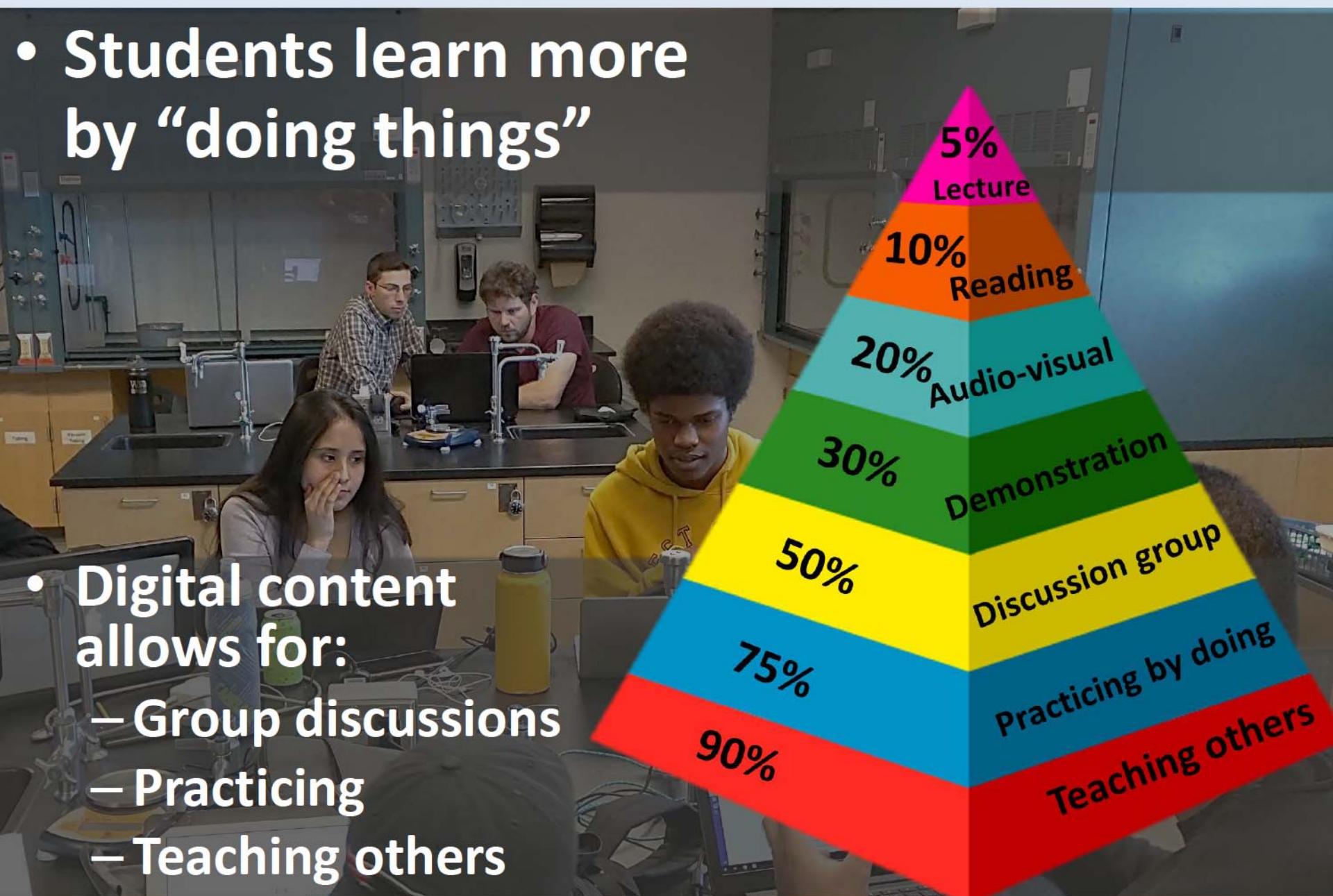
Digital content allows for frequent groups activities, building collaborative and interpersonal skills



- In-class, group activities result in:
  - Improved understanding and retention of information
  - Increased engagement
  - Development of problem-solving skills

# Improve learning retention

- Students learn more by “doing things”



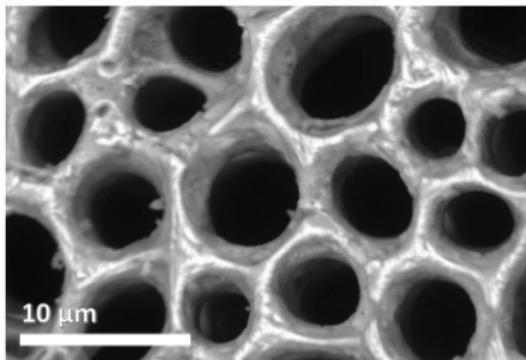
- Digital content allows for:
  - Group discussions
  - Practicing
  - Teaching others

# Sneak peek: assessments

## Question 8

3.67 / 11 pts

With regards to the image below of a sea urchin shell, which of the following statements are most likely to be correct?



Correct!

This micrograph is a good example of the charge-up phenomenon occurring on a non-conductive biological sample.

This is correct! Sea urchin shells are composed of minerals, which are non-conductive biological materials. As is typical for biological and other non-conductive samples, the abnormal contrast that is characteristic of the charge-up phenomenon is visible in this micrograph. For more details, review the slides about the charging effect.

You Answered

This image must have been acquired in BSE-SEM mode because the heavier elements that sea urchins selectively position on the surface of their shells are clearly seen as bright bumps.

This is incorrect. Although heavier elements do appear brighter in BSE-SEM micrographs, sea urchin shells are typically homogeneous in composition throughout. Furthermore, animals do not selectively position elements in this way. For more details, search the web.

- Our curriculum includes hundreds of automatically-graded assessment questions with detailed feedback immediately available to students.

- Grades are automatically recorded, and grading settings are fully customizable at both the course and quiz levels.
- This significantly lowers the instructors' workloads.

# Real-time analytics

Why do you think it's important for you to learn nanotechnology?



Why do you t

- Hint: Think a

63%  It has been

26%  It can prov

11%  There is so

47%  We want to

26%  We can choose better materials and devices to make our houses "smart" and well-insulated.

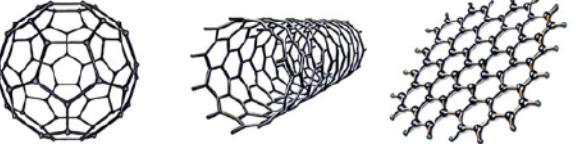
16%  No answer

- Analytics of students' performance allow teachers to:
  - Teachers can evaluate the results online.
  - Offer in-depth guidance.
  - Offer personalized feedback.

# Sneak peek: assessments

- Our educational resources support all types of learning environments including in-class (traditional), virtual, hybrid, and flipped classroom models.
- Instructors have immediate access to assessment statistics for a quantitative, visual representation of their students' strengths and areas of need.

Attempts: 259 out of 259



As an example, instructors can use select assessment questions for in-class quizzes and use the detailed statistics available in order to better tailor their lessons to their students.

Which of the following are types of carbon-based nanomaterials?

Material	Respondents	Percentage	Feedback
Graphene	252 respondents	97 %	✓
Carbon fibers	11 respondents	4 %	
Carbon nanotubes	255 respondents	98 %	✓
Buckyballs	247 respondents	95 %	✓
Buckminster Fuller	9 respondents	3 %	
Graphite	11 respondents	4 %	



# Labs within in the curriculum

- “Hands-on” activities are critical to learn science.
- Teachers need to know where to place these “nano labs” in their lesson plans.
- We suggest an appropriate place across the curriculum
  - All the prerequisite concepts have been discussed.

The screenshot shows a digital curriculum interface with a sidebar navigation and a main content area. The sidebar on the left lists categories: 'Unit 6 – The Large Surface-to-Volume Ratio of Nanomaterials', 'Unit 7 – Basic Concepts of Materials Science', and 'Unit 8 – Tuning the Properties of Nanomaterials'. Under 'Unit 8', there is a section titled 'Module 80 - The Nano Effect and Quantum Confinement' which contains three sub-modules: 'Module 81 - Tunable Properties of Nanomaterials', 'Module 82 - Plasmonic Nanomaterials', and 'Module 82'. Below 'Module 82', there are four items: 'Module 82', 'Module 82 - Assignment Group 1', 'Module 82 - Assignment Group 2', and 'Module 82 - Assignment Group 3'. The item 'Lab 8A - Plasmonic Nanoparticles' is highlighted with a red border and a yellow background. At the bottom of the sidebar, there is a button labeled '+ ADD TO MODULE 82 - PLASMONIC NANOMATERIALS'. The main content area below the sidebar lists three more modules: 'Module 83 - Quantum Dots', 'Module 84 - Applications Requiring Customizable Optical Properties', and 'Module 85 - Tuning the Dispersibility of Nanomaterials'.

- Unit 6 – The Large Surface-to-Volume Ratio of Nanomaterials
- Unit 7 – Basic Concepts of Materials Science
- Unit 8 – Tuning the Properties of Nanomaterials
  - Module 80 - The Nano Effect and Quantum Confinement
    - Module 81 - Tunable Properties of Nanomaterials
    - Module 82 - Plasmonic Nanomaterials
      - Module 82
      - Module 82 - Assignment Group 1
      - Module 82 - Assignment Group 2
      - Module 82 - Assignment Group 3
    - Lab 8A - Plasmonic Nanoparticles
  - + ADD TO MODULE 82 - PLASMONIC NANOMATERIALS
  - Module 83 - Quantum Dots
  - Module 84 - Applications Requiring Customizable Optical Properties
  - Module 85 - Tuning the Dispersibility of Nanomaterials

# Nanotech labs



- How to include labs?
  - Dry and wet labs
- Three examples:
  1. Virtual/videotaped
  2. NanoSchoolBox
  3. Customized lab (ex: UCLA-CNSI “teach the teachers” program)

What are the advantages  
and disadvantages?

# Virtual labs



- Videotaped labs with (translatable) caption explanation the procedure step by step.
- At each critical step, pop up questions related to the technique used, instruments used, good practice, and other science questions.
  - **No additional cost (included in the curriculum package).**
  - **Rapid worldwide distribution**
  - **Not really “hands-on”**

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# Thank You!



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