iHub: A Research-Practice Partnership to Design New NGSS Curriculum

NSELA PDI 2015
Chicago

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DENVER PUBLIC SCHOOLS
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NSF

BSCS
A SCIENCE EDUCATION CURRICULUM STUDY

UCAR
UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

University of Colorado **Boulder**

DLESE

Educational Resources | Earth Science Literacy Maps | For Developers | About DLESE

Digital Library for Earth System Education

Supported by the National Science Foundation
and managed by the National Center for Atmospheric Research Library

Getting started with DLESE

Browse the library

Educational resources

Grade Level

Resource Type

Search

Collections

News & opportunities

Standards

Clear selections

Tips

A free service for learners of all ages

What's new at DLESE

- The Earth Science Literacy Maps have been updated
- Newest Resources in DLESE

Resource of interest

<< Previous | Next >>

Climate Change and Colorado's Future

Climate change is real and it is occurring faster than originally predicted. In this video series, scientists explain how climate change is affecting the state of Colorado, while citizens share stories and solutions. One of the more recent videos features an interview with University of Colorado Boulder Professor Emeritus Al Bartlett on the "arithmetic of growth". A set of problem-based model lessons were developed by teams of middle and high school teachers with CU-Boulder scientists and science educators. Also available are the Colorado Science Standards for Climate and Energy.

Suggest an interesting Earth system site.

View or subscribe to all resources of interest

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

National Science Digital Library
Serving science, technology, engineering, and mathematics education

me | Explore | Standards | About | Contributors and Developers

Find a resource [ ] Search

Educational level | Resource type | Subject

Explore...

- Science Literacy Maps
- NSDL on iTunes U
- K-12 Educational Standards
- Resource Categories
- Collections

Browse an alphabetical list of all participating collections, or explore collections devoted to a subject area of interest, or refine the list by subject matter and main audience (educators or researchers).

Browse NSDL Collections

DLESE Teaching Boxes

Evidence for Plate Tectonics

Essentials of Weather

Feeding Frenzy: Seasonal Upwelling

Global Ups and Downs: Changing Sea Level

Living in Earthquake Country

Mountain Building

What are Teaching Boxes?

Teaching boxes are classroom-ready instructional units created by collaboration between teachers, scientists, and designers. Each box helps to bridge the gap between educational resources and how to implement them in the classroom. The Teaching Boxes contain materials that model scientific inquiry, allowing teachers to build classroom experiences around data collection and analysis from multiple lines of evidence, and engaging students in the process of science. - focusing on gathering and analyzing scientific evidence. All educators may use DLESE Teaching Boxes free of charge.

http://
www.teachingboxes.org/

NSDL Science Literacy Maps

Helping teachers connect concepts, standards, and NSDL resources

Search for maps | Search | or | Browse Topics

NSDL Science Literacy Maps are a tool for teachers and students to find resources that relate to specific science and math concepts. The maps illustrate connections between concepts as well as how concepts build upon one another across grade levels. Clicking on a concept within the maps will show NSDL resources relevant to the concept, as well as information about related AAAS Project 2061 Benchmarks and the Next Generation Science Standards.

Next Generation Science Standards corresponding to Benchmarks for Science Literacy are now available in selected SLM Benchmarks. Find out more about the crosswalk developed between AAAS benchmarks and the Next Generation Science Standards (NGSS).

Table of contents

- The Nature of Science
- The Nature of Mathematics
- The Nature of Technology
- The Physical Setting
- The Living Environment
- The Human Organism
- Human Society
- The Designed World
- The Mathematical World
- Historical Perspectives
- Common Themes
- Habits of Mind
- View All Topics

Getting started

- How to use Science Literacy Maps
- Frequently asked questions (FAQ)
- How do I... (Tutorial Videos)

For developers

- Technical training
- How to align resources to benchmarks
- Service API documentation

See Also

- Text-based Version

A Shared Vision: DPS and CU Boulder

Science Programs Selection Criteria

- Aligned with the National Science Education Standards
- Grounded in contemporary research on learning and teaching
- Support doing science as inquiry
- Incorporate assessment, literacy, mathematics, technological design
- Based on a carefully developed conceptual framework
- Revised as a result of thoughtful and comprehensive field testing
- Include hands-on materials and kits
- Science Resource Center for kit refurbishment

In place prior to Inquiry Hub

DPS Secondary Science

- District adoption of programs using AIM process
- District-wide implementation of inquiry-based programs k-12 in Math and Science
- Ongoing professional development provided for all redesigned courses and New Users
- Implementation tools including a planning matrix, pacing guide, and Key Concepts documents including the "Big Ideas" and subconcepts that support each grade's curriculum

In place prior to Inquiry Hub

DPS Technology

District

Longitudinal Student Tracking Systems

Teacher

Approach:
The Curriculum Customization Model

Inquiry Hub Goals

Increase achievement for all students through effective STEM teaching

- Rigorous, learner-centered STEM curriculum, aligned to emerging standards
- Software services, using DLs, supporting customization for diverse learners
- Study impact on teaching and learning
- Hub Consortium: research-district-publisher partnership for systemic change

Hub Consortium

- School Districts: Denver Public Schools, St. Vrain Valley, Mapleton, Douglas County, Davis, Clark County
- Researchers: University of Colorado, University Corporation for Atmospheric Research, Utah State University, University of Utah
- Curriculum Developers: BSCS
- Digital Libraries: PBS LearningMedia, DLESE, comPADRE, National Science Digital Library
- Publishers/Ed Tech: It's About Time, Key Curriculum Press, Kendall/Hunt, FACET Innovations

Participatory Design

Inquiry Hub (iHub): Research and Development Agenda

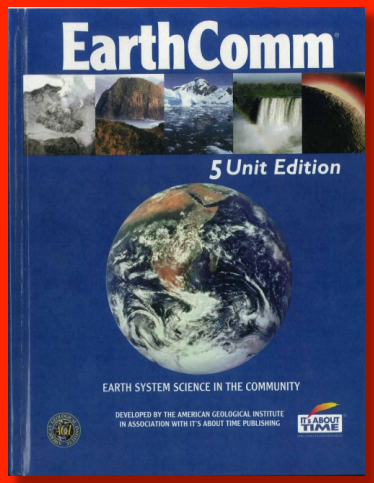
Development Agenda

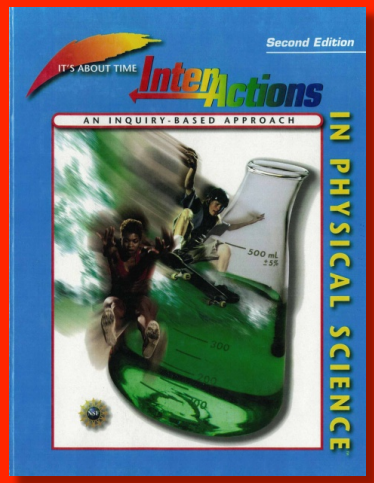
Curriculum Customization

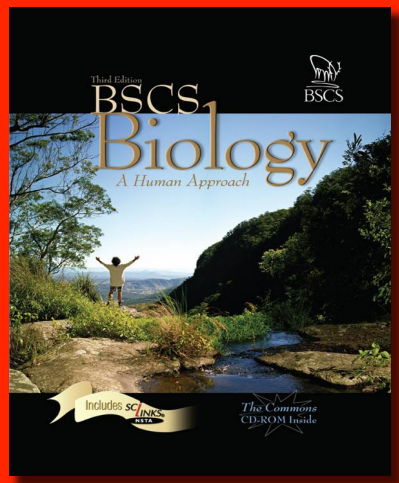
Contingent Pedagogies

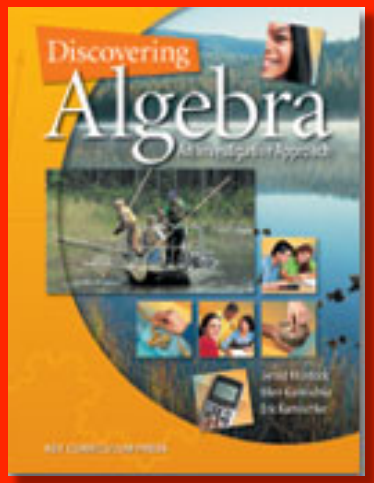
Curriculum Analytics

Integration, Implementation, & Coordination









Services

API

Curriculum

Research Agenda

- Adoption and use of iHub Services
- Support for teachers' planning and instruction processes, including differentiated instruction
- Use of interactive resources in the classroom
- Support for professional learning community
- Student learning outcomes
- District level factors that influence the above

Research and Development Timeline

- Field Trial – Earth Science
- CCS – Physical Science
- Replication Study – Earth Science
- iHub – Algebra and Biology

Concept-Focused Planning Tool

Unit 1: Understanding Your Environment

Lynne Davis (lynne) | Logout | My profile | Find people | Units of Stud

Bedrock Geology

The geologic history of the Earth is determined by Earth Science principles such as differing rocks and sediments in different locations, forces inside the Earth and basic geologic principles.

Bedrock Geology

Units of Study » Unit 1: Understanding Your Environment: Bedrock Geology » Forces and Faults

View All Stuff

Key Concepts

a. Geologic Maps

b. Rock Types

c. Interpretation Principles

d. Forces and Faults

Forces inside the Earth can create folds or faults over time. Different types of faults (reverse, normal and strike-slip) are formed by different forces (compression, tension or shearing).

e. Land Use & Geology

Forces and Faults

EarthComm Activities | Interactive Resources | Education Standards | My Stuff for this Concept | Shared Stuff for this Concept

Activity 5 +

Bedrock Geology: Activity 5: Structural Geology and Your Community

http://ccs.dls.ucar.edu/dps/protected/iat/bedrock_geology/chap01/ec_u2...

Page: U 39
Number of periods: 2

Classroom activity

Students use craft clay to model how a real fold looks in map view and in cross-section view. Students use foam blocks to model faults and determine the direction of forces needed to cause normal faults, reverse faults, and strike-slip faults. Students interpret a simple map and cross section that contains folds and faults.

Keywords from Denver Public Schools: fault, fold, compression, tension, shear

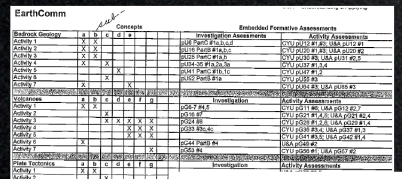
+ essential learning: must grade

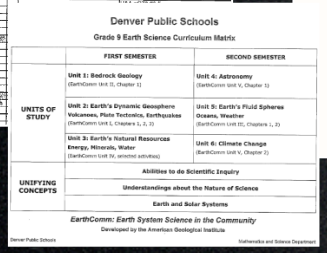
From: It's About Time

- My Stuff for this Activity
- Shared Stuff for this Activity
- Key Concepts for this Activity (1)
- Instructional Support Materials (5)
- Teaching Tips (7)
- Student Conceptions (1)
- Embedded Assessments (5)

Customized for Each District

- District specific content
- Sequencing
- Vocabulary
- Pacing guidance
- Education standards
- Essential learning





Publisher Materials

- Student textbook
- Embedded assessments
- Teaching tips
- Instructional support materials
- Student conceptions

Unit 1: Understanding Your Environment

Lynne Davis (lynne) | Logout | My

Bedrock Geology

The geologic history of the Earth is determined by Earth Science principles such as differing rocks and sedime different locations, forces inside the Earth and basic geologic principles.

Units of Study » Unit 1: Understanding Your Environment: Bedrock Geology » Forces and Faults

Key Concepts

- a. Geologic Maps
- b. Rock Types
- c. Interpretation Principles
- **d. Forces and Faults**

  Forces inside the Earth can create folds or faults over time. Different types of faults (reverse, normal and strike-slip) are formed by different forces (compression, tension or shearing).
- e. Land Use & Geology

Forces and Faults

EarthComm Activities | Interactive Resources | Education Standards | My Stuff for this Concept | Shared Stuff for this Concept

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http://ccs.dls.ucar.edu/dps/protected/iat/bedrock_geology/c[illegible]an01/ec_u2...

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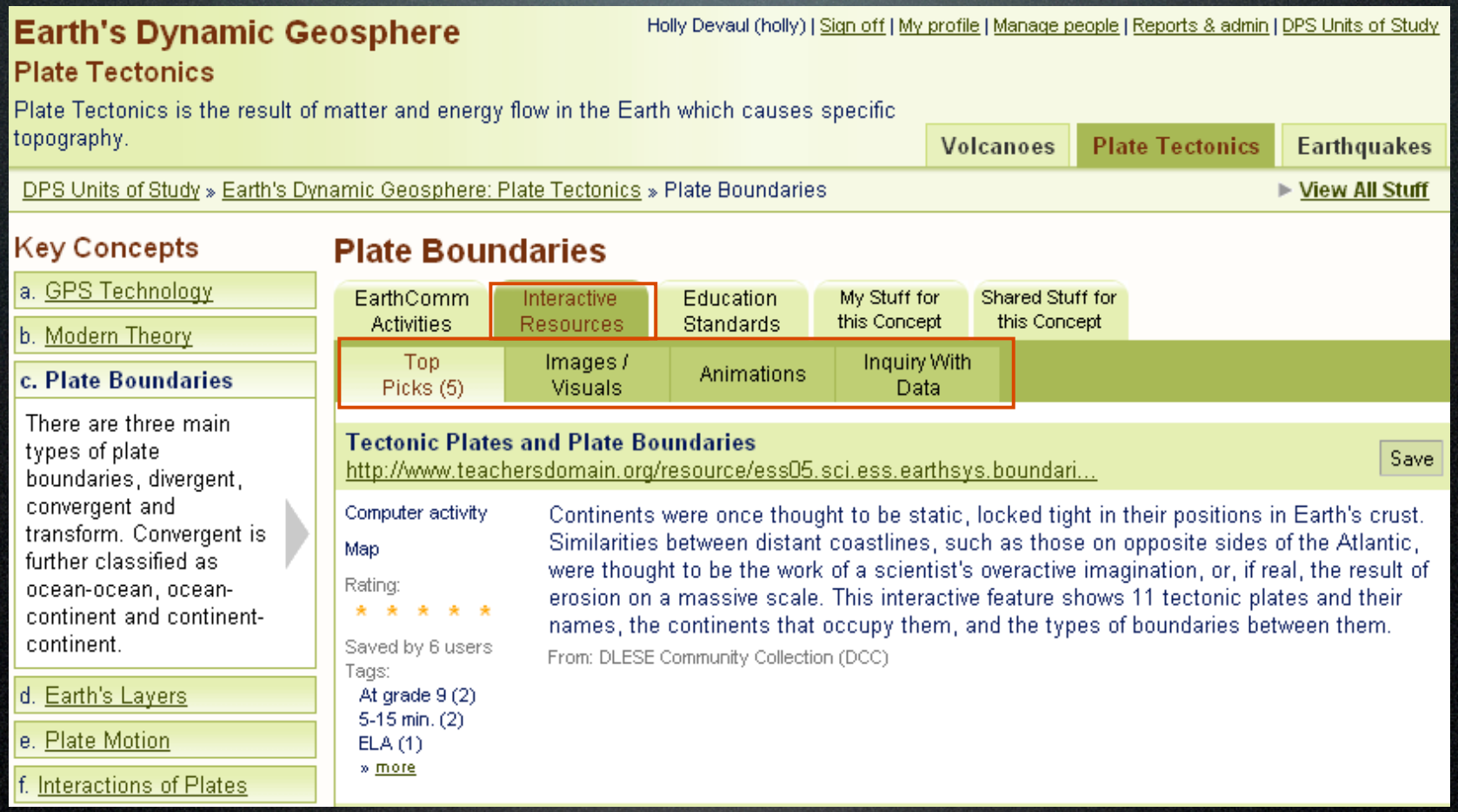
- Embedded Assessments (5)

Opens full text

Activity 5 Structural Geol[illegible]

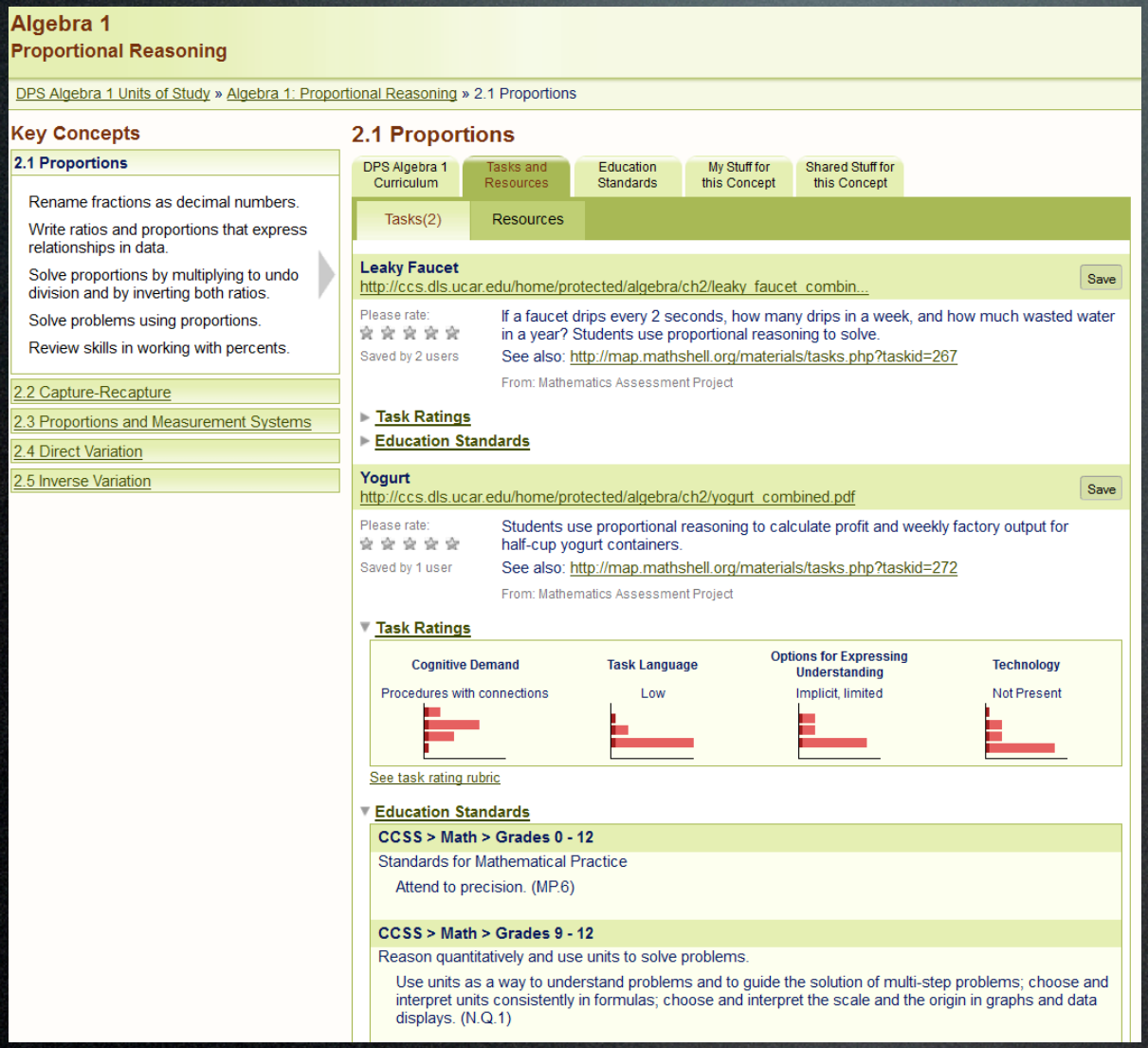
Goals Think about It

Instruction and Support Differentiation



- From educational digital libraries - NSDL and DLESE
  - Images, Animations, Data, Visuals, etc.

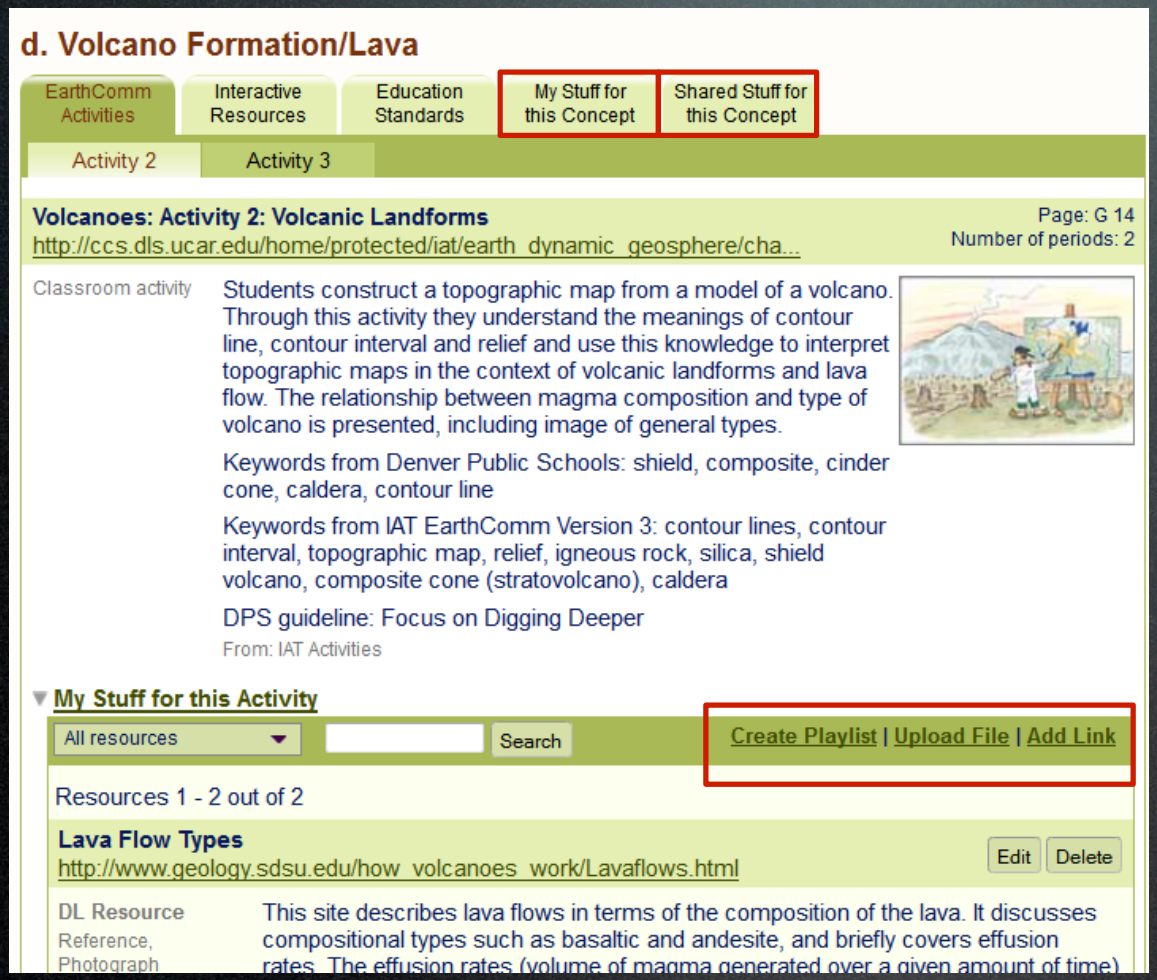
Algebra Tasks



Teachers rating according to:

- **Cognitive Demand**
- **Tasks Language**
- **Options for Expressing Understanding**
- **Technology**
- **CCSS – Standards for Mathematical Practice**
- **CCSS – Content Standards**

Create Personalized Collections for Customized Instruction



"MyStuff"
Embedded assessments
Interactive resources
Own materials
Shared materials

"SharedStuff"
Materials contributed by other teachers

"Playlist"
Organize, sequence, annotate resources
Create lesson plans or other new resources

Supporting Communities of Practice

- InterActions in Physical Science
- Investigating Earth Systems
- EarthComm - Earth System Science in the Community

Understanding Your Environment
- Bedrock Geology

Earth's Dynamic Geosphere
- Volcanoes
- Plate Tectonics
- Earthquakes

Earth's Natural Resources
- Water Resources
- Energy Resources

Recent Places
- Units of Study - EarthComm - Earth System Science in the Community
- Climate Change » a. Climate and Weather
- Climate Change
- Bedrock Geology » b. Rock Types

Activity Stream

Save to My Stuff — 3 hours ago
Playlist Investigation #7 - Rocks and Landforms has been saved by 3 users.
Latest user saved in:
- Rocks and Landforms » g. Glacial Processes | Investigation 7: Glaciers, Erosion and Deposition

Save to My Stuff — 3 hours ago
Resource Glaciers Powerpoint has been saved by 7 users.
Latest user saved in:
- Rocks and Landforms » g. Glacial Processes | Investigation 7: Glaciers, Erosion and Deposition

Save to My Stuff — 3 hours ago
Resource Glacier Simulation has been saved by 2 users.
Latest user saved in:
- Rocks and Landforms » g. Glacial Processes | Investigation 7: Glaciers, Erosion and Deposition

Tectonic Plates and Plate Boundaries
http://www.teachersdomain.org/resource/ess05.sci.ess.earthsys.boundari...
Save

Computer activity
Map
Rating: ★ ★ ★ ★ ★
Saved by 6 users
Tags:
At grade 9 (2)
5-15 min. (2)
ELA (1)
» more

Continents were once thought to be static, locked tight in their positions in Earth's crust. Similarities between distant coastlines, such as those on opposite sides of the Atlantic, were thought to be the work of a scientist's overactive imagination, or, if real, the result of erosion on a massive scale. This interactive feature shows 11 tectonic plates and their names, the continents that occupy them, and the types of boundaries between them.

From: DLESE Community Collection (DCC)

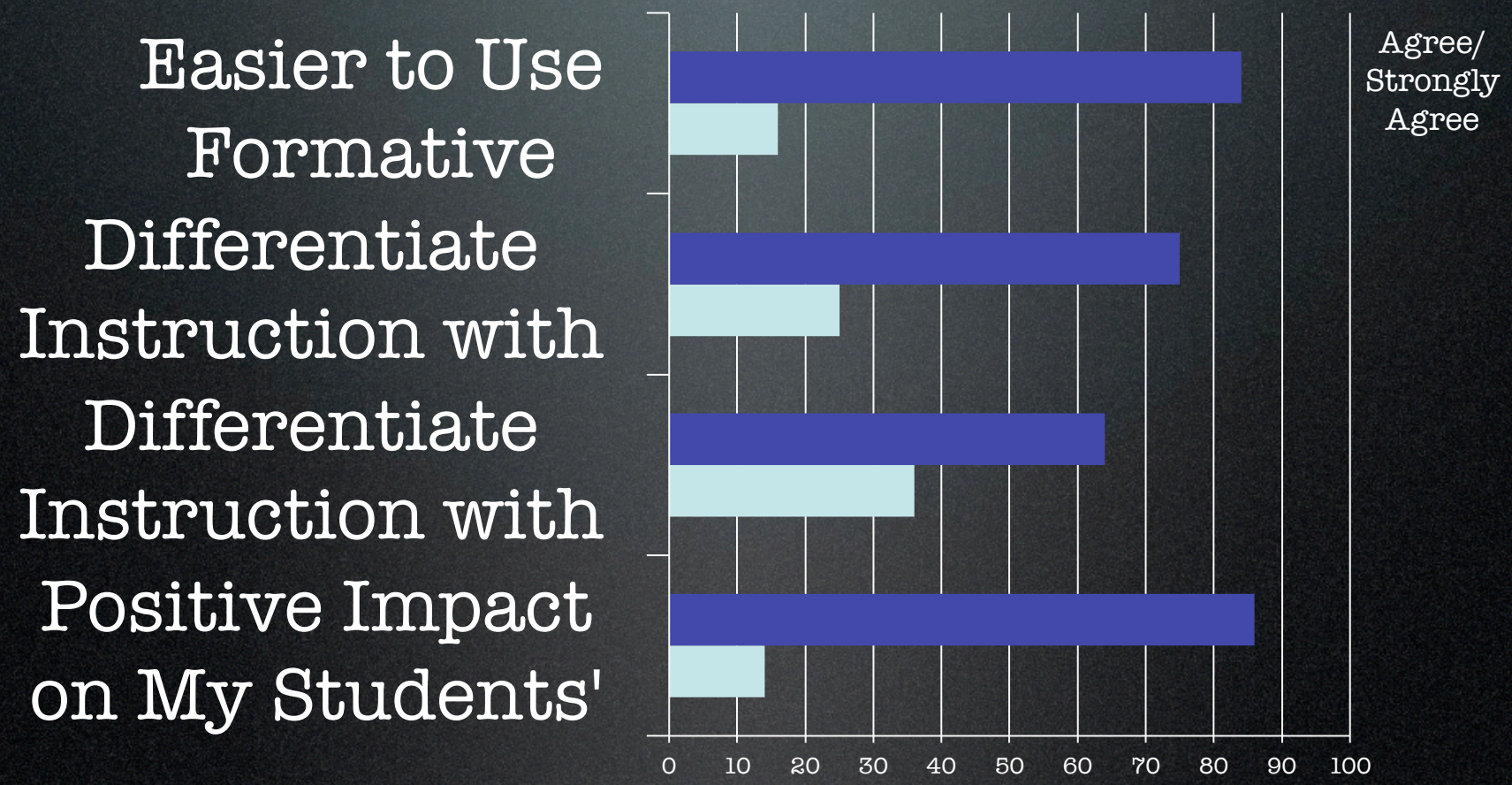
Outcomes: Field Trial in Denver Public Schools

124 middle and high school Earth science teachers

Study Results

- Strong uptake and adoption (68%)
- Helps them to use their time more efficiently (80%)
- Increased awareness of other teachers' practice (61%)
- Integrated DL resources with greater frequency, confidence, effectiveness
- Teachers differentiated to support high needs learners, offer alternative representations of science concepts, and improve engagement
- Student learning outcomes increased 200+%

How well did the CCS support teachers' to differentiate instruction?



What Teacher's Said

I tried to use it [the CCS] *with almost every lesson that I could... We have so many second-language learners that they needed the* [visual] *resources provided in the system.*

I saw that some teachers had uploaded some really high-level PowerPoint [slideshows]. *It made me wonder if my expectations were too low for my students.*

It [the CCS] is a space for me to save my materials on that won't be erased...It's a centralized location where I can find that extra material that I know is going to be, nine times out of ten, useful for me. It actually has cut down on [my] random searching on the Internet.

Outcomes: Replication Study with 6 School Districts

200 middle and high school Earth science teachers

Replication Study Results

- Four categories of users
  - Power User
  - Feature Explorer
  - Specialist
  - Lukewarm

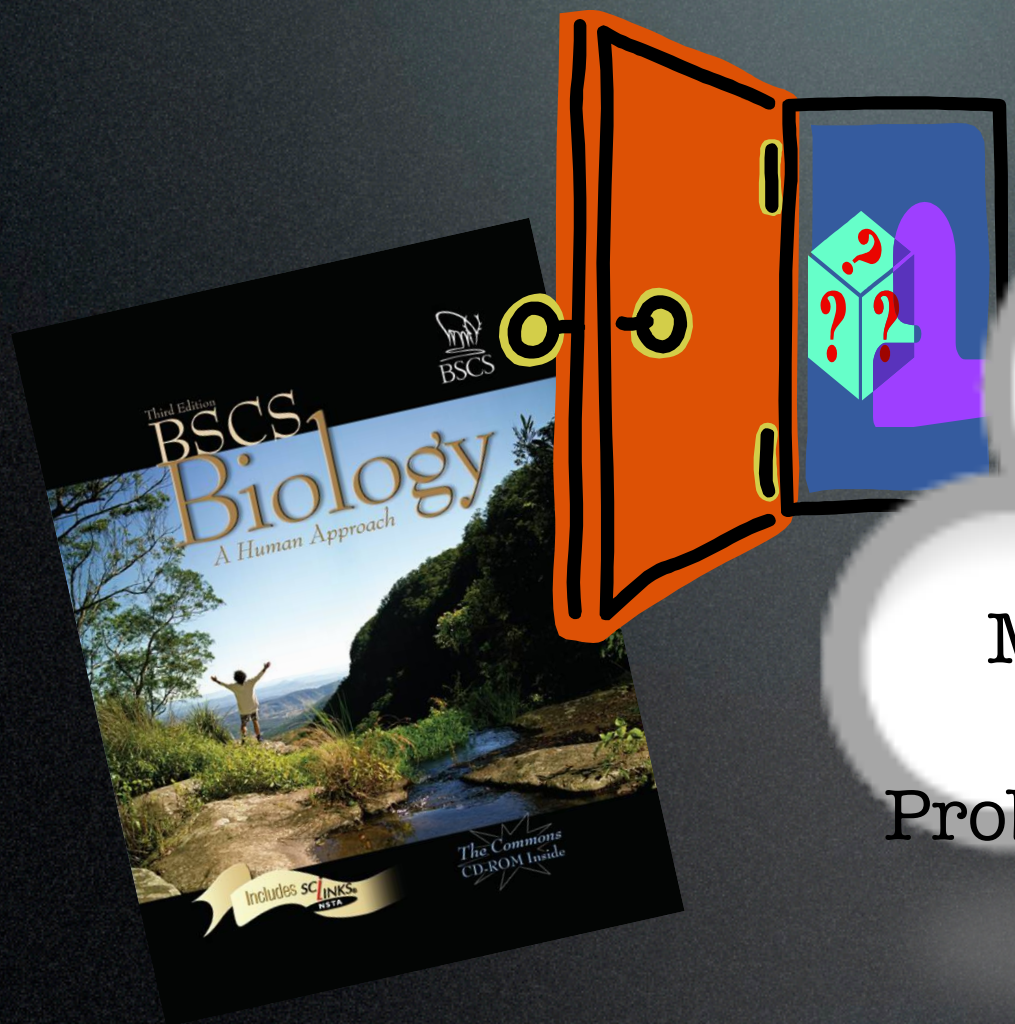
- Student assessment learning gains (pre/post)
  - Power users (ES=.44)
  - Feature explorer (ES=.29)
  - Specialist (ES=.14)
  - Compared to Lukewarm users, students of Power Users and Feature Explorers had statistically significant higher gains

Status, Next Steps, Challenges & Reflections

Status & Next Steps

- Expand to new disciplines
- Development
  - Google Apps integration
  - Student access
- NGSS and more CCSS-M alignment

Moving into new content and new subjects: Will *Inquiry Hub* make a difference in instruction and student learning?



OER
Badges
Gaming
Avatars
Open Textbooks
MOOCs & Informal Learning
Problem-based Learning

NGSS Core Ideas

HS-LS2 - Ecosystems: Interactions, Energy, and Dynamics

HS-LS4 - Biological Evolution: Unity and Diversity

TBD

HS-LS3 – Heredity: Inheritance and Variation of Traits

HS-LS1 – From Molecules to Organisms: Structures and Processes

DPS High School Biology: Units of Study

Choose a different organization

NGSS High School Biology

Ecosystems: Interactions, Energy, and Dynamics

- Why Should We Care About Trees?
- How Many Trees Can We Plant?
- What Roles Do Trees Play in an Ecosystem?
- How Do We Introduce Trees that Maintain Stability in an Ecosystem?

Recent Places

- Why Should We Care About Trees? » How Trees Cool the Air
- Why Should We Care About Trees? » Modelling How Trees Benefit People
- Why Should We Care About Trees? » Our Challenge
- Why Should We Care About Trees?

Ecosystems: Interactions, Energy, and Dynamics

Why Should We Care About Trees?

How Does Changing the Number of Trees Affect an Ecosystem?

Unit Overview

Key Concepts

Our Challenge

A key motivation for planting trees is that it can make life better for people, lowering temperature, improving air quality, and reducing flooding in the city.

- Our Challenge

Urban Heat Islands

Cities create heat islands; canopy cover lowers surface temperature.

- Analyzing Urban Heat Islands

How Trees Cool the Air

Trees cool the air through evapotranspiration and through the influence of land cover on albedo.

- Investigating How Trees Cool the Air

Modelling How Trees Benefit People

Trees can mitigate effects of human activity at different spatial scales (both the schoolyard and at the level of the city) through the mechanisms of re-radiating heat and evapotranspiration.

- Building and Using a Model of How Trees Benefit People

Increasing Biodiversity

Biodiversity is the variability among living organisms in an ecosystem and includes diversity within species, between species, and of ecosystems.

- How Can Planting Trees Increase Biodiversity in a Community?

Erosion, Runoff, and Turbidity

Trees influence erosion and run-off in an urban setting

- Urban Trees: Erosion, Runoff, and Turbidity

Ecosystems: Interactions, Energy, and Dynamics

Why Should We Care About Trees?

How Does Changing the Number of Trees Affect an Ecosystem?

Key Concepts

Our Challenge

A key motivation for planting trees is that it can make life better for people, lowering temperature, improving air quality, and reducing flooding in the city.

- Urban Heat Islands
- How Trees Cool the Air
- Modelling How Trees Benefit People
- Increasing Biodiversity
- Erosion, Runoff, and Turbidity

Our Challenge

NGSS High School Biology | Interactive Resources | Education Standards | My Stuff for this Concept | Shared Stuff for this Concept

Lesson 1.1

Our Challenge
https://drive.google.com/open?id=1SeAYCNuyOOwSEbaufwF3jT1dU1aet9a5Dp53...

Classroom activity

In this lesson, students will learn about the challenge they are being asked to address and define a set of benefits of planting trees that are important to them. Students engage in a warm-up activity in which they develop ideas about why people have planted so many trees in Denver since Anglos began settling in the region. Then, the teacher will provide a definition of ecosystems and show a brief video that introduces them to the challenge. Students will work in small groups out what they know already that might help them solve the challenge and what they need to figure out. The lesson closes with students working to define why, if at all, trees might matter to them.

From: NGSS Biology Activities

- **My Stuff for this Activity**
- **Shared Stuff for this Activity**
- **Instructional Support Materials (5)**

DPS Lesson Plan Template v2.3

File Edit View Insert Format Tools Table Add-ons Help Last edit was made 7 days ago by severans

kincaidpatty@gmail.com

Comments Share

Ecosystem Unit Lesson Plan Template

Section 1 - Outline of Lesson

Lesson Author *What is your name, position, and organization?*	

Essential Question of Unit	
Unit Phenomenon	

Your Group's Driving Question *See green boxes in Unit Storyline.*	
Lesson Title / Main Phenomena *See your Question Storyline. Phenomena are observable and foster engagement with science*	

DPS Lesson Plan Template v2.3

File Edit View Insert Format Tools Table Add-ons Help Last edit was made 7 days ago by severans

kincaidpatty@gmail.com

Comments Share

NGSS Disciplinary Core Ideas addressed *Review the NGSS DCIs.*	
NGSS Crosscutting Concepts addressed *See NGSS Appendix on Cross-Cutting Concepts.*	
NGSS Practices addressed *See NGSS Appendix on Practices.*	
Colorado Academic Standards addressed *See CAS.*	
Common Core State Standards in Math and ELA addressed *See CCSS. If no obvious links, leave blank.*	
Lesson Objectives *List objectives for students for this lesson. See gold and blue boxes in your Question Storyline.*	

DPS Lesson Plan Template v2.3

File Edit View Insert Format Tools Table Add-ons Help Last edit was made 7 days ago by severans

kincaidpatty@gmail.com

Comments Share

Opening Procedure *How will you meaningfully begin the lesson?*	
Body of Lesson Procedure *Write detailed instructions for what you and students will do during the lesson. See example. Note any possible talk moves and differentiation strategies.*	
Closing Procedure *How are you going to conclude the lesson (e.g. review, discussion, update rules for the class "Model Board")?*	

Assignment(s) / Homework *Provide meaningful and engaging activities that reinforce or synthesize the day's or week's learning.*	

Safety Concerns *List all of the lab safety*	

Why do you think CCS/iHub is working?

Reflections – What We've Learned

Embedded in Curriculum and Easy-to-Use:

Design matters and teacher expertise in the design process crucial for creating something that can be integrated into their workflow

Differentiation and Effective Teaching:

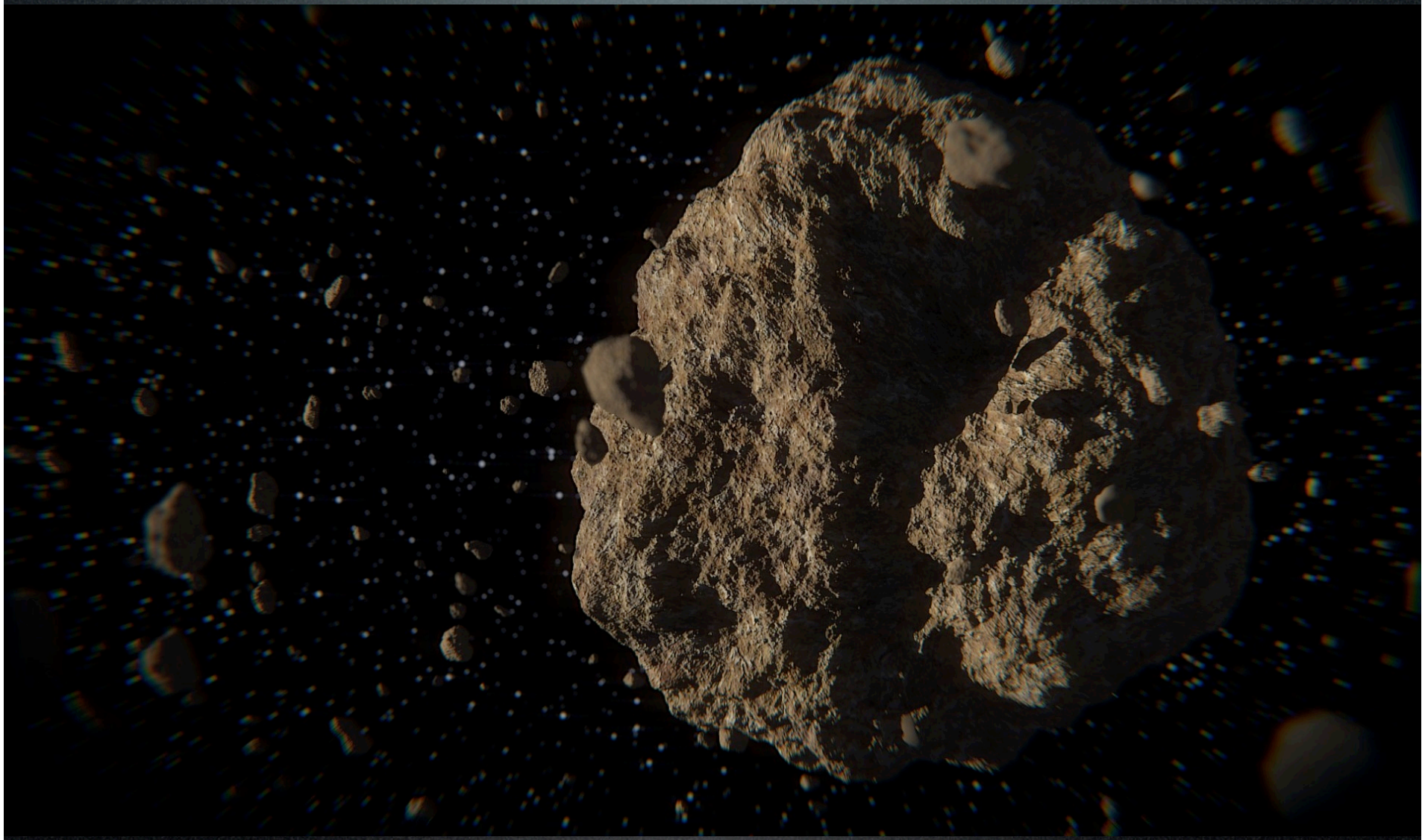
If link to instructional improvement is clear, many teachers are ready and willing to use new technology; need buy-in from all (district leaders and teachers)

More Lessons Learned

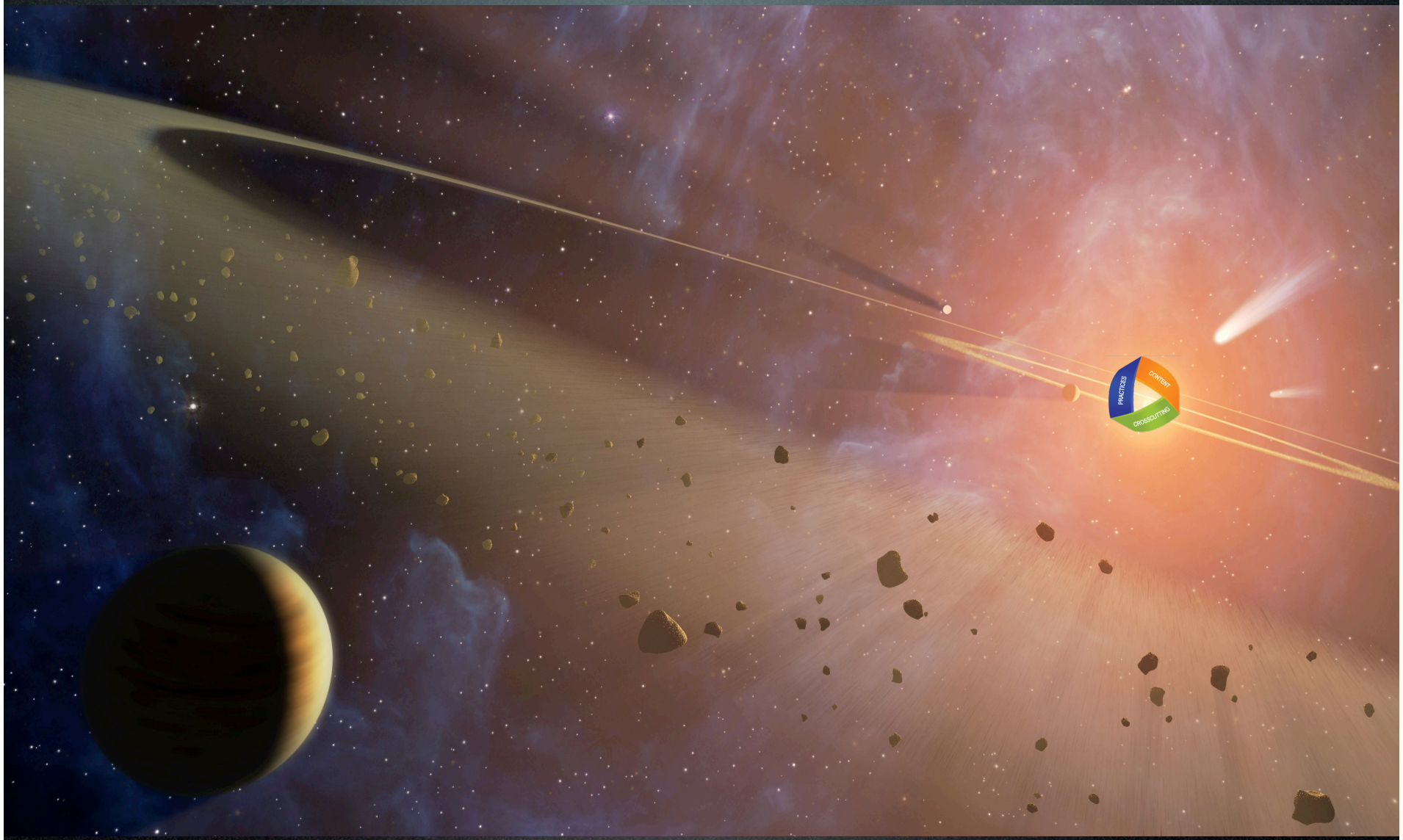
- Rethinking technology development processes
  - Learn to be agile
  - Minimum viable product is ok
  - Iterative testing, smaller releases of the tool features
  - Self-crafted development vs. using third party resources
- Technology is and will continue to be radically disruptive (+/- of state, local assessment requirements)
- Curation of resources is still a challenge
- Each district has its own culture
  - Challenges our notions of scalability
- Element of luck should not be understated
  - Engagement of districts as coPIs on projects
  - Publishers full engagement
  - Mature technological infrastructure in DPS

DPS Now...When

DPS: Where are we now?



Destination



Opportunity/Constraint

10 yr + old curricula / not @ top of multi-year queue
State STEM push / State NGSS stall
Teacher Enthusiasm / Professional learning required
NGSX – iHub courses / Development time

We have some work to do

Questions

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CCS Help: ccshelp@dls.ucar.edu

Miller, Jeffrey (2011) Customizing Curriculum With Digital Resources, The Science Teacher, Vol. 078, Issue 07, Pages: 5.

Saldivar, M. G. (2011) Report 4: Teacher Integration of Digital Resources into Instructional Practice, Pages: 26, Available at: https://wiki.ucar.edu/display/dlsccs/Publications+and+Presentations