Stuart A. Sutton, University of Washington, USA
Diny Golder, JES & Co., USA

ACHIEVEMENT STANDARDS NETWORK (ASN)

An Application Profile for Mapping K-12 Educational Resources to Achievement Standards

National Science Foundation

DC-2008, Berlin

ASN is a Project of the
National Science Digital Library
Funded by

NATIONAL SCIENCE FOUNDATION (NSF)

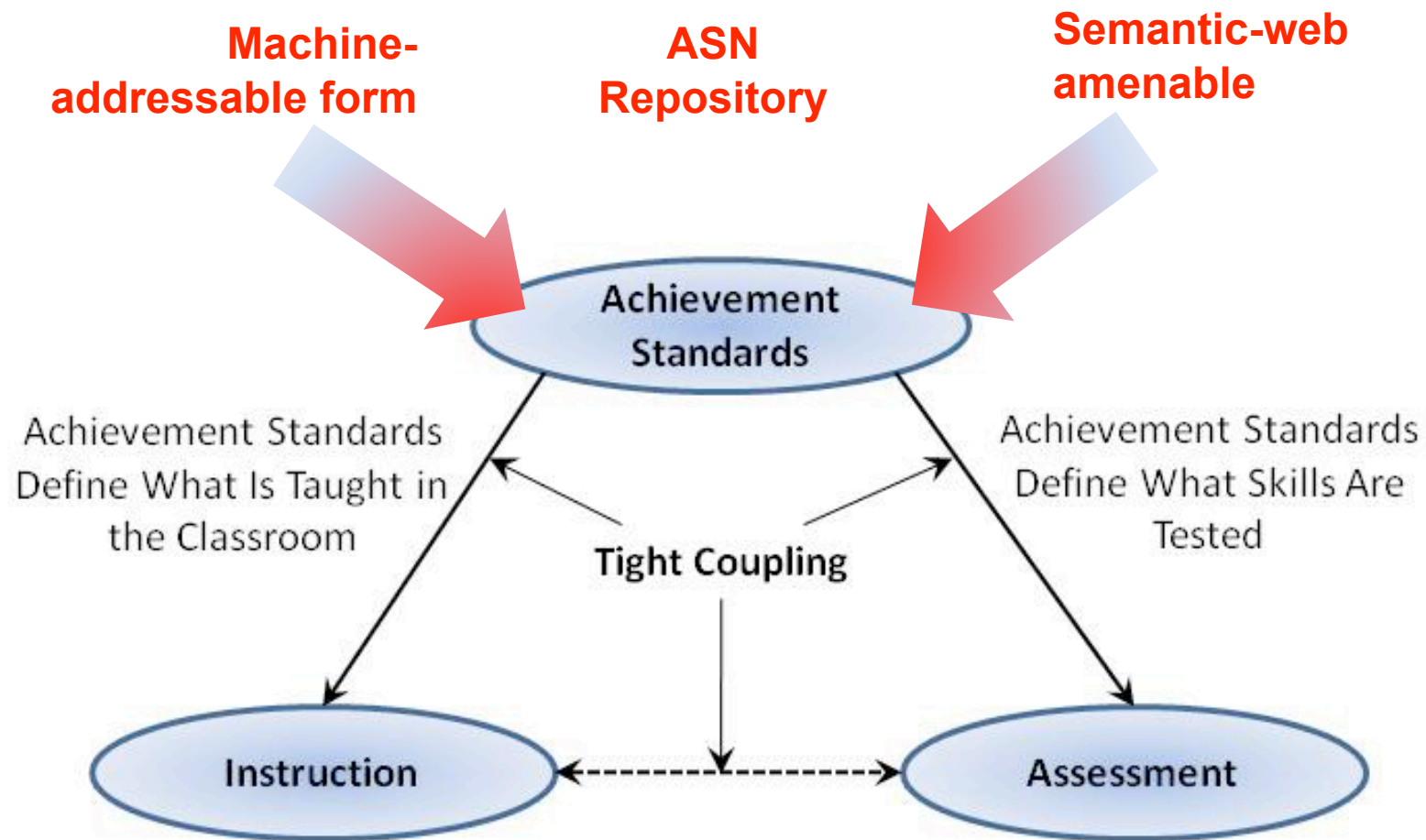**National Science Foundation**

DC-2008, Berlin

THE PROBLEM…

* Large repositories of educational resources are being created in the form of lesson plans, learning objects, curriculum units, and activities for use in kindergarten through upper grades

* Jurisdictional controls of education include various forms of mandated achievements standards—e.g., national curricula and state content standards

* Metadata mapping educational resources to achievement standards supports teaching, learning and accountability

Machine-addressable form

ASN Repository

Semantic-web amenable

Achievement Standards

Achievement Standards Define What Is Taught in the Classroom

Achievement Standards Define What Skills Are Tested

Tight Coupling

Instruction

Assessment

INSTRUCTIONAL GOAL

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--Cut and paste standards text from documents to metadata describing educational resources

--Rekeying (interpreted) standards data to metadata records

--Proprietary, closed standards databases for closed systems

Confusion of Tongues

TOWER OF BABEL

ASN GOALS...

* Create a national (international?) repository of achievement standards in machine addressable form that
  + Are accurate digital representations of standards documents and their component statements (semantic units);
  + Are consistent in form; and
  + Are modeled in RDF and amenable to the Semantic Web
* Extensible framework to support evolving uses
* Open access with cost recovery model

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PROCESS AND RESULT...

✖ Gathered all current and historical U.S. standards documents

✖ 761 standards documents have been decomposed (atomized) into "statements" derived from document structure and content

+ In excess of 350,000 standards statements

✖ All documents and statements assigned URI and are dereferencable over the Web

Core Functions Supported
CORRELATION & ALIGNMENT

FUNCTIONS...

A correlation is

+ An assertion of a relationship between an educational resource and a standards statement

"Educational resource "A" is useful in meeting the requirements of standards statement "B"

An alignment is

+ An assertion of a relationship between two standards statements

"Standards statement "C" is the same as standards statement "D"

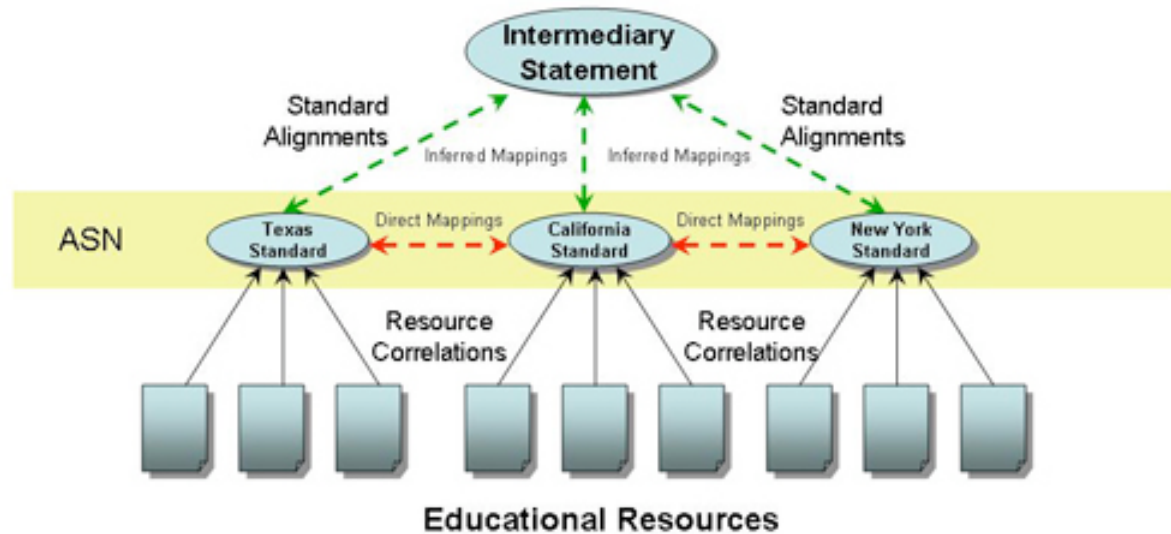**Alignment**

• Direct Mappings

    1-to-many

• Inferred (indirect) mappings

    Many-to-1

Experimentation in the
U.S. (1) Automatic (NLP
/machine learning), (2)
defined intermediary
statements (uber /master
statements); and (3)
controlled vocabulary

CORRELATION & ALIGNMENT
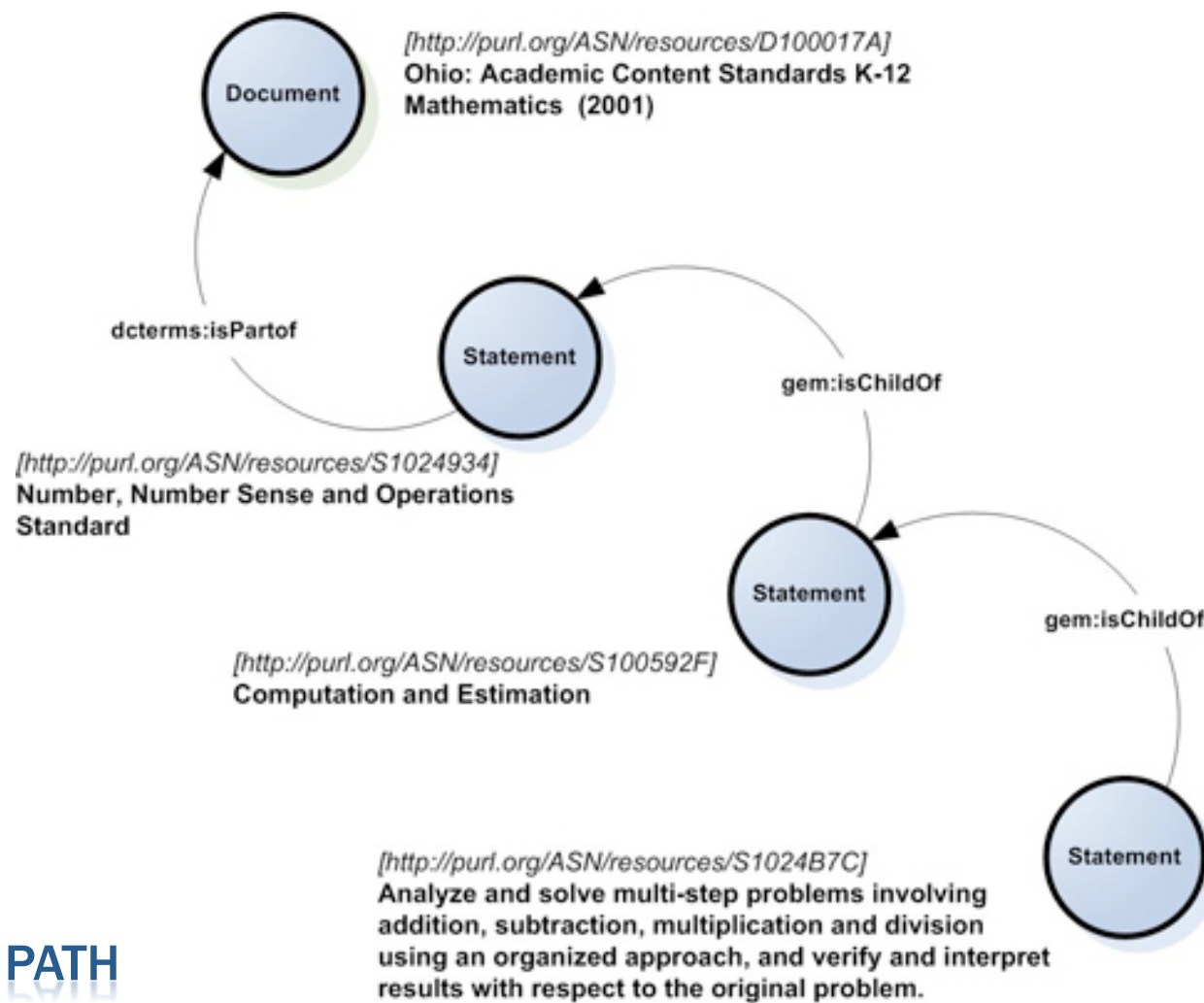
RDF Modeling

MODELING DOCUMENTS AND STATEMENTS

[http://purl.org/ASN/resources/D100017A]
Ohio: Academic Content Standards K-12
Mathematics (2001)

dcterms:isPartof

[http://purl.org/ASN/resources/S1024934]
Number, Number Sense and Operations
Standard

gem:isChildOf

[http://purl.org/ASN/resources/S100592F]
Computation and Estimation

gem:isChildOf

[http://purl.org/ASN/resources/S1024B7C]
Analyze and solve multi-step problems involving
addition, subtraction, multiplication and division
using an organized approach, and verify and interpret
results with respect to the original problem.

ASN TAXON PATH

Contextualizing Statements

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STATEMENT PROPERTIES

Creator (DC)	A person or organization chiefly responsible for the intellectual content of the statement being described when different from the creator of the standards document (e.g., 3rd party derived statement).
Comment (ASN)	Supplemental text provided by the promulgating body that clarifies the nature, scope or use of the statement being described.
Concept Term (ASN)	A word or phrase used by the promulgating agency to refine and differentiate the statement being described contextually (e.g., a McREL concept term).
Created (DC)	Date of creation of the statement.
Description (DC)	The text of the statement being described.
Education Level (DC)	The grade or grade bands covered by the standards statement being described.
Identifier (DC)	An unambiguous reference to the resource within a given context. For the ASN standards statement, the value of the «identifier» is always a network-resolvable URI.
Is Child Of (GEM)	The statement being described is lower in some arbitrary hierarchy than the statement identified in the «isChildOf» property. The statement identified is a parent of the statement being described.
Is Part Of (DC)	The described statement is a physical or logical part of the referenced standards document.

STATEMENT PROPERTIES (CONT.)

Jurisdiction	A legal, quasi-legal, organizational or institutional domain of the entity mandating the use of the achievement standard--e.g., California.
Local Subject (ASN)	The text string denoting the subject of the statement as designated by the promulgating agency.
Relation (DC)	A related resource.
Statement Label (ASN)	The textual label identifying the class of the statement as designated by the promulgating body—e.g., "Standard," "Benchmark," "Strand," or "Topic."
Statement Notation (ASN)	An alphanumeric notation or ID code as defined by the promulgating body to identify the statement.
Status (ASN)	The publication status of the statement taken from the ASN Status controlled vocabulary.
Subject (DC)	An ASN topic of the content of the statement being described.

†For document properties, see paper appendix.

AUGMENTING THE ASN…

Refining Statements & Adding New Relationships
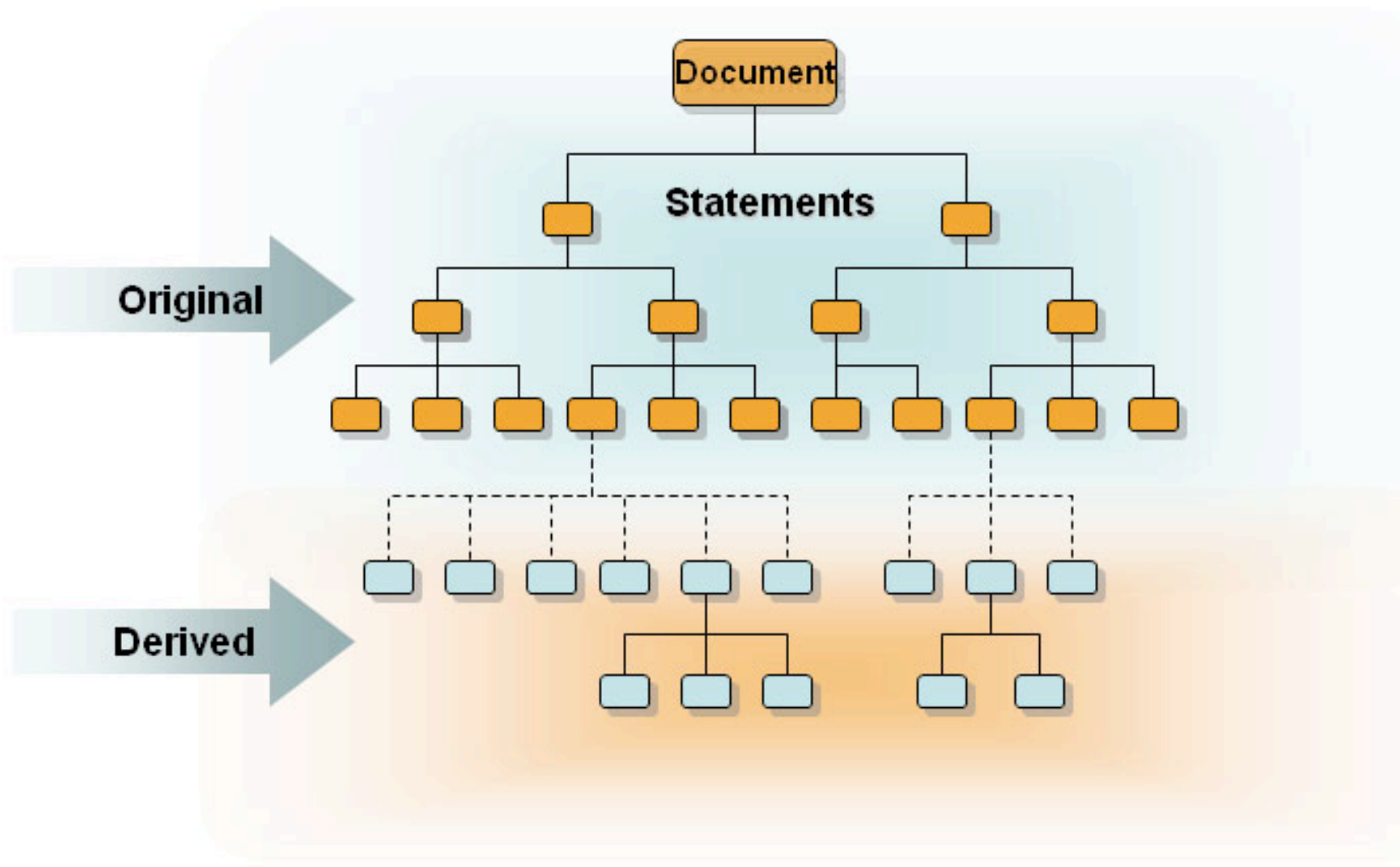
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"Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem."
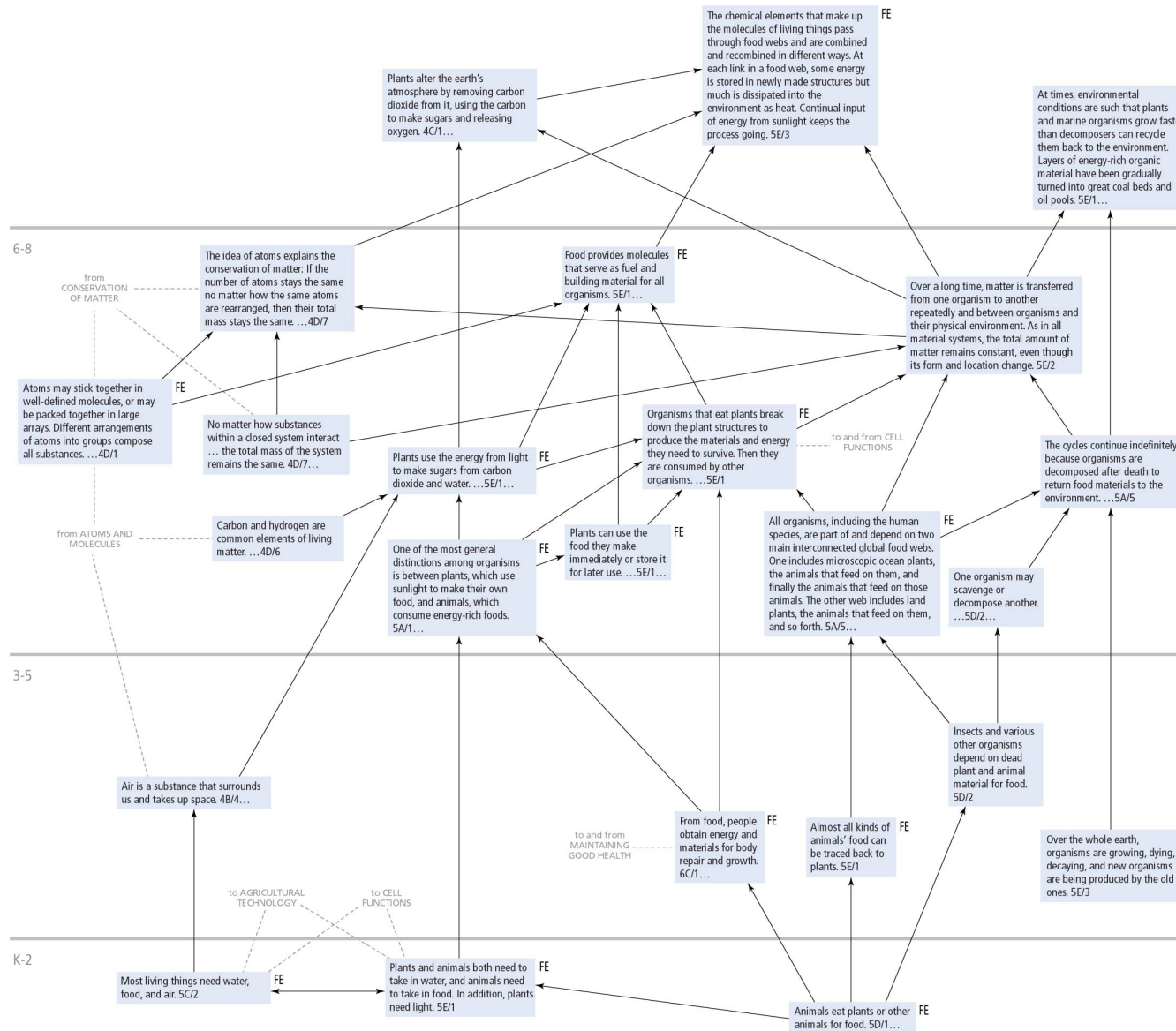
	involving addition	involving subtraction	involving multiplication	involving division
Analyze multistep problems …	analyze addition	analyze subtraction	analyze multiplication	analyze division
Solve multistep problems …	solve addition	solve subtraction	solve multiplication	solve division
Verify multistep problems …	verify addition	verify subtraction	verify multiplication	verify division
Interpret multistep problems …	interpret addition	interpret subtraction	interpret multiplication	interpret division

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3RD PARTY AUGMENTATION (DERIVED STATEMENTS)

NEW RELATIONSHIPS—STRAND MAPS

Boxes (top to bottom, left to right):

- Plants alter the earth's atmosphere by removing carbon dioxide from it, using the carbon to make sugars and releasing oxygen. 4C/1…

- The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going. 5E/3 — FE

- At times, environmental conditions are such that plants and marine organisms grow faster than decomposers can recycle them back to the environment. Layers of energy-rich organic material have been gradually turned into great coal beds and oil pools. 5E/1… — FE

6-8

- from CONSERVATION OF MATTER

- The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same. …4D/7

- Food provides molecules that serve as fuel and building material for all organisms. 5E/1… — FE

- Over a long time, matter is transferred from one organism to another repeatedly and between organisms and their physical environment. As in all material systems, the total amount of matter remains constant, even though its form and location change. 5E/2

- Atoms may stick together in well-defined molecules, or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances. …4D/1 — FE

- No matter how substances within a closed system interact … the total mass of the system remains the same. 4D/7…

- Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms. …5E/1 — FE

- to and from CELL FUNCTIONS

- The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment. …5A/5

- from ATOMS AND MOLECULES

- Carbon and hydrogen are common elements of living matter. …4D/6

- Plants use the energy from light to make sugars from carbon dioxide and water. …5E/1… — FE

- Plants can use the food they make immediately or store it for later use. …5E/1… — FE

- All organisms, including the human species, are part of and depend on two main interconnected global food webs. One includes microscopic ocean plants, the animals that feed on them, and finally the animals that feed on those animals. The other web includes land plants, the animals that feed on them, and so forth. 5A/5… — FE

- One organism may scavenge or decompose another. …5D/2…

- One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. 5A/1… — FE

3-5

- Insects and various other organisms depend on dead plant and animal material for food. 5D/2

- Air is a substance that surrounds us and takes up space. 4B/4…

- to and from MAINTAINING GOOD HEALTH

- From food, people obtain energy and materials for body repair and growth. 6C/1… — FE

- Almost all kinds of animals' food can be traced back to plants. 5E/1 — FE

- Over the whole earth, organisms are growing, dying, decaying, and new organisms are being produced by the old ones. 5E/3

- to AGRICULTURAL TECHNOLOGY

- to CELL FUNCTIONS

K-2

- Most living things need water, food, and air. 5C/2 — FE

- Plants and animals both need to take in water, and animals need to take in food. In addition, plants need light. 5E/1 — FE

- Animals eat plants or other animals for food. 5D/1… — FE

plants making food   food web   matter cycle

Editors
Viewers
Web Services

ASN TOOLS & SERVICES...

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TOOLS & SERVICES

- Batch downloads of standards

- Mechanism to dereference an ASN URI

- Web Services for interactions with the ASN by metadata generation tools

- Searching & browsing interfaces to the ASN

ASN XML Export v1.2.5 - Windows Internet Explorer

http://dev.jesandco.org/asn/xml_export/

Google

Convert ▼ Select

ASN XML Export v1.2.5

Page ▼ Tools ▼

ASN-XML Export v1.4.1

Existing Documents (Check Documents for Text File Export)

Export Text File(s)

- ⊞ Achievement Standards Network
- ⊞ Alabama
- ⊞ Alaska
- ⊞ American Assoc Advancement of Science Proj 2061 (AAASP)
- ⊞ Arizona
- ⊟ Arkansas
  - ☐ Math-1998- 3/25/2008 12:17:46 PM View
  - ☐ Science-1999- 3/13/2008 5:10:20 PM View
  - ☐ Geography-2000- 3/13/2008 5:10:02 PM View
  - ☐ Historical Understanding-2000- 3/13/2008 5:10:02 PM View
  - ☐ Economics-2000- 3/13/2008 5:10:02 PM View
  - ☐ Civics-2000- 3/13/2008 5:10:00 PM View
  - ☐ Behavioral Studies-2000- 3/13/2008 5:10:00 PM View
  - ☐ Social Studies-2000- 3/13/2008 5:10:04 PM View
  - ☐ K-4 History and State History-2000- 3/13/2008 5:10:04 PM View
  - ☐ World History-2000- 3/13/2008 5:10:06 PM View
  - ☐ The Arts-2001- 3/13/2008 5:10:00 PM View
  - ☐ English-2003- 3/13/2008 5:09:58 PM View
  - ☐ Math-2004- 3/25/2008 12:17:44 PM View
  - ☐ Science-2005- 3/13/2008 5:09:20 PM View
  - ☐ Social Studies-2006- 6/26/2008 2:36:34 PM View
- ⊞ California
- ⊞ Colorado
- ⊞ Connecticut

Generate a Document

Organization: --Select an Organization-- ▼

ParseTree - Windows Internet Explorer

http://dev.jesandco.org/asn/xml_export/ParseTree.ASPX?strFileName=US%20History-2000-Arizona-US%20His ▼

Google

Convert ▼ | Select

⭐ ❄ | ParseTree

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Tree navigation (left panel):
- S1001EB3
  - S101E2B2
    - S1013512
  - S101B228
    - S102695F
    - S1004AFE
  - S10210AF
    - S1004ACE
    - S1023DE7
    - S101EB54
  - S1011506
    - S1017475
    - S1006006
    - S100AB7B
    - S101B3D2
    - S100D6CA
    - S10067EE
    - S1019067
  - S1020103
    - S100E5B1
    - S1005F19
    - S10037C7
  - S10113BF
    - S102494F
    - S101E248
    - S1020A26
  - S101FC7A
    - S100F5EF
    - S1000FAA
    - S1004A36
    - S1004AED
  - S10160C6
    - S1011CE1
    - S100A2EC

Academic Standards: Social Studies

File Name: US History-2000-Arizona-US History.xml

File Created: Mar 13 2008

Export Version: 1.4.1

Subject: http://purl.org/ASN/scheme/ASNTopic/usHistory

Selected Statement Details

Statement: S10210AF
FOCUS: American History from Discovery through the U.S. Constitution
1SS-E5. Describe the causes, course, and consequences of early European exploration of North America, with emphasis on:

Child Statement: S1004ACE
PO 1. the reasons for European exploration of the Americas.
Children:

Child Statement: S1023DE7
PO 2. the characteristics and results of various European expeditions, including those of Christopher Columbus, John Cabot, Hernando Cortes, and Hernando de Soto
Children:

Child Statement: S101EB54
PO 3. the political, economic, and social impact on the indigenous peoples
Children:

No errors found in the document

http://dev.jesandco.org/asn/xml_export/OutputFile/Civics-2000-Arkansas-Civics%20Framework%20Rev - Windows Internet Explorer

http://dev.jesandco.org/asn/xml_export/OutputFile/Civics-2000-Arkansas-Civics%20Framework%20Revised%2

Google

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http://dev.jesandco.org/asn/xml_export/OutputF...

Page ▼ Tools ▼

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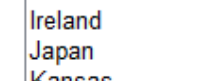
ASN EDITOR

IMPLEMENTATION FRAMEWORK FOR ACHIEVEMENT STANDARDS TOOLKIT

SETDA

GEM X

National Science Foundation

NSDL:ASN
Achievement Standards Network

State/Organization: --Select a State/Organization--

--Select a State/Organization--
Alabama
Alaska
American Assoc Advancement of Science Proj 2
Arizona
Arkansas
California
Canada
Colorado
Connecticut
Delaware
District of Columbia
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Ireland
Japan
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi

...ome to the ASN Editor!

The *ASN* provides tools... ...on with the authoritative collection of learning and content standards from states and national content groups.

Organizations that prov... ...collections, or who conduct research involving learning standards face their own set of challenges. Without an... ...ds and agreement on the best way to represent them in metadata, basic research and application developmen... ...sible. The ASN provides the tools and services for researchers, service providers and application builders to... ...n catalog and metadata records in an open, extensible way.

The ASN exposes both... ...ces) access through platform independent, interoperable and extensible services that support current technical stand... ...GEM, IMS, IEEE-LOM, OAI-PMH and SIF (Schools Interoperability Framework).

Align to Achieve
The Academic Standards e-Library

Harcourt

PEARSON
Education

Riverdeep

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IMPLEMENTATION FRAMEWORK FOR ACHIEVEMENT STANDARDS TOOLKIT

National Science Foundation
NSDL:ASN
Achievement Standards Network

State/Organization: Arizona

| Documents | Details | Subjects | Grades | Dates | Statements | Alignment | Reports |

Documents: (24)   ○ 5 ○ 10 ○ 25 Per Page   ☑ Show IDs

1 2 3 4 5

Document ID		Title	Subject	Adoption	Status
http://purl.org/ASN/resources/D1000355	View	Arizona Mathematics Standard Articulated by Grade Level	Math	2008	Active
http://purl.org/ASN/resources/D1000287	View	Social Studies Strand 3 - Civics/Government	Civics	2006	Active
http://purl.org/ASN/resources/D1000285	View	Social Studies Strand 5 - Economics	Economics	2006	Active
http://purl.org/ASN/resources/D1000286	View	Social Studies Strand 4 - Geography	Geography	2006	Active
http://purl.org/ASN/resources/D1000305	View	Arizona Academic Standards for Dance	The Arts	2006	Active

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NSDL:ASN
Achievement Standards Network

State/Organization: Arizona **Document:** Arizona Mathematics Standard Articulated by Grade Level

| Documents | Details | Subjects | Grades | Dates | Statements | Alignment | Reports |

Keyword:

Unique Identifier (URI or ID):

Grade Level:

⦿ All ◯ PreK-2 ◯ 3-5 ◯ 6-8 ◯ 9-12

Overides Keyword and Grade Level

SEARCH   RESET

⦿ Input Mode ◯ Align Mode   RESET SEARCH   ADD H1 STATEMENT

☑ Show

Hierarchy Level 1 (5)

RefID		Order	Statement	Grade	Subject	Local Subject	Statement Code
http://purl.org/ASN/resources/S1134CD0	↓	1	Strand 1: Number and Operations	K,1,2,3,4,5,6,7,8,9,10,11,12	Math		
http://purl.org/ASN/resources/S1134D59	↓	2	Strand 2: Data Analysis, Probability, and Discrete Mathematics	K,1,2,3,4,5,6,7,8,9,10,11,12	Math		
http://purl.org/ASN/resources/S1134DCA	↓	3	Strand 3: Patterns, Algebra, and Functions	K,1,2,3,4,5,6,7,8,9,10,11,12	Math		
http://purl.org/ASN/resources/S113501B	↓	4	Strand 4: Geometry and Measurement	K,1,2,3,4,5,6,7,8,9,10,11,12	Math		
http://purl.org/ASN/resources/S11350A3	↓	5	Strand 5: Structure and Logic	K,1,2,3,4,5,6,7,8,9,10,11,12	Math		

Align   CERTIPORT   PEARSON

FUTURE WORK

National Science Foundation

- **Statement versioning**
  - Deviation from current document-centric focus to evolving statements
- **Vocabulary extensions**
  - Strand map (navigable paths) extensions & authoring environment
- **Enhanced array of properties**
  - Continuous discovery of new assertions to be made

Who's using it?

ADOPTION OF THE ASN…

National Science Foundation

DC-2008, Berlin

COST RECOVERY BUSINESS MODEL...

✖ All ASN URI are freely dereferencable

✖ Repository and web services are accessible free of charge to non-profits (registration required)

✖ Modest annual fees for commercial access

National Science Foundation

ASN ADOPTERS...

FOR-PROFIT APPLICATIONS

* Cambridge University Press
* Thinkfinity—Verizon Foundation (formerly Marco Polo)

NON-PROFIT APPLICATIONS (Select)

* American Association for the Advancement of Science (AAAS)
* International Reading Association
* National Center for Family Literacy
* Council on Economic Education
* National Council of Teachers of English
* National Council of Teachers of Mathematics

* ProLiteracy Worldwide
* Smithsonian National Museum of American History
* John F. Kennedy Center for the Performing Arts
* WGBH (Teacher's Domain)
* Center for Natural Language Processing (CNLP—Syracuse University)
* TeachEngineering (University of Oregon)
* Michigan State Libraries
* Gateway to 21st Century Skills

UNDER CONSIDERATION

* IMS Global Consortium
* Harcourt
* McGraw Hill

THANK YOU!

Achievement Standards Network (ASN)
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