Reference model for linking between curriculum standards and digital resources using linked data

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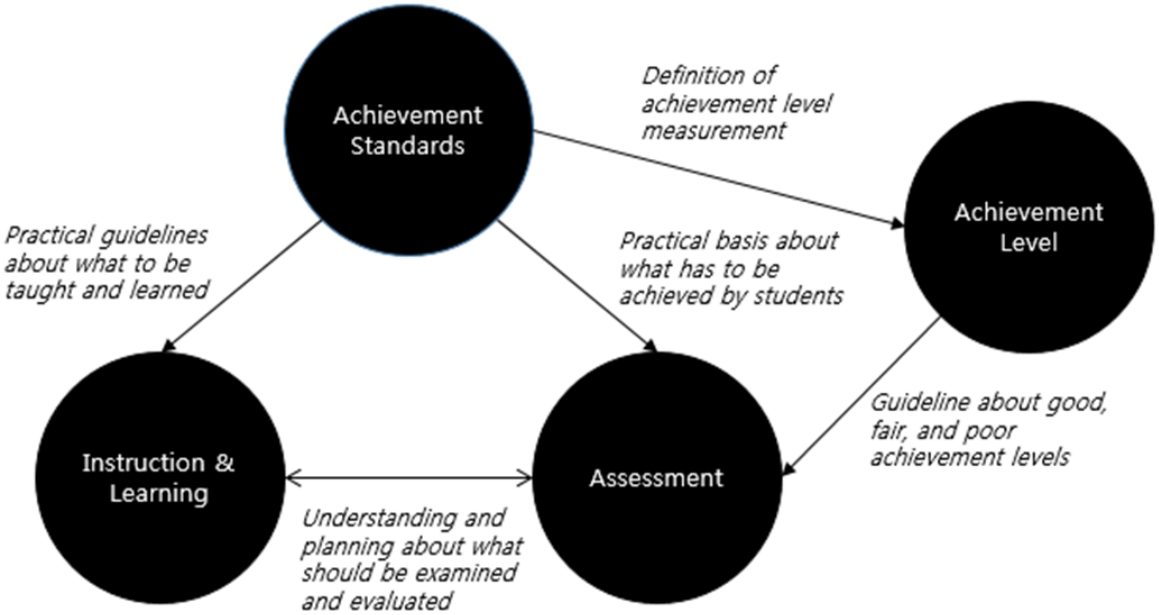
What is Achievement Standards?

- **Achievement Standards**
  - Definition : a statement of the ability and characteristics of knowledge, skills, and attitude that students must achieve through learning, to be presented as a practical basis of teaching/learning and assessment.(According to the 2009 Revised National Curriculum of Korea)



What is Achievement Standards?

- Example(Connecticut Science Grade-level Expectation)

Second criteria of science subject (second level)

Curriculum standard per school grade

First criteria of science subject (top level)

Goal of achievement

Properties of Matter — *How does the structure of matter affect the properties and uses of materials?*

PREKINDERGARTEN ← School level

PK.1 - Objects have properties that can be observed and used to describe similarities and differences

Core Science Curriculum Framework	Preschool Curriculum Framework	Grade-Level Expectations *Students should be able to:*	Preschool Assessment Framework
PK.1.a. Some properties can be observed with the senses, and others can be discovered by using simple tools or tests.	Cognitive Development: Logical-Mathematical/Scientific Thinking - 1. Ask questions about and comment on observations and experimentation; 2. Collect, describe and record information; 3. Use equipment for investigation; 4. Use common instruments to measure things; 5. Demonstrate understanding of one-to-one correspondence while counting; 6. Order several objects on the basis of one attribute; 7. Sort objects by one or more attributes and regroup the objects based on a new attribute; 8. Engage in a scientific experiment with a peer or with a small group.	1. Use senses to make observations of objects and materials within the child's immediate environment. 2. Use simple tools (e.g., balances and magnifiers) and nonstandard measurement units to observe and compare properties of objects and materials. 3. Make comments or express curiosity about observed phenomena (e.g., "I notice that…" or "I wonder if…"). 4. Count, order and sort objects (e.g. blocks, crayons, toys) based on one visible property (e.g., color, shape, size). 5. Conduct simple tests to determine if objects roll, slide or bounce.	**COG 1** Engages in scientific inquiry **COG 3** Sorts objects **COG 5** Compares and orders objects and events **COG 6** Relates number to quantity

Achievement statement (third level)

What is Achievement Standards?

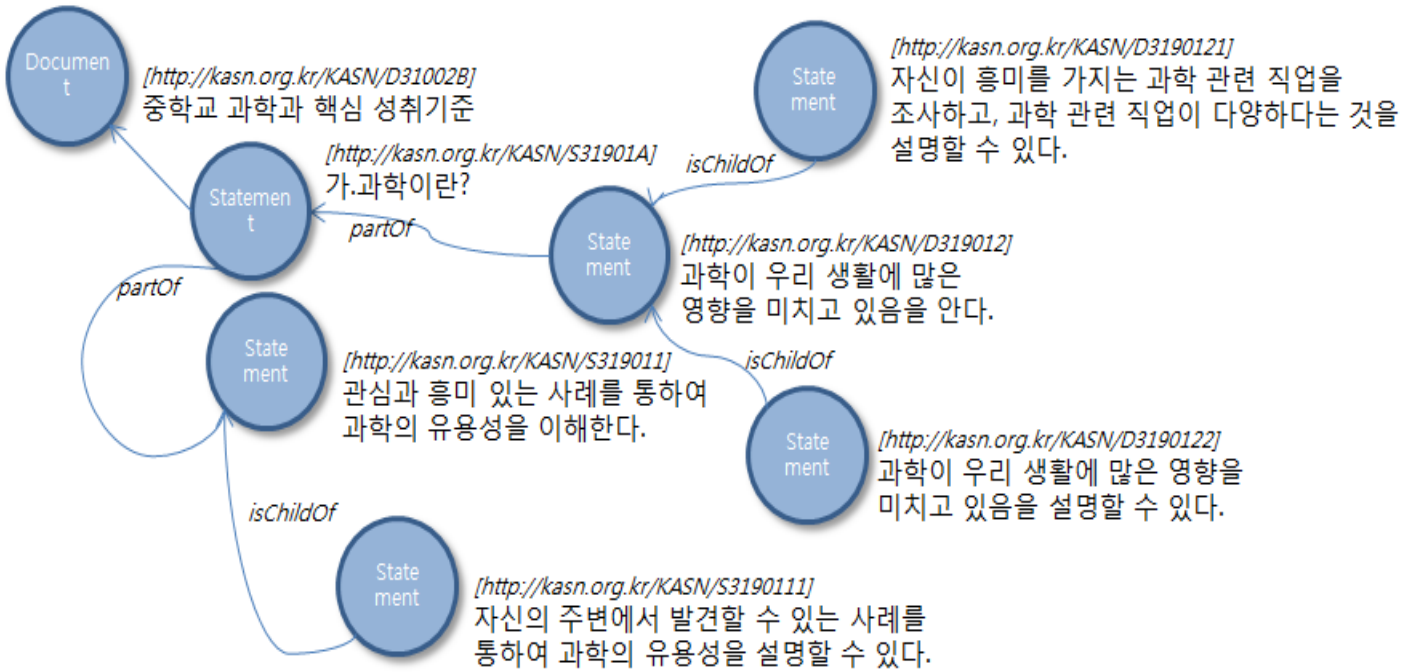
- **An example of the achievement standards of the science subject of middle school.**

A. What is Science?

교육과정 내용	성취기준	핵심 성취 기준	핵심 성취기준 선정 근거
과9011. 관심과 흥미 있는 사례를 통하여 과학의 유용성을 이해한다.	과9011. 자신의 주변에서 발견할 수 있는 사례를 통하여 과학의 유용성을 설명할 수 있다.	√	·과학이란? 단원은 3개의 성취기준으로 구성되어 있으며, 이 중 1개를 핵심 성취기준으로 선정한다. ·과9011은 주변의 사례를 통하여 과학의 유용성을 인식하도록 하는 것으로, 이는 과학에 대한 긍정적인 태도 함양에 중요하므로 핵심 성취기준으로 선정한다. 또한 이 성취기준은 과9012-2를 포괄할 수 있다.
과9012. 과학이 우리 생활에 많은 영향을 미치고 있음을 안다. [탐구 활동] 과학 관련 직업 조사하기 [탐구 활동] 과학이 우리 생활에 미치는 영향 조사하기	과9012-1. 자신이 흥미를 가지는 과학 관련 직업을 조사하고, 과학 관련 직업이 다양하다는 것을 설명할 수 있다.		
	과9012-2. 과학이 우리 생활에 많은 영향을 미치고 있음을 설명할 수 있다.		

Achievement Statements Path

- **Hierarchical Path**
  - Achievement standards are composed of many statements, which have hierarchy relationships

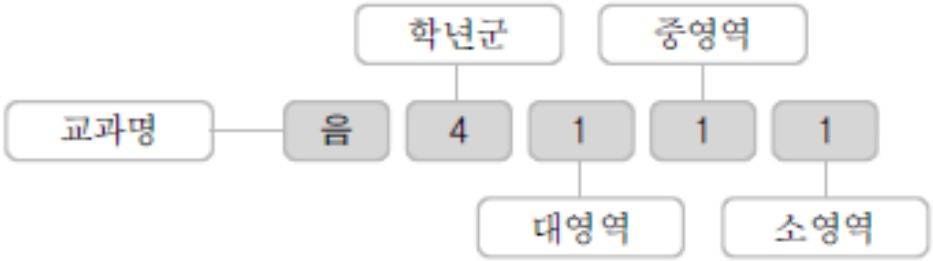


Code Format

- **Achievement Statement Code Format**

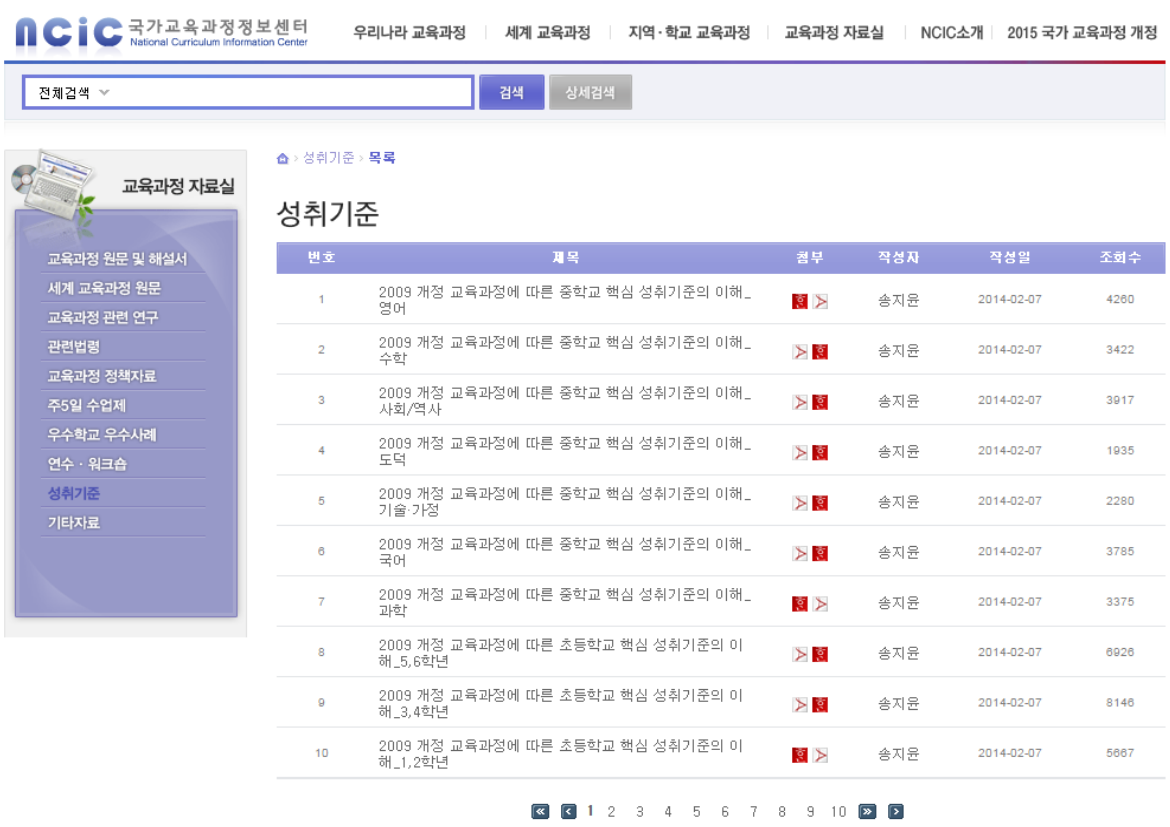
School Grade	Coding
Elementary 1-2 grade	2
Elementary 3-4 grade	4
Elementary 5-6 grade	6
Middle 1-3 grade	9

Section	Subsection	Detailed statement
1. 표현	1-1. 바른 자세로 표현하기	(1) 바른 자세로 노래 부를 수 있다.
		(2) 바른 자세와 주법으로 악기를 연주할 수 있다.



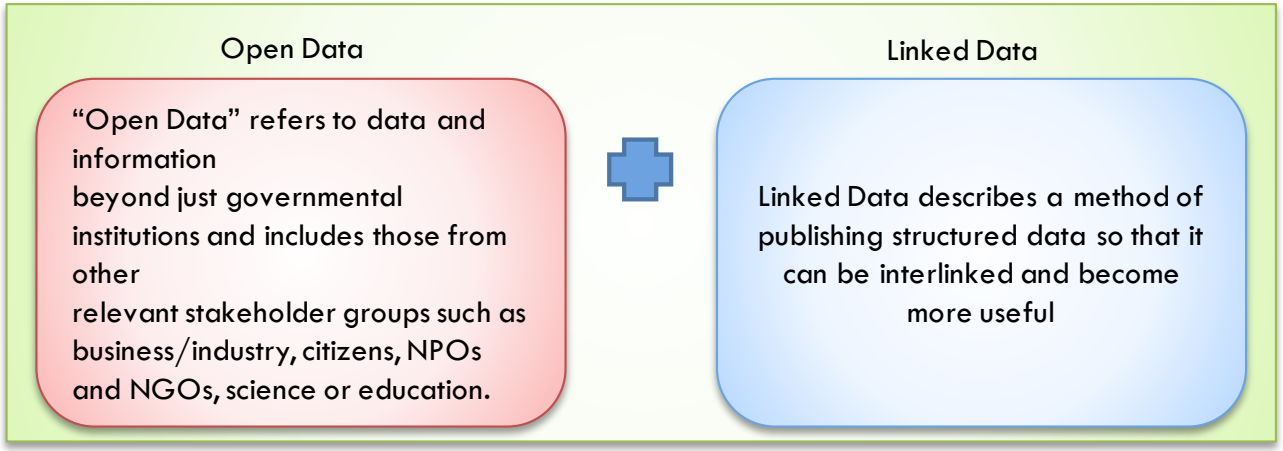
Achievement Standards Repository

- **Need of the digitized achievement standards**
  - It is necessary to convert the contents of achievement standards distributed presently in a document format for each subject into a data structure that a machine can process through conversion to data and hierarchical structuralization.
  - Approaches
    - RDB(ER Modeling)
    - Linked Data



What is Linked Open Data?

- **Linked Open Data**



Wikipedia

Exposing, sharing, and connecting pieces of data, information, and knowledge on the Semantic Web using URIs and RDF

Linked data describes a method of publishing structured data so that it can be interlinked and become more useful

Principles of Linked Data

- 1. Use URIs to identify things.
- 2. Use HTTP URIs so that these things can be referred to and looked up ("dereferenced") by people and user agents.
- 3. Provide useful information about the thing when its URI is dereferenced, using standard formats such as RDF/XML.
- 4. Include links to other, related URIs in the exposed data to improve discovery of other related information on the Web.

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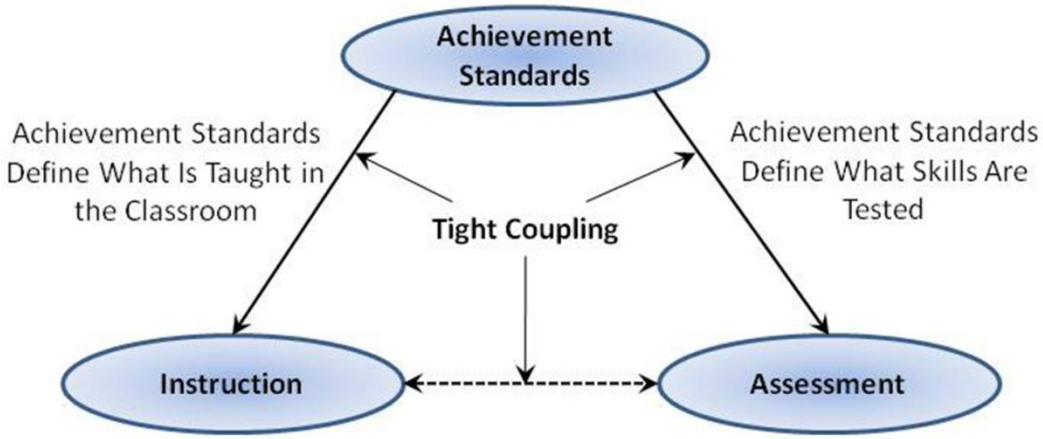
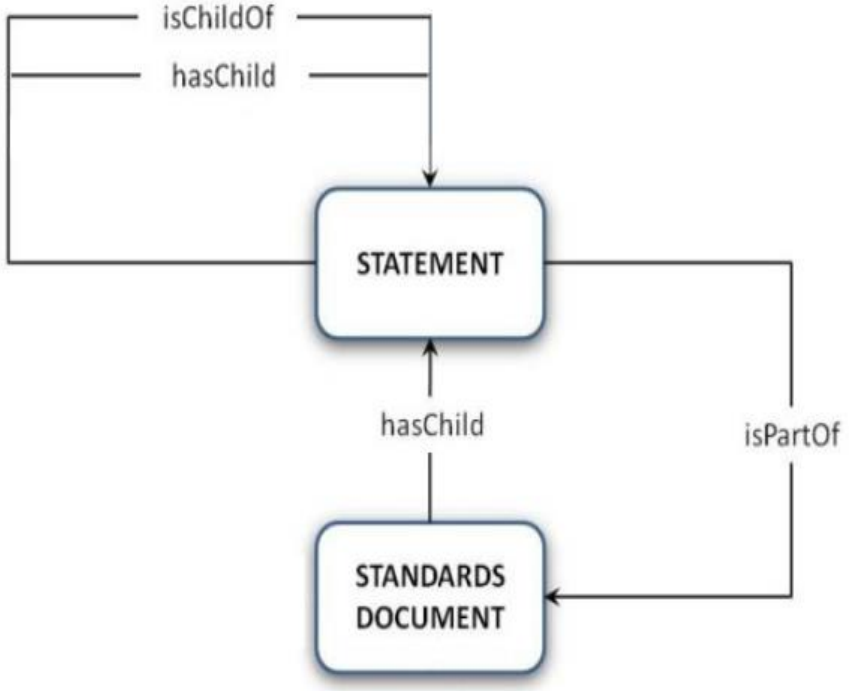
Overview of ASN

- **Achievement Standards**
  - Generic term indicating all forms of statements formally promulgated by a jurisdiction, community or organization to help shape teaching and learning in K-12 schools.
  - Curriculum standard describes what should take place in the classroom. Specifically, curriculum standards address instructional technique or recommended activities as opposed to knowledge and skill per se (Marzano & Kendall, 1997).
  - Content standards specify 'what students should know and be able to do.' They indicate the knowledge and skills—the ways of thinking, working, communicating, reasoning, and investigating, and the most important and enduring ideas, concepts, issues, di ɔuld be taught and learr



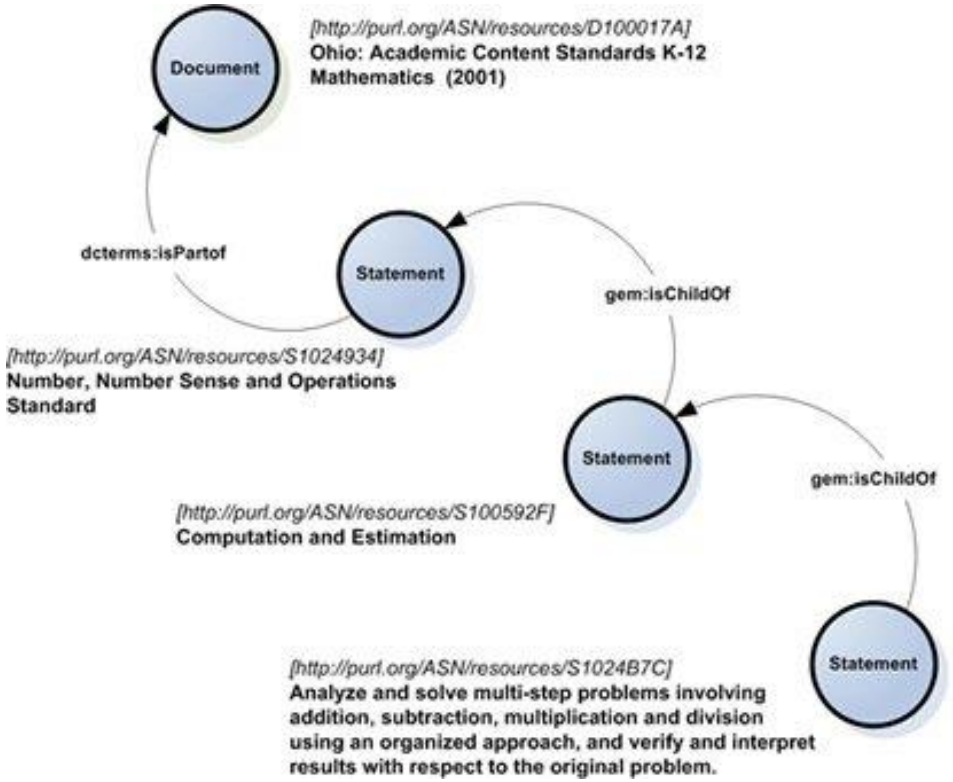
Overview of ASN

- **Achievement Standards Network**
  - The ASN is made up of two fundamental entities: (1) standards documents, and (2) statements.
  - ASN takes each standards document as it is produced by its official promulgating agency and "atomizes" its content into atomic statements.
  - These two entities—documents and statements—are framed in terms of an entity-relationship model (ER) and embodied in RDF/XML (Resource Description Framework).
  - Both structural and semantic relationships between the ASN's primary entities—the standards document entity and its atomic statement entities—have been defined.



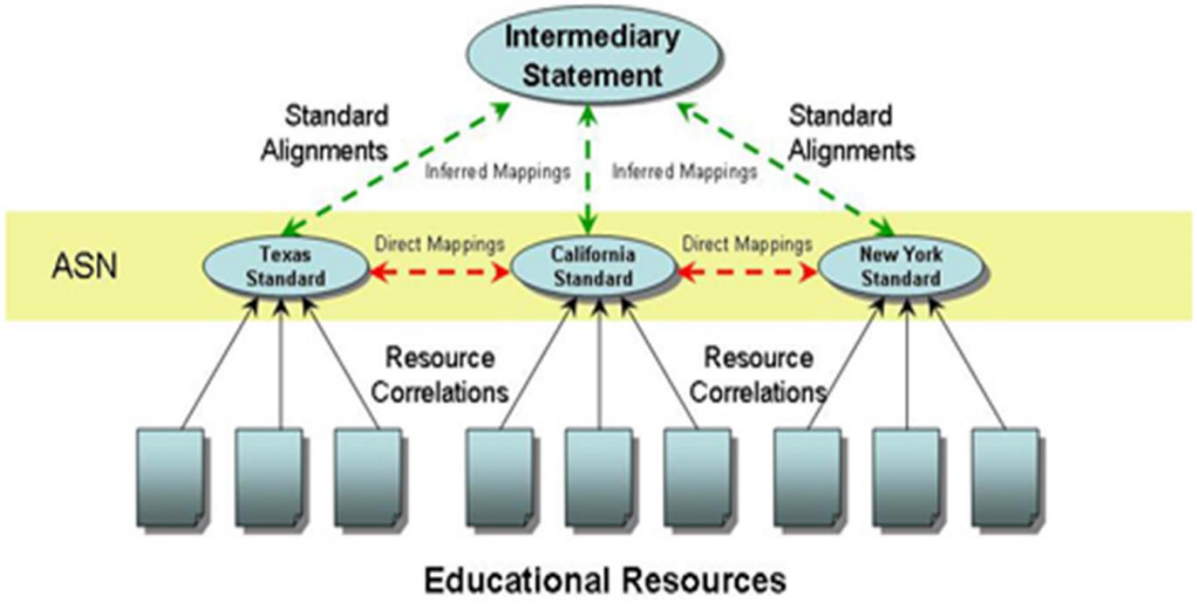
Overview of ASN

- **ASN Taxon Paths**
  - A single traversal of a branch of a standards document--here from the root (i.e., the standards document description) to a leaf (i.e., a statement at some arbitrary level in the branch hierarchy).



Overview of ASN

- **ASN Goals**
  - Create an international repository of curriculum in machine addressable form that
    - **Are accurate digital representations of curriculum and their component statements (semantic units);**
    - **Are consistent in form; and**
    - **Are modeled in RDF and amenable to the**
    - **Semantic Web**



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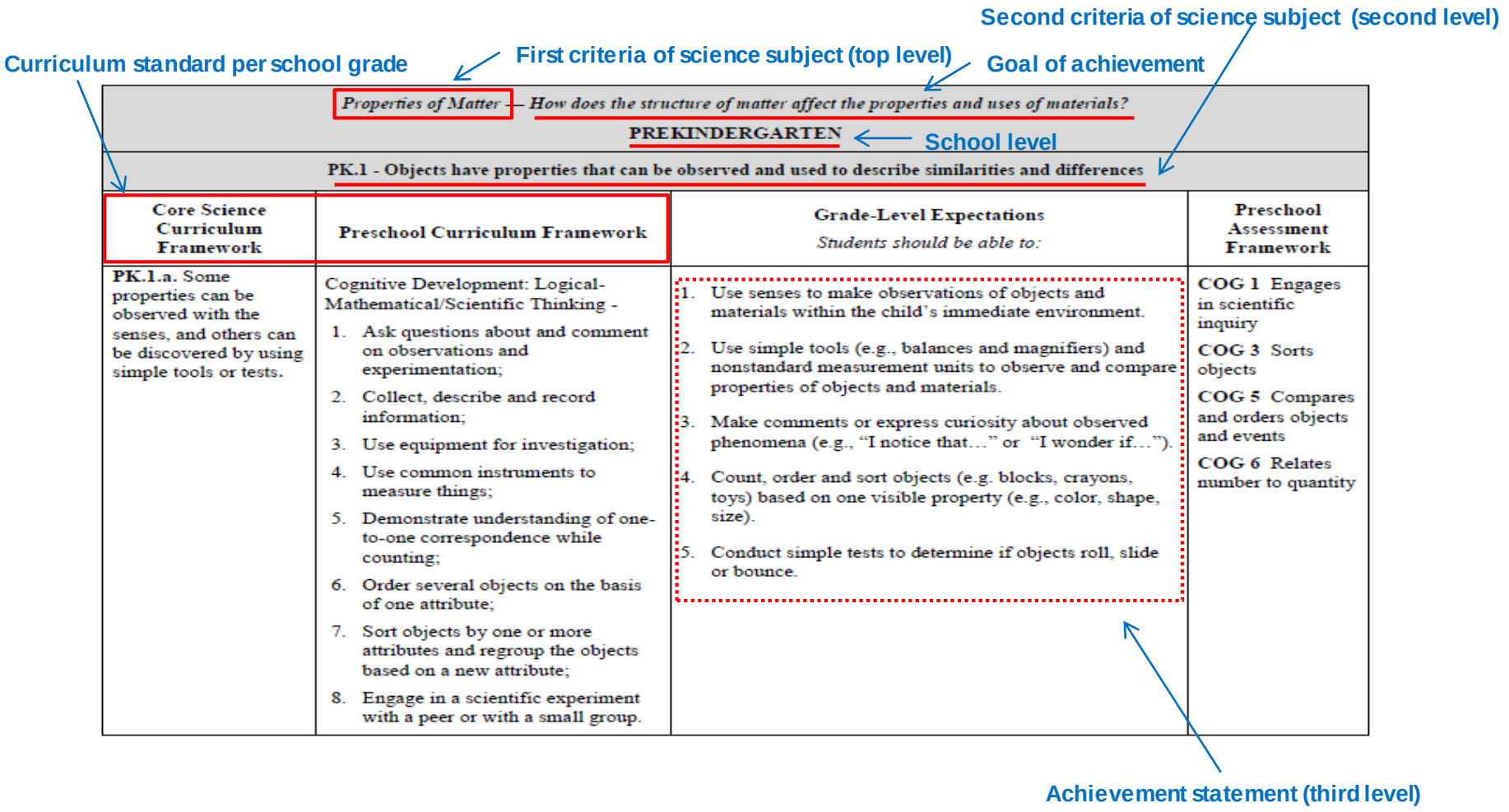
ASN Documents and Implementation

- ASN Achievement Standards Document and Implementation



Properties of Matter — *How does the structure of matter affect the properties and uses of materials?*

PREKINDERGARTEN

PK.1 - Objects have properties that can be observed and used to describe similarities and differences

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ASN Documents and Implementation

- **ASN Achievement Standards Document and Implementation**
  - All data of the standard are registered into ASN Framework and can be browsed each information on the web

Connecticut Science Curriculum Grade-Level Expectations

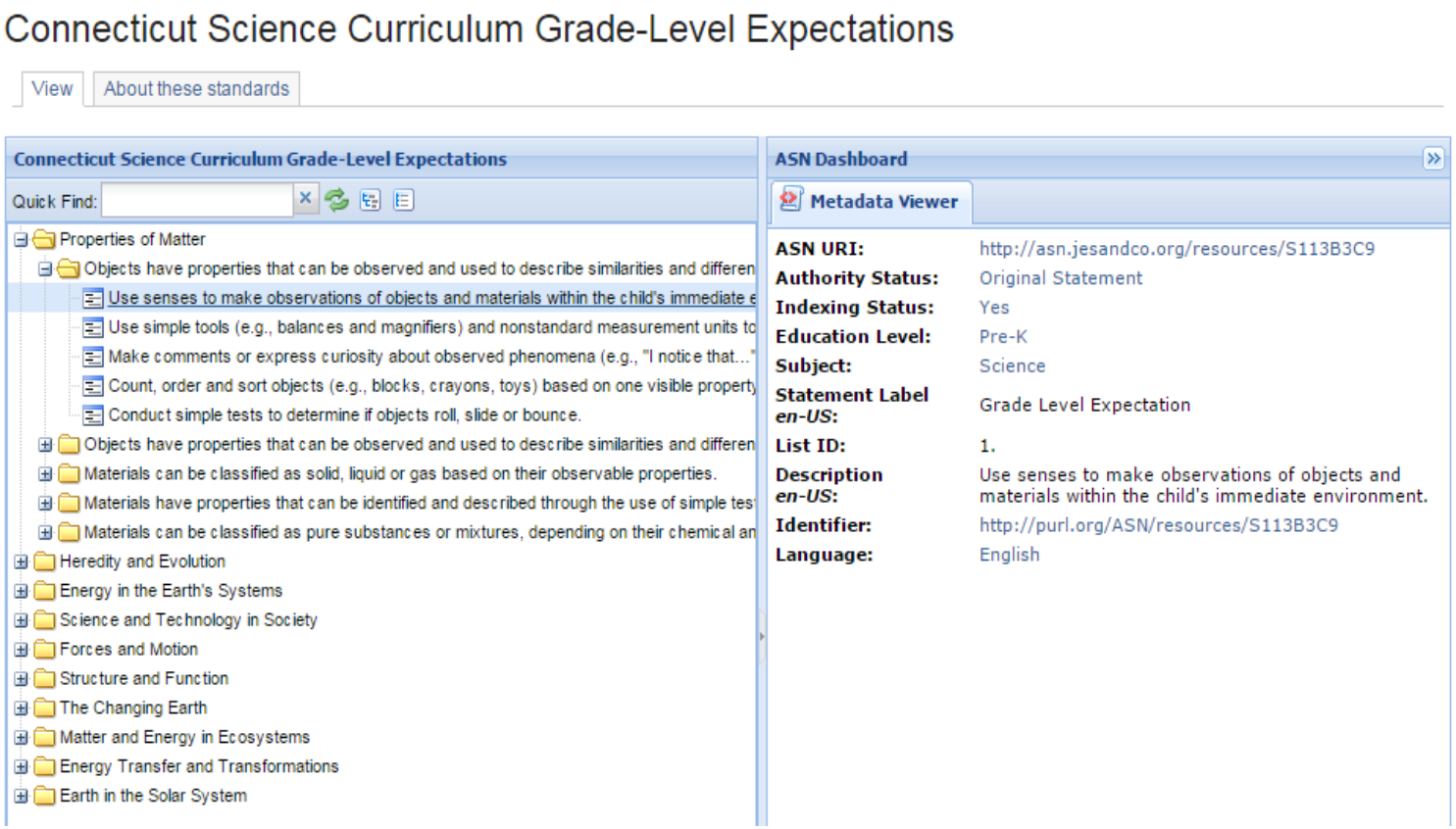
View | About these standards

About this resource:

Title *en-US*: Connecticut Science Curriculum Grade-Level Expectations
Description *en-US*: The Connecticut Prekindergarten-Grade 8 Science Curriculum Standards Including Grade-Level Expectations is a resource that supports the use of the 2004 Core Science Curriculum Framework to develop rigorous science curriculum, instruction and assessments. Grade-level expectations (GLEs) are instructional guidelines that describe what students should be able to do to demonstrate the science knowledge and abilities they have developed as a result of a series of learning experiences and a comprehensive curriculum.
Publication Status: Published
Subject: Science
Education Level: Pre-K, K, 1, 2, 3, 4, 5, 6, 7, 8
Language: English
Source: http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/pk8_science_curriculums...
Date Valid: 2010
Repository Date: 2011-03-02
Author *en-US*: Connecticut State Department of Education
Publisher *en-US*: Connecticut State Department of Education
Identifier: http://purl.org/ASN/resources/D10003B3
Manifest: http://asn.jesandco.org/resources/D10003B3/manifest.json

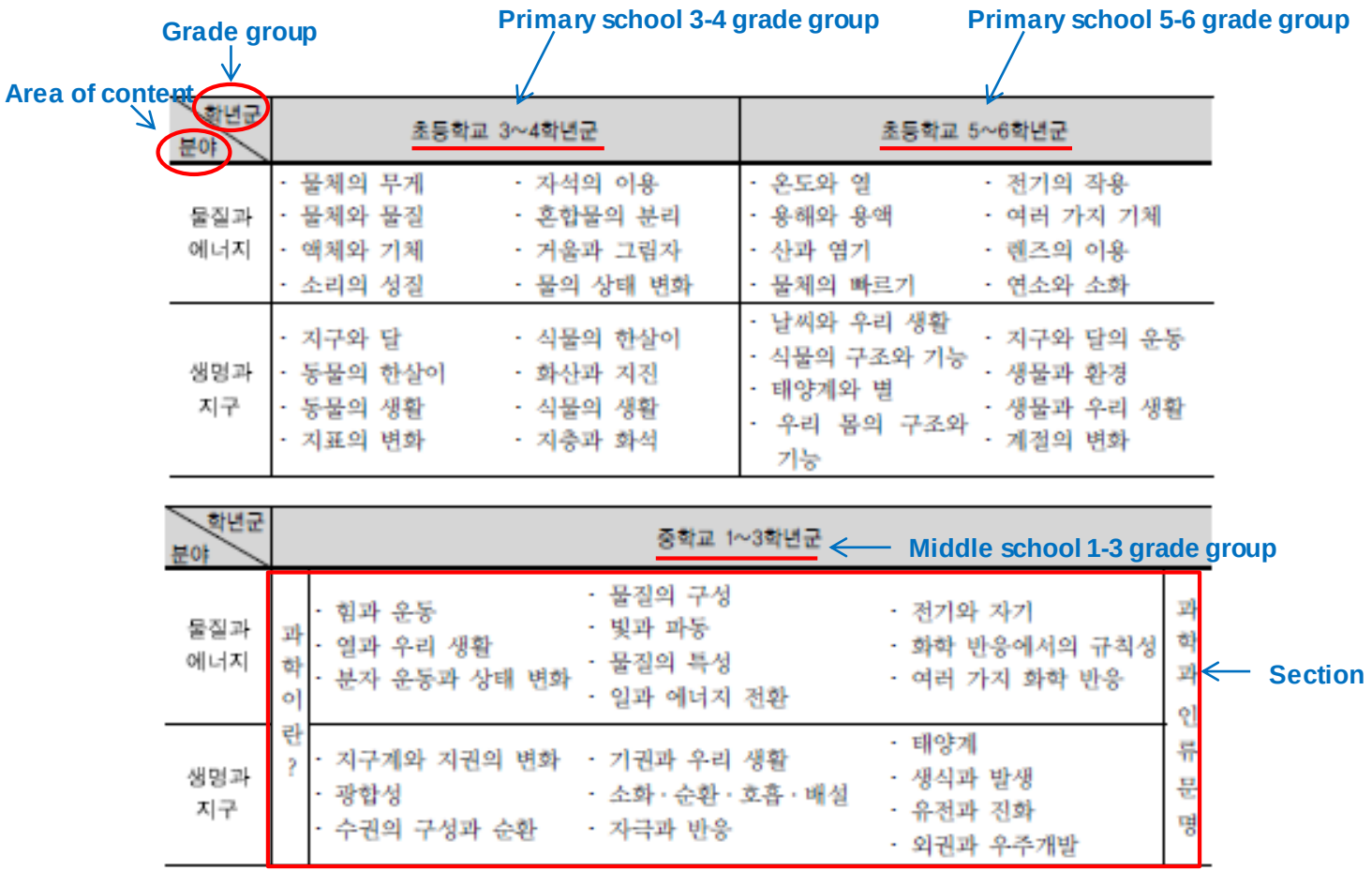
ASN Documents and Implementation

- **ASN Achievement Standards Document and Implementation**
  - Achievement stated in the document could be interpreted to metadata applied ASN entity and properties as follows:



Korean Achievement Standards Document

- **The curriculum standard area of content per education level**



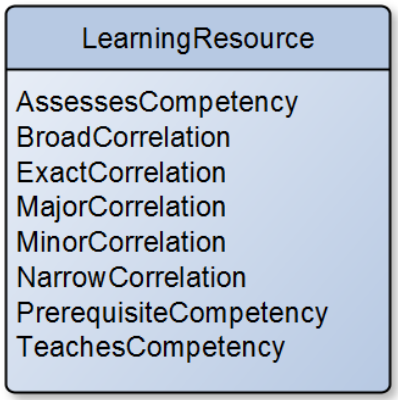
Korean Achievement Standards Document

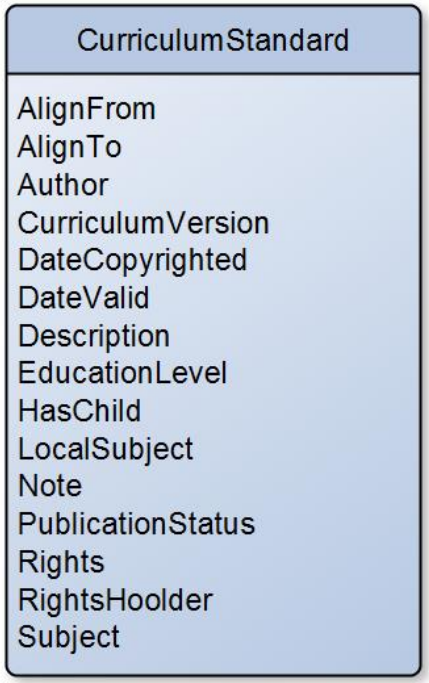
- **Definition of Korean Achievement Standards Document**
  - According to ASN class/property model, Korean achievement standards documents can be defined as follows:

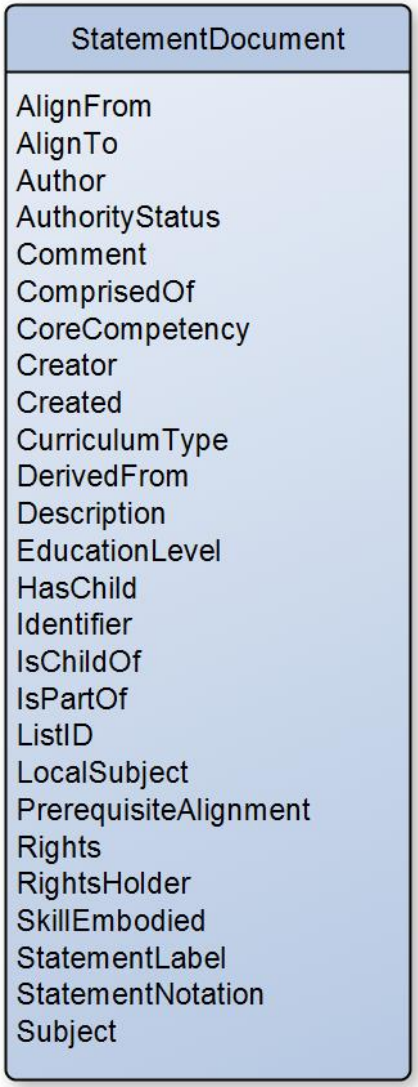
    - **Title (*en*):** Science subject curriculum
    - **Description (*en*):** *(omission)*
    - **Publication Status:** Published
    - **Subject:** Science
    - **Education Level:** K-3, 4, 5, 6, 7, 8, and 9
    - **Language:** Korean
    - **Source**: http://ncic.re.kr/nation.dwn.ogf.inventoryList.do
    - **Date Valid:** 2011
    - **Repository Date:** 2012-12
    - **Author (*en*):** Ministry of Education
    - **Publisher (*en*):** Ministry of Education

Korean Achievement Standards Model

- **Based on three classes of ASN profile**
  - CurruculumStandard(StandardDocument)
  - StatementDocument(AchievementStatement)
  - LearningResource

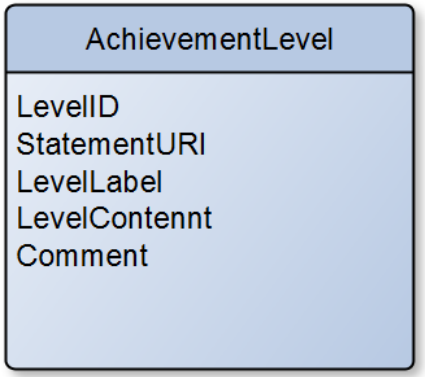


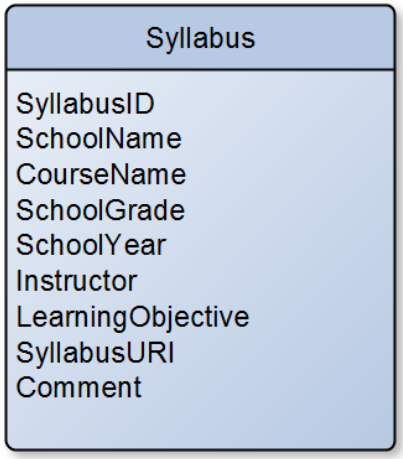




Korean Achievement Standards Model

- **Additional Entities**
  - Achievement Level
  - Teaching/Learning Plan





<표 Ⅱ-14> 중학교 최대공약수와 최소공배수에 대한 성취수준 진술

성취기준	성취수준	
수91013-1. 최대공약수의 성질을 이해하고, 이를 구할 수 있다.	상	소인수분해를 이용하여 세 자연수의 최대공약수를 구할 수 있다.
	중	소인수분해를 이용하여 두 자연수의 최대공약수를 구할 수 있다.
	하	두 자연수의 최대공약수를 구할 수 있다.

Korean Achievement Standards Model

- **Implementation of Achievement Standards Linked Data**
  - Namespace definition
    - xmlns:asn="http://purl.org/ASN/schema/core/"
    - xmlns:dc="http://purl.org/dc/elements/1.1/"
    - xmlns:skos="http://www.w3.org/2004/02/skos/core#
  - RDF/OWL specification

```
<asn:Statement rdf:about="http://kasn.keris.org/resources/S382119">
    <dcterms:isPartOf rdf:resource="http://kasn.keris.org/resources/D10003B3"/>
    <asn:authorityStatus rdf:resource="http://purl.org/ASN/scheme/ASNAuthorityStatus/Original"/>
    <asn:indexingStatus rdf:resource="http://purl.org/ASN/scheme/ASNIndexingStatus/No"/>
    <dcterms:educationLevel rdf:resource="http://purl.org/ASN/scheme/ASNEducationLevel/7"/>
    <dcterms:educationLevel rdf:resource="http://purl.org/ASN/scheme/ASNEducationLevel/8"/>
    <dcterms:educationLevel rdf:resource="http://purl.org/ASN/scheme/ASNEducationLevel/9"/>
    <dcterms:subject rdf:resource="http://purl.org/ASN/scheme/ASNTopic/science"/>
    <asn:statementNotation xml:lang="ko">과9011</asn:statementNotation>
    <dcterms:description xml:lang="ko">자신의 주변에서 발견할 수 있는 사례를 통해 과학의 유용성을 설명할 수 있다
</dcterms:description>
    <gemq:hasChild rdf:resource="http://kasn.keris.org/resources/S382119A"/>
    <gemq:isChildOf rdf:resource="http://kasn.keris.org/resources/D10003B3"/>
</asn:Statement>
```

Q&A