

# Introducing Canonical Structures over a Domain-Specific Collection

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# Motivation

## Lesson: The NXT Circuit

Submitted by [Randy Steele](#) on 10 July, 2011 - 16:13

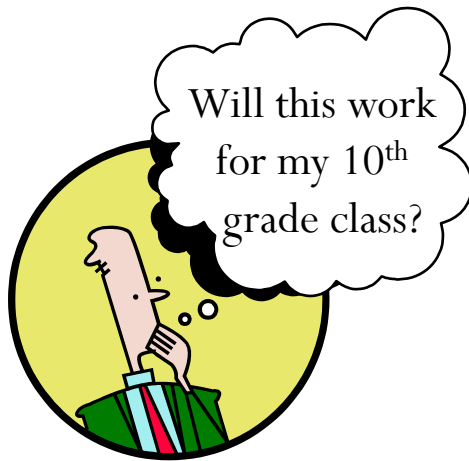
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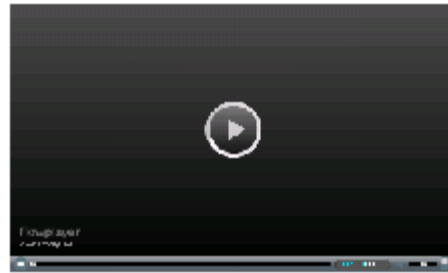
**Overview:**  
This lesson explores the NXT from an electrical circuit perspective. It is intended to follow the "Circuits and Switches" lesson.

**Objectives:**  
Students will be able to:  
1. Describe the components of an electrical circuit.  
2. Explain the function of various semiconductors.

Linked as the primary instructional material in a 7<sup>th</sup> grade course



## NXT Circuit Video



## Tutorial Unit: Essentials: NXT Tutorial by Dale Yocum

Submitted by [Lois Delcambre](#) on 21 July, 2011 - 16:21

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These lessons assume you have a basic robot built. See the RoboCenter or Robot Educator in the NXT Editor. You can also download a paper copy that came with your set.

**Instructional Materials:**  
Introduction to the NXT  
The NXT Editor  
Moving the NXT  
Looking at the NXT  
Working with the NXT  
Using the NXT  
Using the NXT  
Using the NXT  
Using the NXT  
Using the NXT

Linked as a tutorial in a 12<sup>th</sup> grade afterschool program

## Concept: Circuit

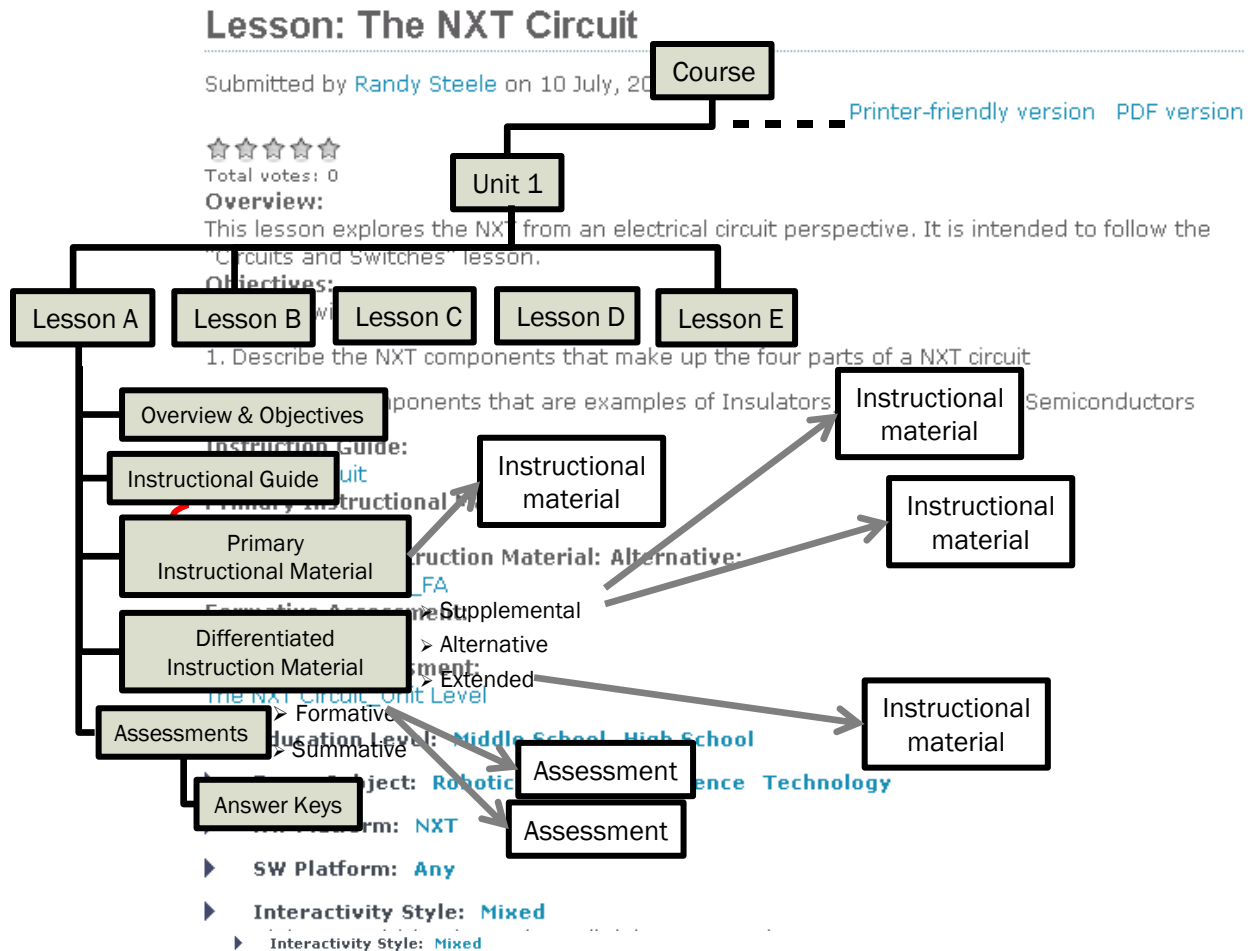
Submitted by [Don Domes](#) on 1 October, 2011 - 11:21

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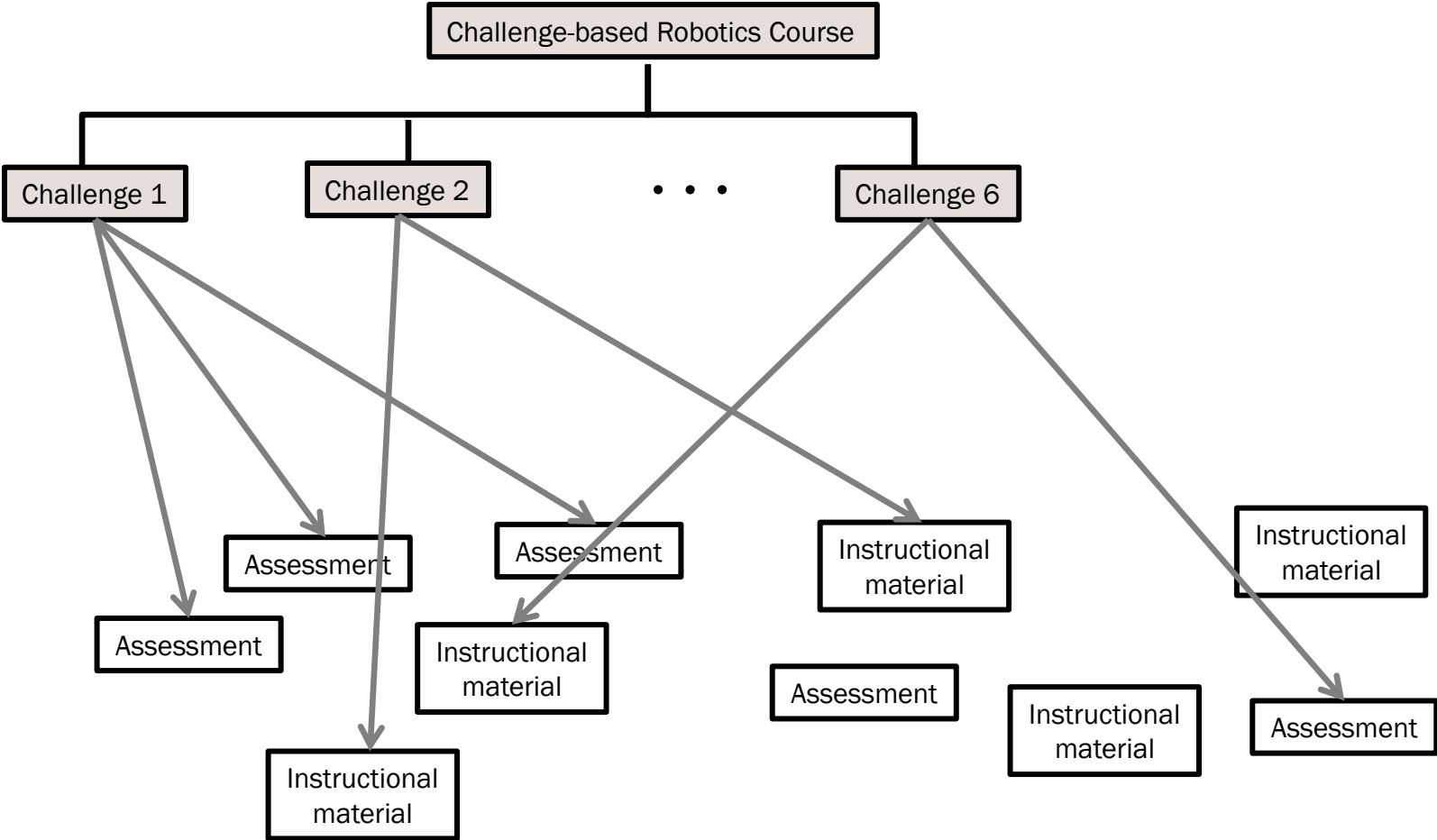
**Definition:**  
An **electronic circuit** is composed of individual electronic components, such as resistors, transistors, capacitors, and integrated circuits, which are connected by conductive wires or traces through which electric current flows. These components and wires allows various simple and complex operations to be performed. Circuits can be amplified, computations can be performed, and signals can be sent from one place to another. Circuits can be constructed using a variety of technologies. While traditionally they were made on a printed circuit board (PCB), modern circuits are often constructed on a laminated substrate. The most common type of circuit is the integrated circuit (IC), which is a silicon chip that contains thousands of interconnected components and is used to perform a specific function. The most common type of IC is the microprocessor, which is used to control the operation of a computer or other electronic device.

Linked to the concept of a circuit in a 9<sup>th</sup> grade course

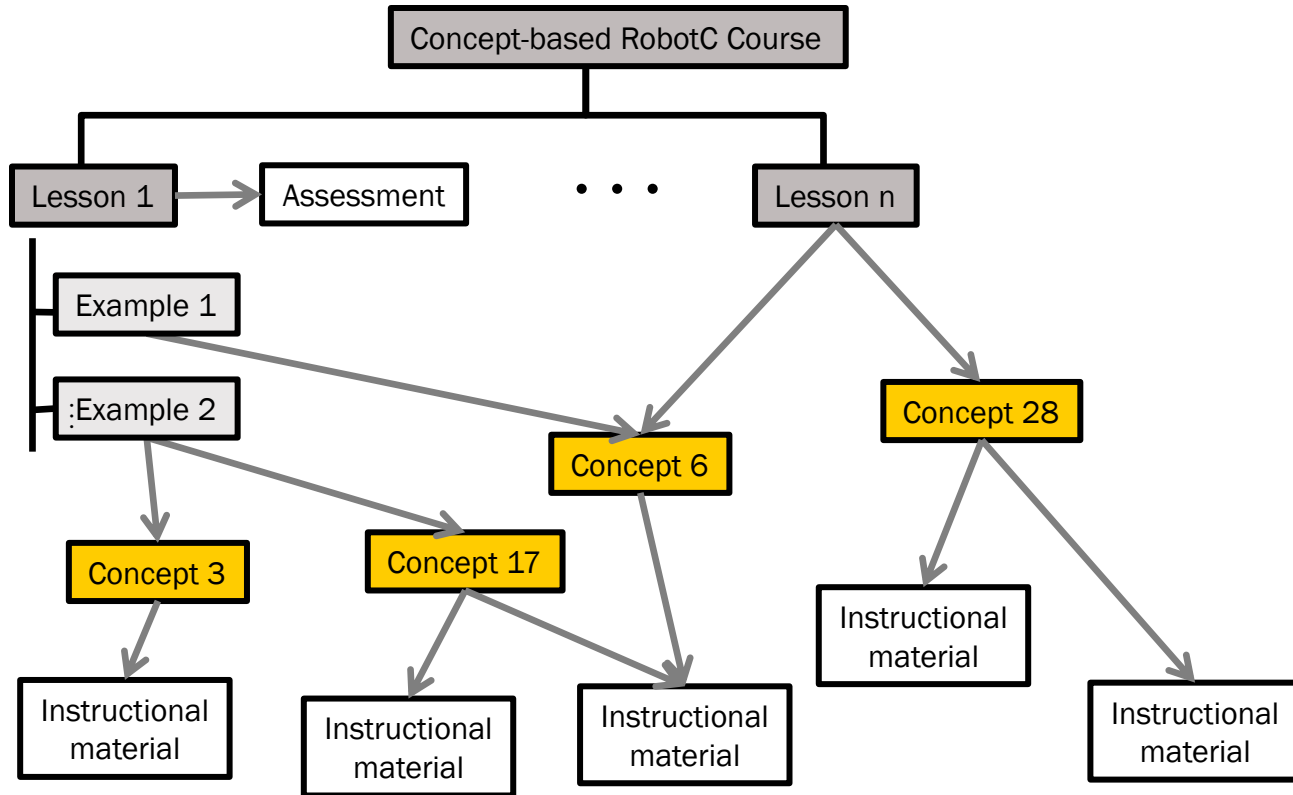
# One possible schema for educational material



# Another schema for educational materials



# Yet another schema for educational materials



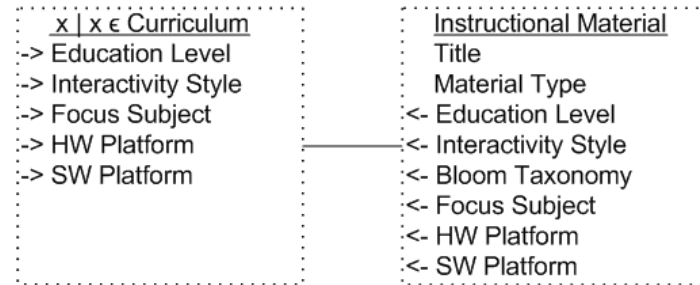
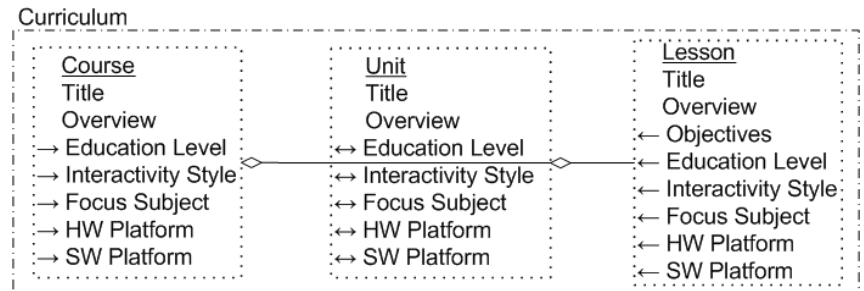
# The problem/opportunity

- Within a domain there are recurring structures
  - Courses, units, lessons ...
- Yet these structures may be arranged in a range of different configurations
  - Lecture-based courses, Challenge-based courses, ...
- Within a domain, objects are informed by the context where they reside. Descriptive information can be inferred from the contexts
  - From interrelationships between objects in the domain
    - Instructional materials referenced as extended differentiated material in a lecture-based course are only intended for advanced students
  - From the attributes of related entities
    - The grade level of an instructional material can only be inferred from the grade levels of the courses that reference it

# Our approach

- Capture the inherent commonalities of a domain in a set of canonical structures that
  - Are schema fragments
  - Represent the **notable** entities, relationships, and attributes
- Map the canonical structures to the existing domain schemas in a pay-as-you-go fashion
- Exploit the canonical structures to
  - Reflect attributes
  - (Re)rank – for searching and browsing
  - Query the domain

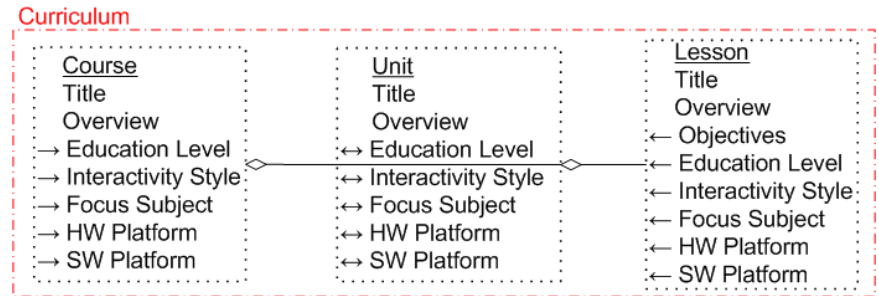
# Some canonical structures for educational materials



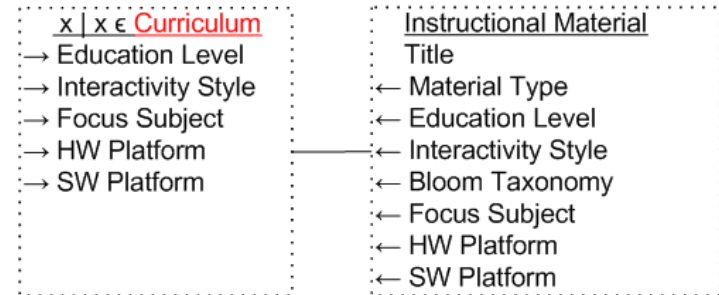


# Canonical structure features

- Entities may be grouped

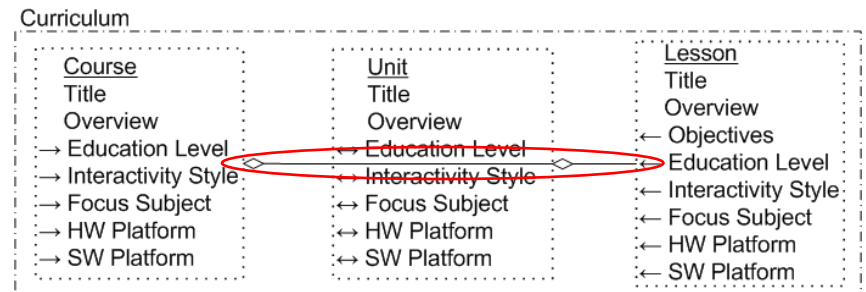


- Entity groups may be used in other structures

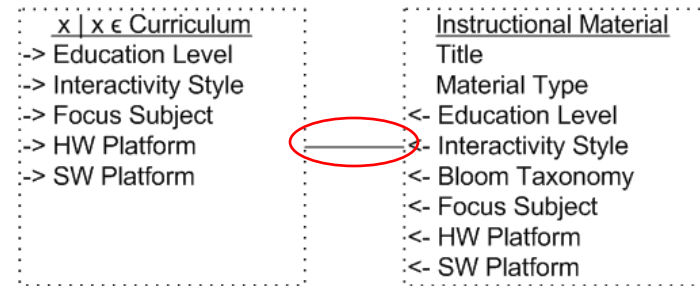


# Canonical structure relationships

- Aggregation
  - May be many-many
  - May pass-through entities  
*(i.e., entities may be missing)*
  - Data must be acyclic

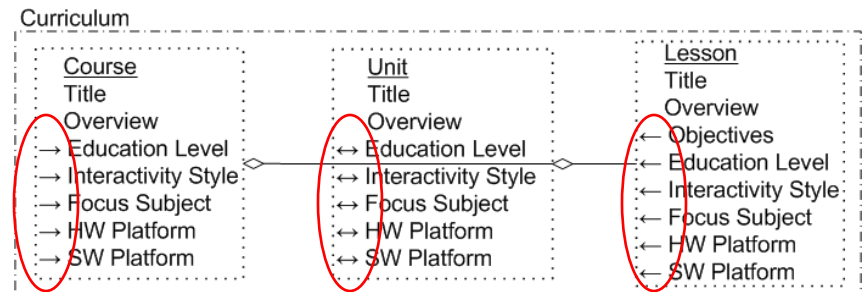


- Regular

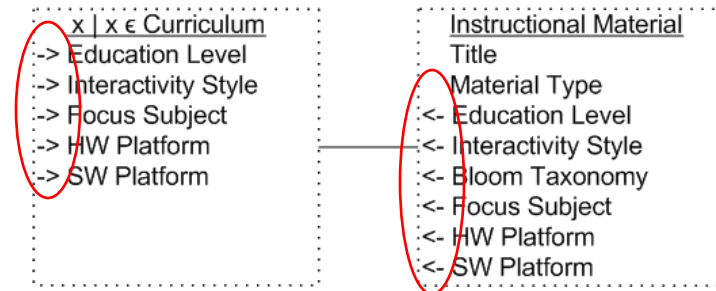


# Canonical structure attributes

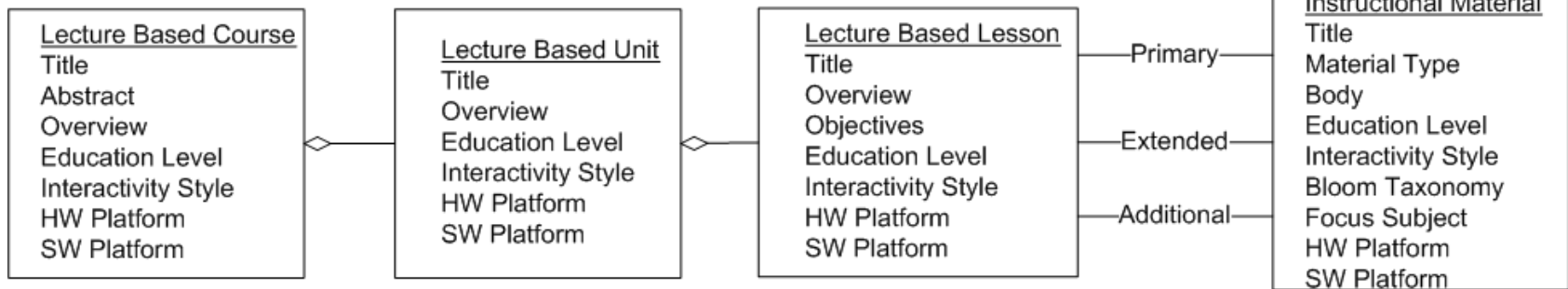
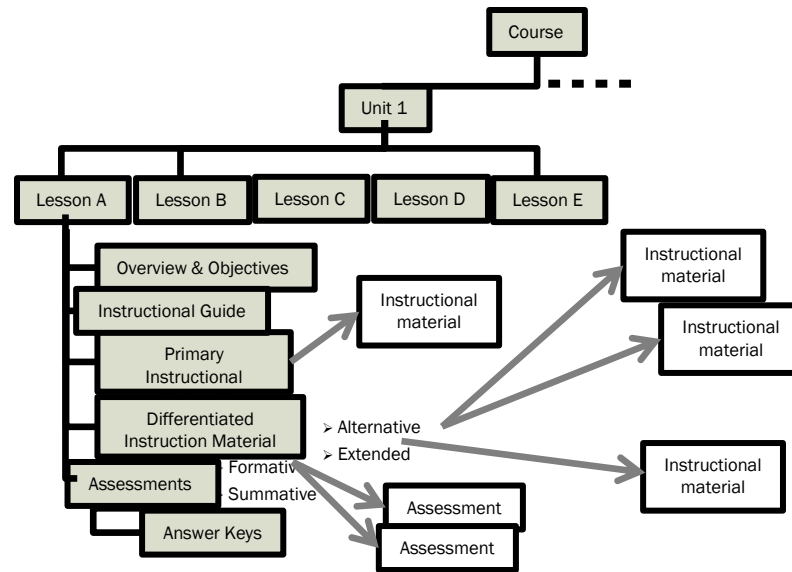
Attributes can reflect  
across relationships



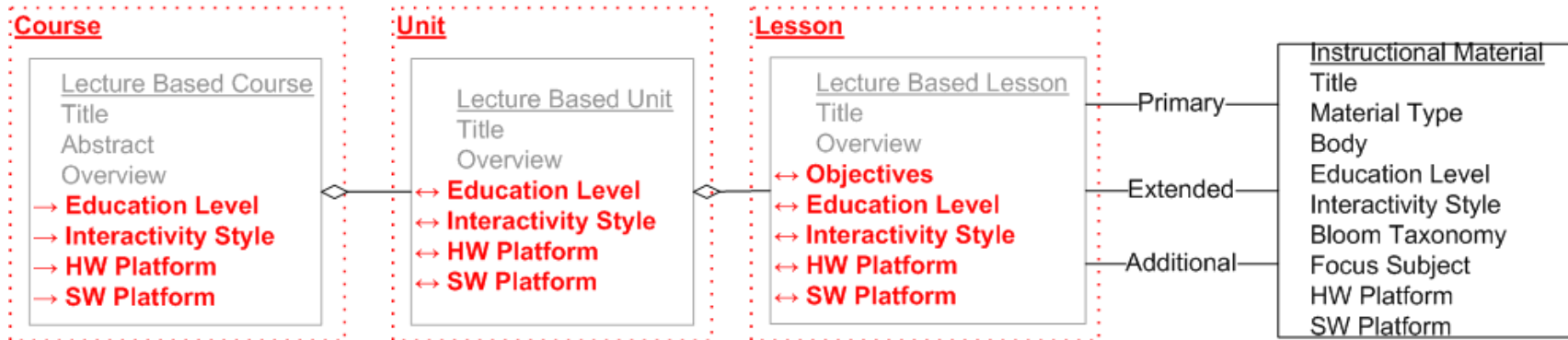
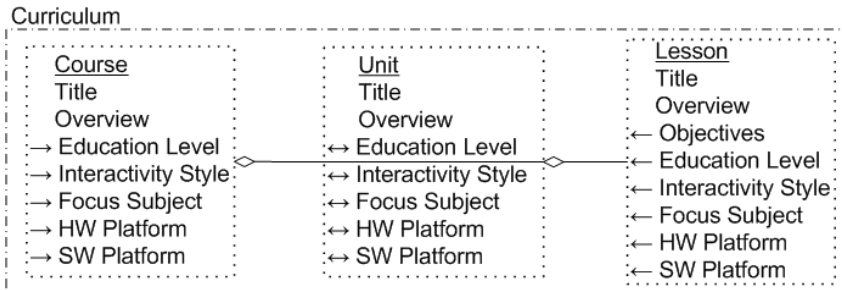
- Are accessible to (viewable by) related entities
- Can travel in both directions across a relationship
- Do not impose local values (i.e. reflection is not inheritance)



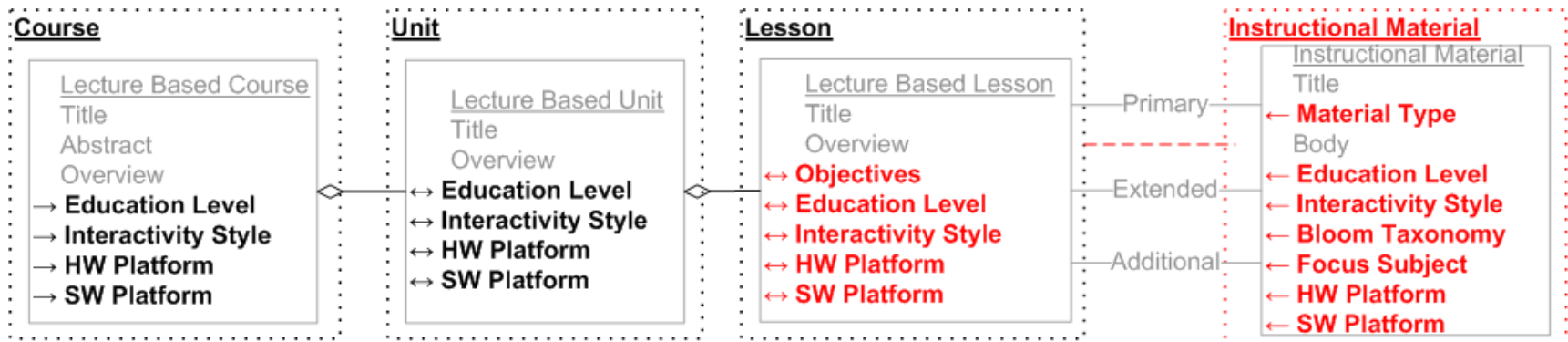
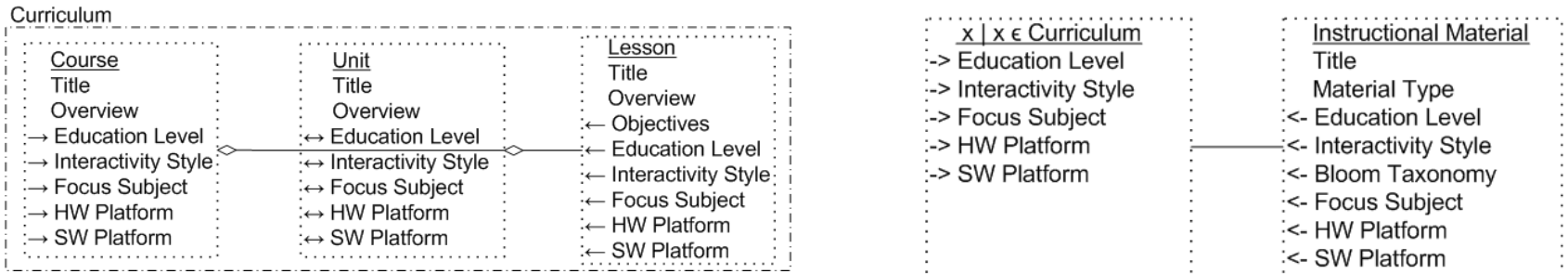
# Mapping the Canonical Structures to the Domain Schemas



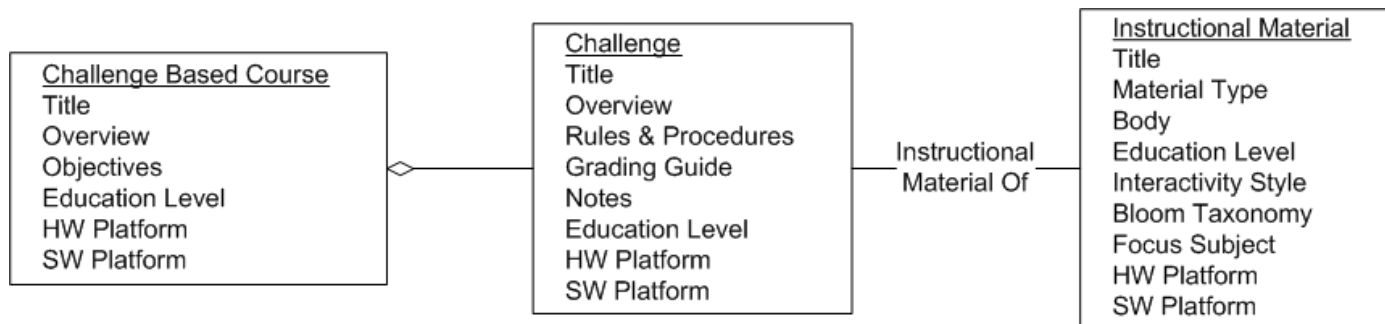
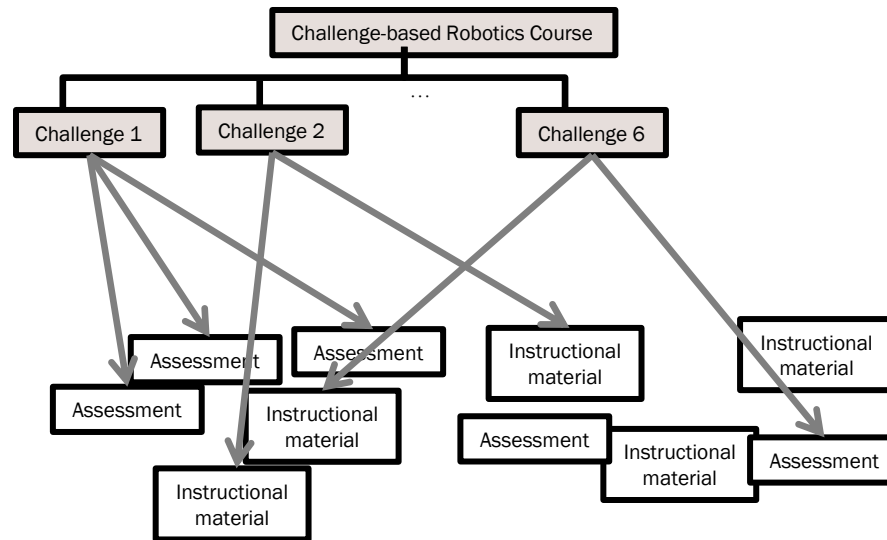
# Mapping the Canonical Structures to the Domain Schemas



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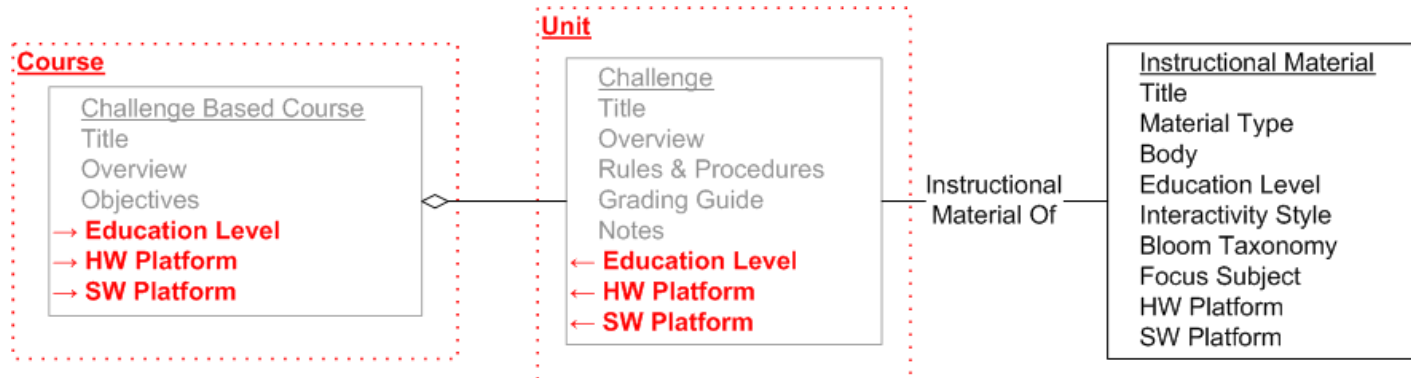
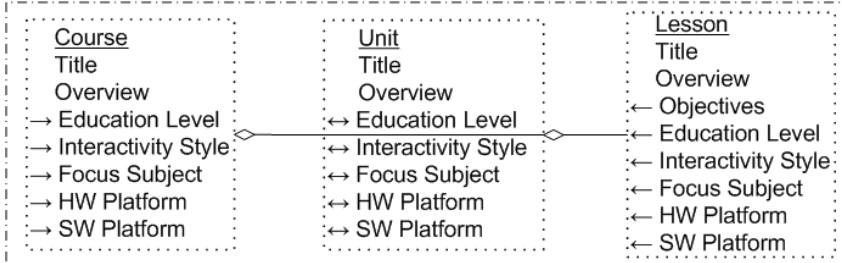


# Mapping the Canonical Structures to the Domain Schemas



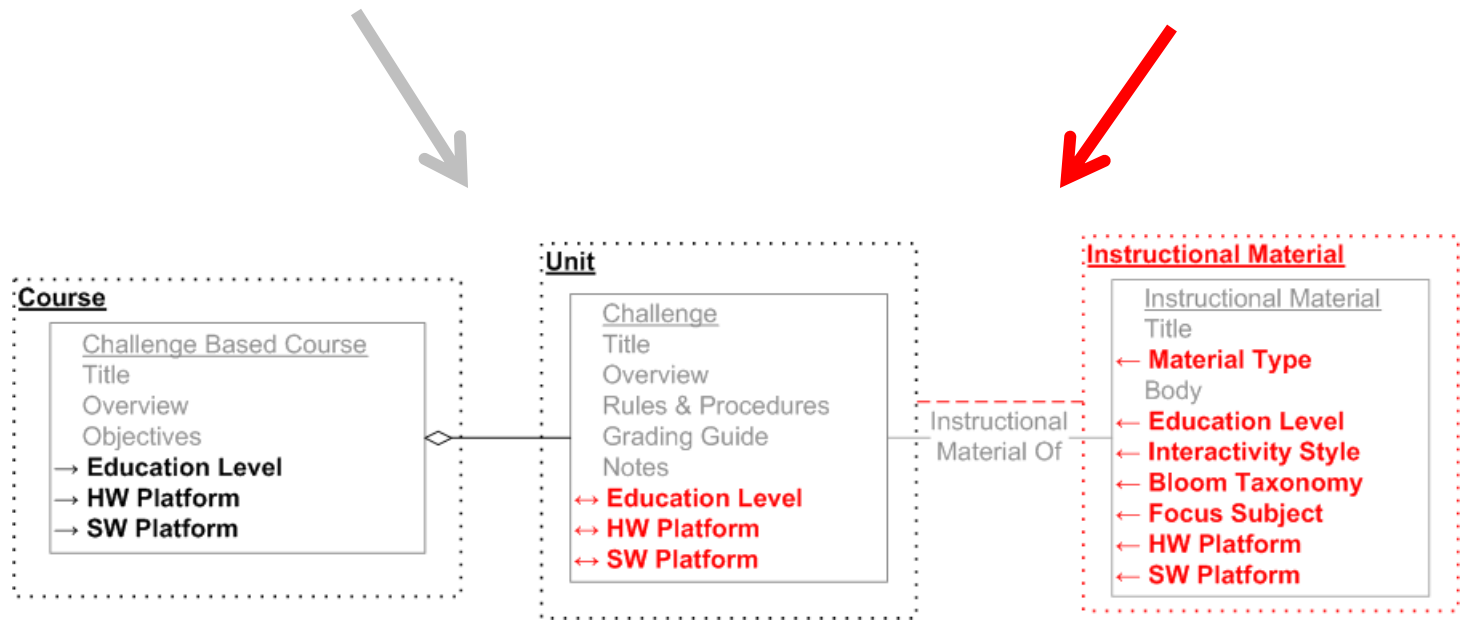
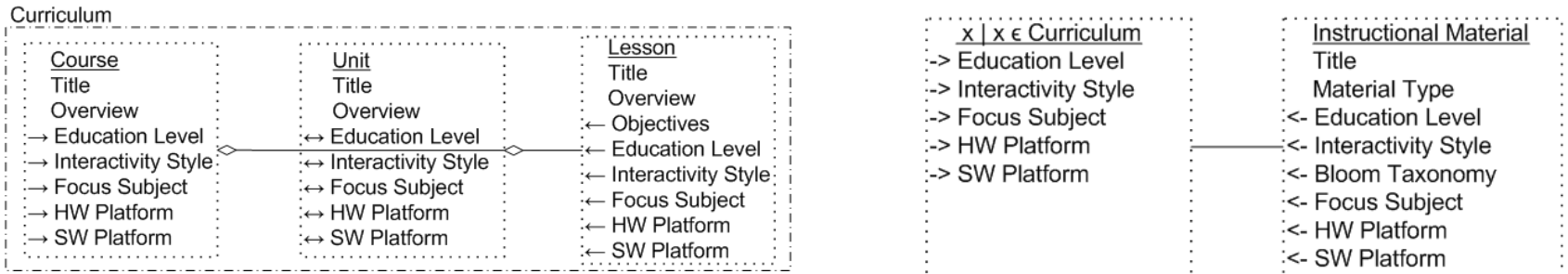
# Mapping the Canonical Structures to the Domain Schemas

## Curriculum



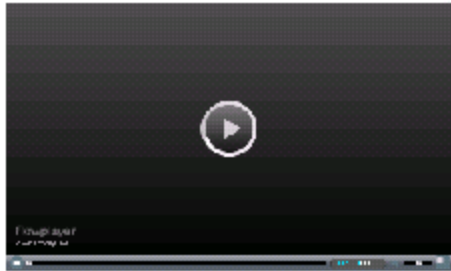


# Mapping the Canonical Structures to the Domain Schemas



# Leveraging canonical structures

What are the grade levels of classes that use this video?



Grade 7 Grade 9 Grade 12 Middle School High School

## Lesson: The NXT Circuit

Submitted by Randy Staele on 10 July, 2011 - 16:13

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Total votes: 0

### Overview:

This lesson explores the NXT from an electrical circuit perspective. It is intended to follow the "Circuits and Switches" lesson.

### Objectives:

Students will be able to:

1. Describe the NXT components that make up the four parts of a NXT circuit.
2. Name NXT components that are examples of Insulators, Conductors and Semiconductors

### Instruction Guide:

The NXT Circuit

**Primary Instructional Material:**  
The NXT Circuit

**Differentiated Instruction Material: Alternative:**  
The NXT Circuit\_AR\_FA

**Formative Assessment:**  
The NXT Circuit\_FA

**Summative Assessment:**  
The NXT Circuit\_Unit Level

Grade 7

## Concept: Circuit

Submitted by Don Domes on 10 October, 2011 - 11:21

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### Definition:

An **electronic circuit** is composed of individual electronic components, such as resistors, transistors, capacitors, inductors, and diodes, connected by conductive wires or traces through which electric current can flow. The combination of components and wires allows various simple and complex operations to be performed: signals can be amplified, computations can be performed, and data can be moved from one place to another. Circuits can be constructed of discrete components connected by individual pieces of wire, but today it is much more common to create interconnections by photolithographic techniques on a laminated substrate (a printed circuit board or PCB). The components are connected to these interconnections to create a finished circuit. The most common components are silicon or (less commonly) gallium arsenide.

**Instructional Material:**  
The NXT Circuit

Grade 9

## Tutorial Unit: Essentials: NXT Tutorial by Dale Yocum

Submitted by Lois Delcambre on 21 July, 2011 - 16:21

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This lessons assume you have a basic robot built. See the RoboCenter or Robot Educator for the NXT Editor software for plans or use the paper copy that came with your set.

### Instructional Materials:

Introduction  
The NXT Circuit  
Editor Intro  
Move Blocks  
Move Exercise  
Loops  
Loop Exercise  
Wait  
Wait Exercise  
Light Sensor  
Light Exercise  
Viewing Sensors  
Switches  
Switch Exercise

Grade 12

# Leveraging canonical structures

## Course: STEM Robotics 101

Submitted by [Randy Steele](#) on 27 June, 2011 - 07:40

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## Instructional Material: Moving Straight\_Prim

Submitted by [Randy Steele](#) on 14 July, 2011 - 14:58

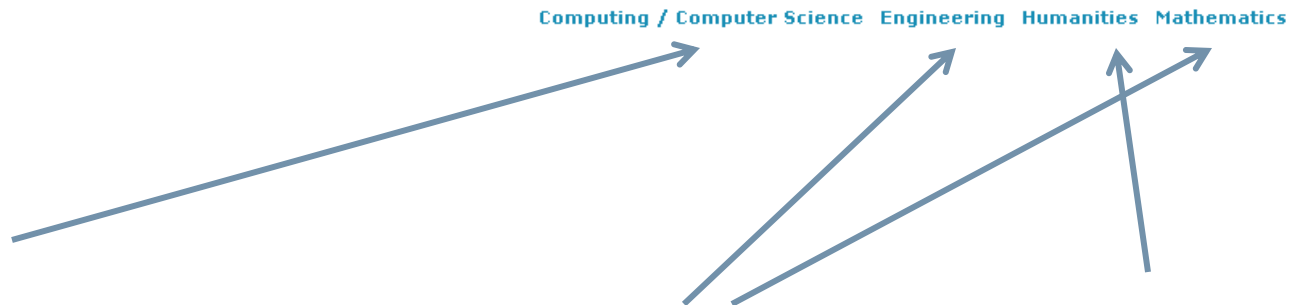
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Have students work through the "Moving Straight" video from the "Behaviors" page in "NXT Video Trainer 2.0" from Carnegie Mellon University's Robotics Academy.

- ▶ **Material Type:** Tutorial
- ▶ **Focus Subject:** [Computing / Computer Science](#)

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# Proposed Contributions

- New model
  - Built upon schema fragments
  - That captures the notion of attribute reflection
  - With appropriate schema mapping
- A formalism of that model
- An evaluation of the model, the formalism, the mappings, and the algorithms that exploit the model

# Related work

- Modeling
  - Semantic Data Models
  - Meta-modeling
  - Ontologies
- Semantic Web
- Schema Mapping
- Data Integration
  - Dataspaces
- Design Patterns

# Acknowledgements

- Collaborators:
  - Randy Steele Olympia School District, Olympia, WA
  - Rob Bryant - Gonzaga University, Spokane, WA
  - Richard Weiss - Evergreen State College, Olympia, WA
  - Don Domes and Devin Hunter - Hillsboro H.S, Hillsboro, OR
- This work is supported in part by NSF Project 0829651 and NSF Project 0840668

# Thank you

- Questions, comments, and insights?