

IQWST Materials: Meeting the Challenges of the 21st Century

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What will we do today?

- Describe the IQWST Project
- Show how IQWST features help meet 21st century skills
- Evidence for meeting 21st century skills
- Concluding comments



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Goals of IQWST

- Design, develop, and assess the next generation of middle school science materials
- Enable teachers to effectively teach students with a variety of backgrounds
- Explore core ideas from each scientific discipline each year
- Support students in building sophisticated and systematic understanding of scientific concepts and practices

Features of IQWST

- Coherence
- Learning-goals driven development
- Develop big ideas of science over time
- Project-based learning

Curriculum Coherence

- The alignment of the specified topic
- The depth at which the topic is to be studied
- The sequencing of the topics within each grade and across the grades
- Curriculum coherence leads to integrated understanding in learners.

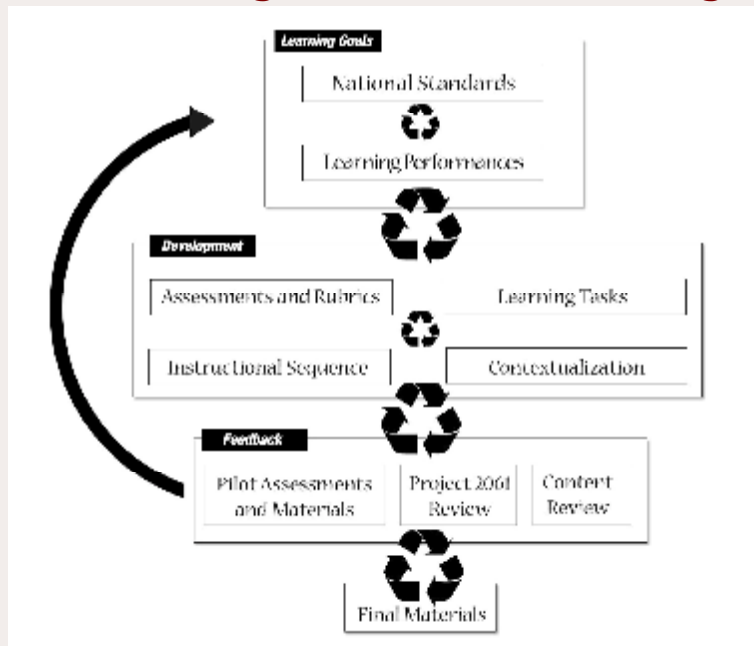
Coherence in IQWST

- Learning goal coherence: selecting key learning goals that build on each other
- Intra-unit coherence: coordination between content learning goals, scientific practices, and curricular activities within a project-based unit
- Inter-unit coherence: coordination among project-based units that support multidisciplinary connections

Built on Big Ideas

- Include both content and scientific practices
- Help learners to understand a variety of different phenomena within and across science disciplines
- Provide a framework for thinking about the long-term development of student understanding
- Allow designers to revisit ideas throughout the curriculum so that student understanding becomes progressively more refined, developed and elaborated.

Learning-Goal Driven Design



Creating Learning Performances

What are Learning Performances?

- Describe what it means for learners to “understand” a scientific idea
- Clarify how the knowledge is used in reasoning about scientific questions and phenomena
- Specify how we want students to use the content knowledge.

Content Standard	×	Scientific Practice	→	Learning Performance
A substance has characteristic properties all of which are independent of the amount of the sample (NRC, 1996, B:1A/5-8).		Develop...explanations... using evidence. (NRC, 1996, A: 1/4, 5-8)		Students construct a scientific explanation that includes a claim if two items are the same substance, evidence in the form of properties of the substances, and reasoning that different substances have different properties.

Meeting 21st Century Skills

- IQWST Feature: Coherence and built on big ideas
- 21st Century Skill: Complex Problem Solving
 - Learners need useable understanding of core ideas to solve non-routine problems
- Example: In the 7th grade physics unit on energy, students are challenged to build and explain a Rube Goldberg machine using principles of energy transformation and transfer.
- Evidence: Demonstration of substantial learning on pre- and post-tests

Meeting 21st Century Skills cont.

- IQWST Feature: Learning performances and scientific practices
- 21st Century Skill: Complex Communications
 - Taking into consideration appropriate and sufficient evidence is a key aspect of developing complex communications skills.
- Example: Throughout IQWST , students construct scientific explanations. Learners need to consider sufficient and appropriate evidence to support their claims.
- Evidence: Students' improvement in the construction of scientific explanations

Meeting 21st Century Skills cont.

- IQWST Feature: Learning Performances and scientific practices
- 21st Century Skill: Adaptability
 - When learners can take other points of view into consideration and see how they do or do not relate to their ideas, they are exhibiting a central aspect of adaptability.
- Example: When constructing of scientific explanations, learners need to rule out other possible explanations.

Meeting 21st Century Skills cont.

- IQWST Feature: Scientific Practices -- constructing models
- 21st Century Skill: Complex Problem Solving
 - Complex problems will not be solved unless learners use all the information they have available to them.
- Example: In the 6th grade physics and chemistry units, students construct models. In constructing models, students need to consider if all evidence is used.
- Evidence: Students' construction of models improves during and across units.

Meeting 21st Century Skills cont.

- IQWST Feature: Scientific Practices – Evaluating and revising models
- 21st Century Skill: Self-development
 - Reflecting on your understanding is critical to self development.
- Example: Learners need to consider if the model they built accurately represents the phenomena. If not, then learners need to revise their models so that they do. As students advance in the curriculum, they consider if the model only includes necessary information.
- Evidence: Students' evaluation and revision of models improves during and across units.

Meeting 21st Century Skills cont.

- IQWST Feature: Scientific Practices – Evaluating and revising models
- 21st Century Skill: Self-management and development
 - Monitoring a process is critical to self-management and development.
- Example: In the 8th grade chemistry unit, *How do I get the energy to do things?*, students design and implement an experiment investigating one variable related to what plants need to grow. Students manage data collection over a five-week period that requires them to monitor their investigations several times a week.

Meeting 21st Century Skills cont.

- IQWST Feature: Big Ideas
- 21st Century Skill: Systems Thinking
 - Tracking how one part of the system affects the rest of the system is a critical aspect of developing systems thinking.
- Examples:
 - In 6th grade biology, students track the flow of energy in an ecosystem.
 - In 7th grade chemistry students consider the mass changes in closed and open-systems.
 - In 8th grade chemistry students investigate how matter and energy move between organisms.

How effective is IQWST in developing 21st century skills?

- Various studies support the claim that students learn both science concepts and scientific practices.
- If constructing scientific explanations, building and revising models, designing investigations, and building products reflects understanding of 21st century skills, then the IQWST assessment program provides evidence that students learn 21st century skills.
- Greatest challenge is students using the reasoning component when constructing scientific explanations.

Concluding Comments

- IQWST provides indirect evidence that learners develop 21st century skills.
- IQWST has the potential to produce a populace who is scientifically literate and has the work skills needed for 21st century employment opportunities.
- This assumption, however, needs empirical support under more carefully designed conditions.

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