

SUMMARY OF FINDINGS

1. Illinois Classrooms and the Critical Technologies

Teachers' knowledge of content and skills in teaching constitute the most important variables in what students learn at school. Most of the concepts examined in this report are so new that only a few are included in teacher preparation programs. On the whole, teachers showed themselves to be inquisitive and willing to introduce new material into their classes. As one teacher commented, "We're being derelict in our duty as educators if we don't at least begin to address these issues to all students, not just those who seek them out independently." In order to assess what teachers knew and were teaching about the 26 concepts, this survey measured five factors – awareness, familiarity, understanding, classroom use, and barriers to implementation.

- **Awareness**
Teachers indicated awareness if they had heard of a concept. For instance, 93% of teachers were aware of Stem Cells, a subject often covered in both the popular and the professional press, but only 8% knew of Proteomics. Overall, 52% of teachers were aware of at least half of the 26 concepts.
- **Familiarity**
When teachers were aware of an advanced concept, 60% took the initiative to learn more. Those who indicated awareness were asked to indicate a degree of familiarity with scientific or mathematic principles surrounding a concept. Of the teachers who indicated awareness, the largest number were familiar (extremely, very, or somewhat) with Alternative Fuels (77%). The least familiar concept was Quantum Computing (36%). Both high school (63%) and middle school (55%) teachers who were aware of the concepts were also familiar with more than half of the critical technologies.
- **Understanding**
Teachers who said they were "extremely," "very," or "somewhat" familiar were then asked whether they understood a concept well enough to teach it. Of teachers who indicated they were familiar with the concepts, more than 60% indicated that they understood Alternative Fuels and Graph Theory well enough to teach them. The least understood concept was Quantum Computing (19%). Reflecting the levels they teach, high school teachers consistently showed a higher level of awareness, familiarity, and understanding than did middle school teachers.
- **Classroom Implementation**
As might be expected, few teachers are prepared to instruct their students in these new concepts. About 20% of science and math teachers included three or more concepts in their teaching, but 62% do not offer instruction in **any** of the 26 technologies. The most frequently taught concepts are Algorithms, Biotechnology, and Recombinant DNA. Only 8% of teachers familiar with Quantum Computing were actually teaching it.

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- **Classroom Implementation (continued)**

For high school teachers who understood concepts well enough to teach them, 68% taught one or more to their students. Eighty-four percent of these knowledgeable teachers indicate that they will add at least one more concept to course work next year. In the case of middle school teachers who were confident in their understanding of the advanced concepts, 62% teach one or more, and 83% will add at least one more next year.

Summary by Category

Some categories were more familiar and more often integrated into class work than others.

Among the five categories, teachers are most likely to be aware of Biosciences (55%) and Environmental and Energy Technologies (54%). Conversely, teachers said they were least aware of Materials Science and Advanced Manufacturing concepts.

Percentage of Category Awareness

Biosciences	55%
Environmental and Energy Technologies	54%
Human Health and Development	49%
Information Technology and Communications	45%
Materials Science and Advanced Manufacturing	38%

Those who teach high school tend to be aware of more items in each category than those who teach middle school.

Percentage of Category Awareness By Type of School

	Middle School	High School	Both MS & HS
Biosciences	51%	59%	58%
Environmental and Energy Technologies	48%	58%	62%
Human Health and Development	45%	51%	53%
Information Technology and Communications	40%	49%	49%
Materials Science and Advanced Manufacturing	32%	43%	44%

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Summary of Concept Awareness

Predictably, concepts that have been in the public consciousness for 10 years or more were best known to educators. Conversely, newer concepts were far less well-known. Concepts with the highest awareness were consistent across both high school and middle school.

Concepts with Highest Awareness

	(% Aware)
Stem Cells	93%
Artificial Intelligence	84%
Alternative Fuels	81%
Gene Therapy	81%
Algorithms	77%
Biotechnology	74%

Concepts with Lowest Awareness

	(% Aware)
Proteomics	7%
Bioinformatics	15%
Bioremediation	20%
Celestial Mining	22%
Modeling Complex Nonlinear Systems	25%

Summary of Concept Familiarity

As teachers progressed through the survey, the filters of awareness, familiarity, understanding, and classroom integration reduced the number of participants responding to each concept. To clarify what the percentages mean, the tables in this report show two columns – valid percentage and total percentage.

Valid percentage refers to the number of qualified teachers responding to an item. In the table at the bottom of page 11, teachers who said they were aware of Alternative Fuels were qualified to indicate their level of familiarity. Seventy-seven percent of teachers who were aware of Alternative Fuels were also extremely, very, or somewhat familiar with the scientific principles surrounding this concept.

“Total” percentage refers to all survey participants. In the case of Alternative Fuels, that means 52% of all teachers who completed the survey.

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Summary of Concept Familiarity (continued)

General Familiarity

As the table below shows, 60% of all survey respondents who were aware of concepts were also familiar with at least half of the 26 concepts. As noted previously, high school teachers were familiar with more concepts than middle school teachers, but strength at both levels implies dedication to professional currency, especially considering the highly technical nature of the more advanced technologies.

Familiarity with Concepts By Type of School

	Middle School	High School	Both MS & HS	% Aware and Familiar
Familiar with fewer than 50%	45%	37%	32%	40%
Familiar with 50% or more	55%	63%	68%	60%

Concepts with Most Familiarity

Three of the five most familiar concepts are related to agriculture, which may be a reflection of teachers' response to real-world issues of interest to students.

Concepts with Most Familiarity (% Extremely/Very/Somewhat Familiar)

	*Valid %	**Total %
Alternative Fuels	77%	52%
Graph Theory	72%	18%
Natural Products	72%	41%
Green Technology	72%	33%
Stem Cells	71%	70%

*Valid % = % of ONLY participants who indicated awareness
 ** Total % = % of ALL participants in survey

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Summary of Classroom Integration

Conscientious teachers introduce advanced concepts to students only when they are satisfied with their own mastery. The valid percentage includes only teachers who were aware and familiar with the concepts. The total percentage covers all survey respondents.

Concepts Understood Well Enough to Teach

	*Valid %	**Total %
Alternative Fuels	64%	29%
Graph Theory	61%	8%
Green Technology	59%	15%
Algorithms	58%	19%
Bioremediation	58%	6%
Natural Products	57%	18%
Fuel Cell	54%	18%
Recombinant DNA	53%	17%
Proteomics	51%	2%

*Valid % = % of ONLY participants who indicated awareness & familiarity

**Total % = % of ALL participants in survey

When teachers understood them well, these concepts were most likely to be taught in Illinois classrooms.

Concepts Taught Most Often

	*Valid %	**Total %
Algorithms	55%	14%
Biotechnology	47%	12%
Recombinant DNA	46%	10%
Alternative Fuels	42%	16%
Genomics	40%	5%
Graph Theory	39%	4%

Concepts Being Added Next Year

	*Valid %	**Total %
Fuel Cell	24%	6%
Biomaterials	23%	3%
Smart Materials	22%	2%
Bioremediation	21%	2%
Celestial Mining	21%	1%
Nanotechnology	20%	4%

*Valid % = % of ONLY participants who indicated awareness, familiarity, and enough understanding to teach

**Total % = % of ALL participants in survey