

# INTRODUCTION

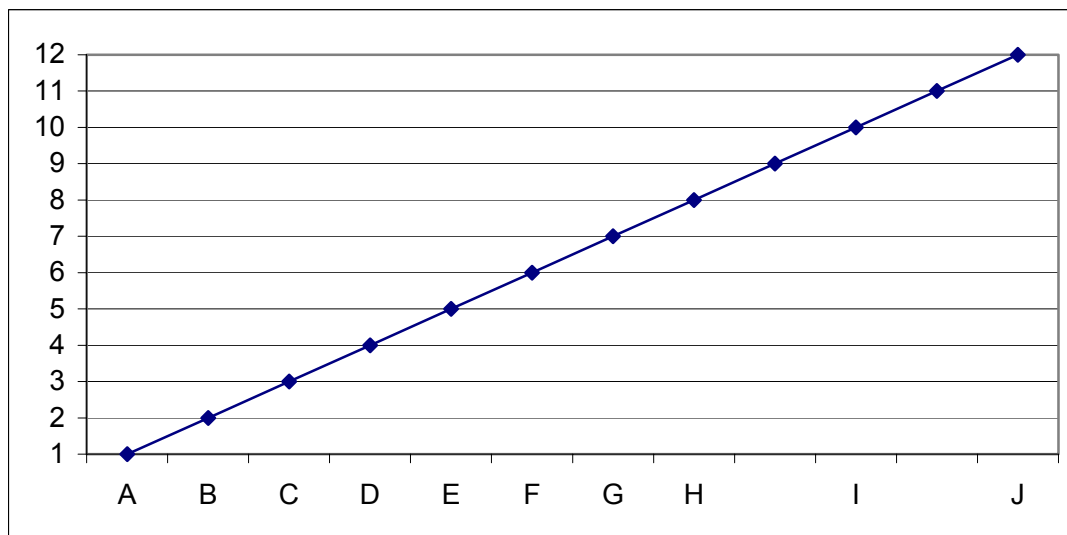
## *Design for Performance Standards*

The Illinois Learning Standards are content standards that describe “*what*” students should know and be able to do in grades K – 12. Each content standard includes five benchmarks that describe what students should know and be able to do at early elementary, late elementary, middle/junior high, early high school, and late high school.

The challenge for the 2000-2001 school year was to produce performance standards that would indicate “*how well*” students should perform to meet the standards. To address this challenge, a number of perspectives needed to be considered. For example, the National Governors Association<sup>1</sup> raised two pertinent questions policymakers should consider for the design of performance standards:

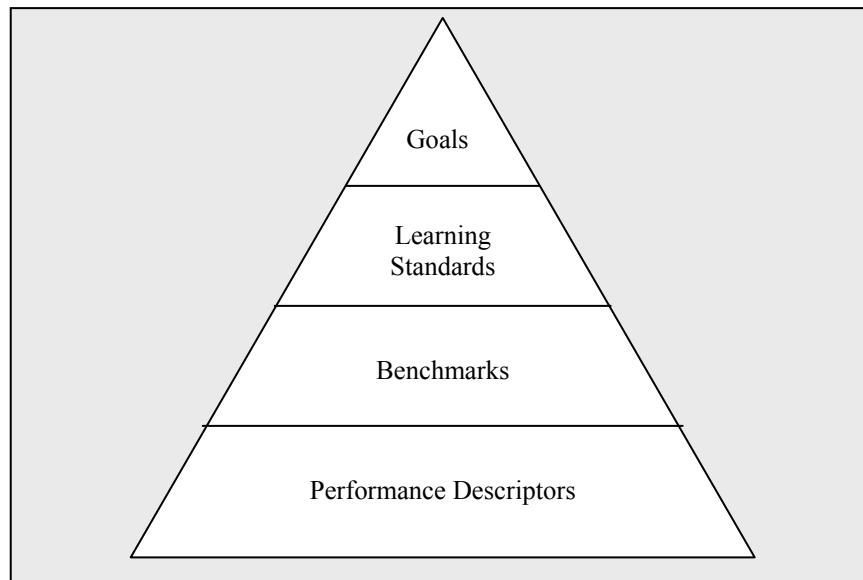
- Do the performance standards indicate the levels of performance students should attain, descriptions of performance at each level, and rules that enable educators to determine whether students have reached a given level?
- Do the performance standards include a range of work . . . to show that students can meet the standards in a variety of ways?

The performance standards describe how well students perform at various points on an educational development continuum. This continuum shows how students can demonstrate mastery of progressively more difficult content and cognitive skills over ten incremental stages of development. Performance within each stage can be assessed by the extent to which students are meeting the standards (i.e., starting, approaching, meeting, exceeding). Performance standards include four essential elements: performance descriptors, performance levels, assessment tasks, and performance examples.



<sup>1</sup> Ouellette, M. (2000). “Maintaining progress through systemic education reform: Performance standards,” Washington, DC: National Governors Association.

The performance standards are classroom resources for voluntary use at the local level. They are not intended to replace the Illinois Learning Standards. Instead, they supplement them by providing sufficient detail and examples to enable teachers to establish appropriate grade-level performance expectations for students. The performance descriptors are a direct outgrowth of the state goals for learning. Whereas the benchmarks filled in detail on each of the standards at five grade-level clusters, the performance descriptors provide additional detail at each grade level.



### **Definitions**

**performance standards:** the knowledge and skills that students are to perform at various stages of educational development (*performance descriptors*) and the performance expectations (*performance levels and assessment tasks*) for student work (*performance exemplars*) at each of the stages.

**performance descriptors:** statements of how students can demonstrate the knowledge and skills they acquired.<sup>2</sup>

**performance levels:** descriptions of how well students have achieved the standards; that is, the range, frequency, facility, depth, creativity, and/or quality of the knowledge and skills they acquired. Students can demonstrate levels of achieving performance standards along six dimensions:

PERFORMANCE LEVEL =	<i>RANGE +</i>	<i>FREQUENCY +</i>	<i>FACILITY +</i>	<i>DEPTH +</i>	<i>CREATIVITY +</i>	<i>QUALITY</i>
Exceeding	extensively	consistently	automatically	profoundly	inventively	excellently
Meeting	fully	usually	quickly	deeply	imaginatively	well
Approaching	partially	occasionally	haltingly	cursorily	commonly	marginally
Starting	narrowly	rarely	slowly	superficially	imitatively	poorly

<sup>2</sup> New Standards. Performance Standards. (1997) Washington, DC: The National Center on Education and the Economy.

**assessment tasks:** descriptions of what students can do to demonstrate they have met the standards and a means for evaluating the levels of their performance.

**performance examples:** student work samples resulting from the classroom-based performance assessment tasks that illustrate performance levels.

***Template For Expanded Performance Descriptors***

BENCHMARKS ⇒	early elementary			late elementary		middle/ junior high			early high	late high
STAGES ⇒ PERFORMANCE LEVELS ↓	A	B	C	D	E	F	G	H	I	J
Exceeding										
Meeting										
Approaching										
Starting										

***Vision for Science Performance***

A major goal of Illinois science education is to develop science literate, life-long learners. Schools create learning communities where each student has multiple opportunities to gain content knowledge and apply that knowledge in a relevant manner to the local, regional and global communities. To help achieve this outcome, performance standards, which indicate how well students are expected to perform specific tasks, provide educators with logical extensions to the Illinois Goals and Learning Standards. Students who meet these performance standards will apply an extensive knowledge base of science content and scientific processes to occupations and everyday life.

Upon completion of their education, students will complete complex investigations and solve problems creatively. They will ask questions, gather evidence, seek and obtain in-depth answers, review, understand and compare findings, and communicate research to others. Students will use a variety of technologies as effective tools to facilitate their research. They will develop a variety of tools using a technological design process. Students will participate in a variety of individual activities and collaborate with other students in group activities. They will relate the scientific fields by applying knowledge gained in one field to another.

Students will understand the impact of science concepts, processes, and connections in their lives as individuals, community members, and citizens. Students will realize the constancy of the nature of science in order to question and answer their future challenges. Upon completion of their education, students will have experienced the excitement of doing science and the joy of learning.

***Vision for Incrementally Improving Science Performance***

Educating today’s science student is an extremely complex and exciting adventure. For the sake of convenience, schools frequently place students in graduated levels called grades. However, within each classroom, students vary by age, physical development, intellectual capacity, background experience, socio-economic level, interests, performance, motivation, and learning styles.

The purpose of Science Performance Descriptors is to furnish educators with a logical and measurable continuum of performance and developmental indicators. Education will benefit by the development of descriptors that provide information about what every student needs to learn to meet Illinois Science Learning Standards and by describing how students perform while doing so. These performance descriptors provide information regarding physiological and intellectual development of students as they progress through their K-12 education. State Science Learning Standards describe what students need to know and how they will apply that knowledge in ten stages of intellectual development. Within each class and grade level, students will be functioning at a variety of stages.

This process is based on utilization of a taxonomy of cognitive-skill levels encompassing various aspects of learning from foundational, more concrete levels (knowledge, comprehension) through more complex and abstract levels (application, analysis, synthesis and evaluation). It will be useful for professional educators to understand that students are located at various stages along this continuum. These stages do not represent individual grade levels, and every classroom will contain students from multiple stages.

There are three equally important science goals. The following statements provide a vision of science performance for students who meet the standards. The performance descriptions provide a synopsis of expectations while the expansion presents a more detailed explanation. [The concepts from Goal 12 provide the context for the processes of science of Goal 11 and the connections within science and from science to technology and society described in Goal 13.](#)

***Goal 11 – Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments, and solve problems.*** This goal encompasses scientific inquiry and methods of technological design. Students will investigate questions, conduct experiments, and solve problems. They will listen, discover, describe, observe, and research scientific inquiry and methods of technological design. As students progress across the developmental spectrum they will continue to increase their knowledge base. They will use this knowledge and comprehension to apply, analyze, synthesize, and evaluate inquiry and design processes. They will choose proper techniques, classify information, demonstrate and modify designs, record data, explain prototypes and use a variety of scientific equipment. Then, they will perform, communicate, analyze, compare, contrast, evaluate, discuss, summarize and support their investigations and designs. [The processes of science should be practiced in the context of the concepts of science found in Goal 12 and with the connections within science and from science to technology and society noted in Goal 13.](#)

***Goal 12 – Understand the fundamental concepts, principles, and interconnections of the life, physical, and earth/space sciences.*** This goal provides fundamental concepts, principles, and interconnections of life, physical, and earth/space sciences. Knowledge of these concepts and principles allows students who meet the standards to relate new subject matter to previously learned material and provide more meaningful levels of understanding and application. They will listen to, discover, describe, and remember science content. They will discover, illustrate, rewrite, edit, and restate this content as their comprehension increases. Subsequently, they will be able to classify, build, report, sketch and use a variety of learning aids to apply content knowledge and

comprehension. Students will be able to point out, analyze, differentiate, dissect, solve, estimate, forecast, role-play, debate, recommend, summarize, and critique aspects within the content areas. [The concepts of science should be mastered using the scientific processes noted in Goal 11 and with the connections within science and from science to technology and society noted in Goal 13.](#)

**Goal 13 – Understand the relationships among science, technology, and society in historical and contemporary contexts.** This goal covers historical and current relationships among science, technology, and society. Students who meet the standards know and comprehend the accepted practices of science, including specifically the nature of science and scientific habits of mind, practicing safe methods, and recognizing risks and limitations of experimentation. While attempting to improve their surroundings students will know and comprehend the relationships between science, technology, and society. [Students will apply their understanding of the processes practiced from Goal 11 and the context of science, noted in Goal 12, in their own world.](#) They will examine, research, analyze, compare, contrast, and evaluate the products, policies, and processes of science in current and future contexts. Students will investigate, hypothesize, infer, predict, critique, and create informed opinions about local, regional, national, and global connections to the world of science.

### ***Intended Use and Interpretation***

The primary function of these descriptors is to provide educators with necessary tools to continue the quest of improving the quality of science education throughout Illinois. They have been written, reviewed, and analyzed by teachers and experts in the field of science education. They are intended to be used as a descriptive tool by teachers, administrators, parents, and students, and have not been created to represent a state-mandated curriculum. They can be powerful tools in determining how to best meet the needs of students from the time they enter elementary school to their graduation from high school as they become life-long learners. The purpose of this section is to explain what these descriptors are and how they can be used to facilitate the learning of science.

***Exactly what are Science Expanded Performance Descriptors?*** Before they can be described it will be helpful to explain what already exists. There are three goals for science that are general statements of what students need to know to be successful in this learning area. These goals are followed by ten science learning standards that are specific statements of knowledge or skills needed for science. They represent what students learn as a result of their schooling. Then, there are thirty-one to thirty-seven learning benchmarks which are clustered throughout early elementary, late elementary, middle/junior high school, early high school, and late high school years. These benchmarks are indicators of student achievement and form a basis for measuring that achievement over time. The science expanded performance descriptors represent the developmental stages of student learning and show a progression through which students develop knowledge and the application of that knowledge in science education.

Each learning benchmark has ten expanded performance descriptors (Stages A, B, C, D, E, F, G, H, I, and J) that furnish educators with a logical and measurable continuum of performance and developmental indicators. They provide information about what students need to learn to meet Illinois Science Learning Standards and by describing how students perform while doing so. These performance descriptors provide

information regarding physiological and intellectual development of students as they progress through their K-12 education.

***How can teachers use the Descriptors to help them teach science?***

These stages are not intended to represent any one specific grade level since teachers will have students at multiple levels in any given classroom. The stages represent the developmental progression of student learning. For clarity, several stages correspond to specific levels for ISAT purposes and represent the “meets” standards and benchmarks at that level. Level C corresponds to the “meets” level for 3<sup>rd</sup> grade, level E for the 5<sup>th</sup> grade, level H to 8<sup>th</sup> grade, level I to early high school, and level J to late high school.

However, teachers should not confine themselves to one specific stage for their grade level. The teacher must look at a series of three stages to find the progression of understanding and application students should experience. The other stages are not meant to correspond to the missing grades. The following chart indicates the stage clusters teachers should look at when determining the developmental needs of their students.

Grade 1 (A-B)	Grade 2 (A-B-C)	Grade 3 (B-C-D)	Grade 4 (C-D-E)	Grade 5 (D-E-F)
Grade 6 (E-F-G)	Grade 7 (F-G-H)	Grade 8 (G-H-I)	Grade 9-10 (H-I-J)	Grade 11-12 (I-J)

***How can these Expanded Performance Descriptors be used as a curriculum development tool through the continuum of the learning stages?*** These stages of development can help a school district devise a science curriculum that will meet state standards and subsequently improve performance of ISAT science tests. It is not the responsibility of any one grade level to cover all standards or curricula. Science curriculum development teams can study the performance descriptors and make the necessary local decisions to determine what material should be covered at each grade level and how it will be taught.

The descriptors do provide a framework for making these decisions. They are descriptive and not prescriptive. The science goals, standards, benchmarks, and performance descriptors provide the minimum amount of information which students need to know and how to apply that knowledge in a developmentally appropriate manner, but the local school districts determine how and when this material should be covered. Using the stages of development provided in this document, school district curriculum teams can develop a science curriculum that will meet state standards.

The format of the Expanded Performance Descriptors for Science is slightly different from the other learning areas in several ways. Links to other goals and standards are suggested. The links are not meant to be an all-inclusive listing, but starting points for curriculum planning. The science descriptors build on each other within each stage, as well as the descriptors from other learning areas. All of the Goal 12 descriptors denote links to the descriptors for scientific inquiry and technological design from Goal 11; most denote specific links to the scientific habits of mind, principles of safety and connections to technologies and society from Goal 13. In many cases, direct links to the other learning areas of English Language Arts, Mathematics, Social Science, Health and Physical Development, and Fine Arts are noted for the distinct purpose of showing the interconnectedness of Science to all learning.

Another distinctive formatting difference is the suggestion of curricular ideas beyond the wording of each descriptor (bold print). The sub-bulleted ideas below each bolded descriptor are possible conceptual extensions to provide clarification, definition or refinement for curricular planning.

The stages provide developmentally appropriate levels of rigor at each level. Every student, regardless of stage, is required to utilize a variety of levels of thinking while learning and applying science skills. Students are asked to know, comprehend, apply, analyze, synthesize, and evaluate whether they are in stage A, stage D, stage H, or stage J. As students progress from stage to stage, the level of difficulty increases. Remember that science descriptors incorporate what students need to know and how to apply that knowledge.

**FOR EXAMPLE**, in Standard 12B, students who meet this standard know and apply the concepts that describe how living things interact with each other and with their environment. The descriptors for 12B should be deeply integrated into the concepts, principles and processes of scientific inquiry and/or technological design from Goal 11, while stressing the practices, principles and relationships among science, technology and society in historical and contemporary contexts from Goal 13.

In stage A, students are applying guided scientific inquiry or technological design processes to explore how living things are dependent on one another for survival. Conceptual suggestions include identifying survival needs of plants and animals, matching groupings of animals or explaining how we adapt to our environments. Ideas about real-world applications and an understanding of conservation of natural resources noted in 13B can be naturally integrated. These conceptual understandings could be integrated with the concepts from the social science standards 16E, 17 C-D and 18C and the health and physical development standards, 22A and 22C.

By the time they reach stage D, students are applying the processes of scientific inquiry or technological design to compare the adaptations of physical features of organisms to their environments by, for instance, identifying physical features that help plants or animals survive in their environments or tracing adaptations to different environments over time. Ideas about the interactions of technology and societal decisions are suggested in standard 13B. Notations are offered to suggest integration with the concepts and processes in social science for standard 17C.

By stage H, students are applying options of the processes of scientific inquiry (including the processes of issue investigations) and/or the processes of technological design (including historic technological designs) to explore the implications of change and stability in ecosystems, to examine species demise or success within ecosystems, to study biogeography and to analyze Illinois-specific ecosystems and biomes. Suggestions to explore the interaction of resource acquisition, technological development and ecosystem impact, for instance from standard 13B are offered to strengthen these curricular concepts. These concepts and processes are linked directly to mathematics goals 7 and 10, as well as social science goals 16 and 17.

By the end of high school, in stage J, students are applying scientific inquiries (including the processes of issue investigations) and/or the processes of technological designs to research the sustainability of water, land, air and energy sources and resources. These applications should be within the context of Goal 13 by applying the appropriate

principles of safety and scientific habits of mind noted in standard 13A. The interactions of technology in science and societal situations and the societal interactions resulting from scientific discoveries and technological innovations described in standard 13B should have direct connections as well, to the concepts and processes of 12 B.

**Who really wrote these descriptors and where did the ideas come from?** A team of experts in science education wrote these expanded performance descriptors. They included teachers, curriculum writers, consultants, professors, and governmental science center directors. Each writer was or currently is an active educator, and all are currently involved in the promotion and improvement of science education. The descriptors were reviewed by teams of teachers from throughout the State of Illinois. All segments from early elementary to late high school were represented.

The descriptors are well grounded in solid science educational research. The two major sources of reference are *Benchmarks for Science Literacy: Project 2061* by American Association for the Advancement of Science and the *National Science Education Standards* by the National Academy of Sciences.

**Final comments.** Educational reform and improvement in science is an ongoing process. The major players in this movement have been, are, and will continue to be teachers; they emerged from some of the finest minds in science education and teaching. They were written by teachers, reviewed by teachers, for teachers, to be used by teachers, to improve the quality of science education for the students of Illinois.