

The Ford PAS Curriculum

How can high school prepare students to thrive in their next big challenges: post-secondary education and the workplace? How can students learn critical academic knowledge—and how to apply this knowledge in complex, real-world situations?

Ford PAS is an academically rigorous, standards-based curriculum that challenges students to integrate academic learning with realistic applications in areas such as design and product development, information systems, environmental sustainability, global economics, business planning, marketing, and personal finance.

Through case study analysis and role plays, simulations and scientific experiments, research, negotiation, and collaboration, students gain both knowledge and interdisciplinary skills for learning, analyzing, and decision-making in complex situations—and in the process, learn to apply classroom learning to choices in the real world. Innovative partnerships connect local high schools with colleges and universities, businesses, and workforce development and community organizations to provide real-world learning opportunities.

Examples of the kinds of questions that students tackle in the Ford PAS curriculum:

- How do people achieve prized goals, from buying a keyboard to getting a college degree—and how can I make financial decisions to reach my own goals?
- What recommendations shall we make about nuclear power to help our country provide energy for its citizens along with energy independence and sustainability?
- How can our company use its time, materials, and people to thrive—economically, socially, and environmentally?

Ford PAS Learning and Teaching Pillars

The more than 20 modules of the Ford PAS curriculum use a hands-on, collaborative, project- and inquiry-based approach to teaching and learning. Modules pose questions for students to explore; students acquire knowledge and skills as they work collaboratively to investigate those questions, carry out long-term projects, and create end products to demonstrate their learning. The Learning and Teaching Pillars detail the curriculum's key research-based principles.¹ Teachers learn to integrate the pillars into their practice through use of the curriculum and on-going participation in Ford PAS professional development opportunities.

Learning Pillars

Ford PAS Learning Pillars focus on the essential academic knowledge and skills students need to succeed in college and careers. They include the essential skills identified by the Partnership for 21st Century Skills²: application of academic knowledge and skills, problem-solving, critical thinking, teamwork, communication, creativity and innovation, and global awareness. These skills complement and strengthen the knowledge and skills defined in national academic standards. Students master each skill by learning and then applying it in their Ford PAS work.

¹ For more details, see *Pillars of Ford PAS* on the Ford PAS Web site.

² A partnership of business, education, and policy leaders to define a vision for 21st century education.

The Ford PAS Curriculum

- **Application of academic knowledge and skills:** Students both acquire essential academic knowledge and skills and develop flexibility in drawing on appropriate disciplinary knowledge and skills to address real-world challenges.
- **Problem-solving:** Students work with open-ended problems and issues that require them to clarify and analyze situations, explore solutions, and evaluate results.
- **Critical thinking:** Students analyze, synthesize, and evaluate information. They learn how to make reasoned judgments based on observation, experience, reflection, reasoning, and discussion.
- **Teamwork:** Students work in teams to conduct investigations, synthesize data, and communicate results. They learn to give and receive feedback, negotiate agreements, facilitate meetings, and take on a variety of leadership roles. Students also work independently and are assessed for the individual contributions they make to team products.
- **Communication:** Students learn strategies for evaluating complex oral, written, and multimedia communications, and create oral, written, and multimedia material for a wide variety of purposes and audiences.
- **Creativity and innovation:** Students learn to think creatively in response to a wide variety of challenges. They invent, try out, and revise designs and solutions, and are encouraged to take risks, learn from failures as well as successes, and value diverse perspectives.
- **Global awareness:** Students tackle issues that cross borders, and consider the perspectives of people and communities around the world. They explore potential solutions tailored to particular cultures, and learn to work and communicate effectively with others who have diverse views.

Teaching Pillars

The Ford PAS Teaching Pillars are the instructional principles—based upon rigorous research and professional experience—that are essential for facilitating learning of the essential knowledge and skills that students need. A teacher following these principles models critical thinking and questioning as students work with real-world problems, offers regular feedback, and helps students learn to give and receive constructive feedback themselves. The teacher helps students structure their work, and provides strategies for working effectively in teams. Teachers also develop classroom connections with representatives from business, higher education, and the community.

- **Academically rigorous:** Teachers facilitate learning of essential academic knowledge, skills, and ways of thinking particular to the core academic disciplines, meeting state and national academic standards and college-readiness expectations.
- **Integration of academic and career-related knowledge and skills:** Teachers help students to develop career-related knowledge and skills in the context of academic courses and also to learn and apply academic knowledge and skills in the context of career-related courses.
- **Inquiry-based:** Teachers organize learning around investigation of significant issues and problems. They structure these investigations, often through hands-on learning experiences, so that students acquire knowledge, skills, and understanding.
- **Project-based:** Teachers guide students in carrying out in-depth, long-term projects which culminate in products or presentations of students' investigations and results.
- **Real-world:** Teachers use real-world situations—such as business and engineering challenges—to build academic knowledge and develop problem-solving, teamwork, and communication skills. Students have opportunities to interact with professionals in careers of interest to them, and venture into businesses, college campuses, and the community as part of their learning.
- **Performance-based:** As students apply the knowledge, skills, and understandings they acquire through the curriculum's learning experiences, teachers use a variety of tools to

The Ford PAS Curriculum

- assess students' progress toward meeting learning goals correlated with academic and (where appropriate) career technical education (CTE) standards.
- **Technology-rich:** Teachers engage students in using technology to conduct research, organize and analyze data, simulate complex systems, and communicate ideas. Students master a variety of technology tools and make good choices about their use.
 - **Career-relevant:** Teachers and school staff structure learning so students understand a broad range of career paths, become aware of the knowledge and skills required to succeed in a variety of careers, and know what education and training are required for entry-level and more advanced positions.

How Ford PAS Is Used

Some schools use all or most of the Ford PAS modules, while many other schools offer a subset of modules within one or more themes. Several modules fit into more than one theme, and many are designed so that they can be used as units in traditional academic courses as well as electives. Although grade levels, from 9 through 12, are suggested for each module, these are general recommendations; the modules do not need to be completed in a particular sequence. Many modules are also appropriate for college courses, and several have been adapted for use in middle schools. Ford PAS modules were designed to be taught over periods ranging from 5 to 12 weeks, but many teachers find they can take more time, extending some modules as long as a semester. Class sessions are designed for 50-minute periods, but the modules are readily adapted for use with other class schedules. The Foundations modules are often taught alongside or as preparation for other thematic sequences. Other modules can provide the core knowledge and skills for career and technical education pathways.

The flexible design of the curriculum allows for the use of the program in a variety of ways:

- To build students' foundational academic and workplace skills (problem-solving, critical thinking, teamwork, and communication)
- To serve as the core for a particular career concentration
- To engage students in building on and applying in real-world contexts some of the knowledge and skills they learn in academic courses
- To serve as the framework for an entire school (small learning community or career academy) designed to prepare students for college and careers
- To introduce middle school students to collaborative, project-based learning experiences³
- To provide college students with real-world contexts for reinforcing and applying academic knowledge and skills

An overview of Ford PAS modules and themes appears on the following pages.

³Only selected modules are appropriate, and require some adaptation, for middle school use.

Ford PAS Themes and Modules

The following table shows the Ford PAS modules by theme. Modules with subject area designations are most suitable for integration into existing academic courses; modules without designated subjects also teach academic content but are fully interdisciplinary and don't focus on a particular academic discipline. Asterisks indicate modules that appear in more than one theme.

Each module has a Student Guide and a Teacher Guide (which includes the Student Guide pages). The Teacher Guide also includes a sample planning calendar showing how the activities may be scheduled. Each module has a coherent topic, and all modules include a module project, one or more quizzes, and a final test.

Ford PAS Modules by Theme

| Theme | Module Titles | Suggested Academic Subjects | Suggested CTE Subjects and Academies | Suggested Grade Levels |
|------------------------------------|---|-----------------------------|--------------------------------------|------------------------|
| Foundations in 21st-Century Skills | <i>From Concept to Consumer: Building a Foundation in Problem-Solving (1)</i> ^{4*} | | Business, Manufacturing | 9, 10 |
| | <i>Media and Messages: Building a Foundation of Communication Skills (2)</i> * | English | Business | 9, 10 |
| | <i>People at Work: Building a Foundation of Research Skills (3)</i> | U.S. History | | 9, 10 |
| | <i>Careers, Companies, and Communities (4)</i> * | | Business, Career Exploration | 9, 10 |

⁴ Numbers in parentheses following module titles correspond to numbers that were assigned to the 15 modules originally published in 2004. With the addition of new modules and the reconfiguring of modules into thematic sequences in 2008, module numbers are no longer used as a primary identifier.

The Ford PAS Curriculum

| Theme | Module Titles | Suggested Academic Subjects | Suggested CTE Subjects and Academies | Suggested Grade Levels |
|-------------------------------|--|---|--|------------------------|
| Working Toward Sustainability | <i>We All Run on Energy</i> | Chemistry, Physical Sciences, Earth Science | Energy & Utilities, Green, STEM | 9, 10 |
| | <i>Energy from the Sun: Biomass</i> | Biology | Energy & Utilities, Green, STEM | 9, 10 |
| | <i>Is Hydrogen a Solution?</i> | Chemistry, Earth Science | Energy & Utilities, Green, STEM | 9, 10 |
| | <i>The Nuclear Revolution</i> | Physics | Energy & Utilities, Green, STEM | 9, 10 |
| | <i>Closing the Environmental Loop (5)*</i> | | Business, Engineering, Green, Manufacturing | 10,11 |
| | <i>Energy for the Future (12)</i> | Physics | Energy & Utilities, Engineering, Green, STEM | 11, 12+ |
| Getting Smart About Business | <i>From Concept to Consumer: Building a Foundation in Problem-Solving (1)*</i> | | Business, Manufacturing | 9, 10 |
| | <i>Media and Messages: Building a Foundation of Communication Skills (2)*</i> | English | Business | 9, 10 |
| | <i>Careers, Companies, and Communities (4)*</i> | | Business, Career Exploration | 9, 10 |
| | <i>Calculating Your Future: Personal Finance*</i> | Math (algebra, data analysis) | Business | 11, 12+ |
| | <i>Planning for Business Success (7)</i> OR | | Business | 11, 12+ |
| | <i>Planning for Business Success (Math-Enriched)*</i> | Math (algebra, data analysis) | Business, Technology | 11, 12+ |

The Ford PAS Curriculum

| Theme | Module Titles | Suggested Academic Subjects | Suggested CTE Subjects and Academies | Suggested Grade Levels |
|-----------------------------|--|--|---|------------------------|
| Manufacturing for Tomorrow | <i>From Concept to Consumer: Building a Foundation in Problem-Solving (1)*</i> | | Business, Manufacturing | 9, 10 |
| | <i>Closing the Environmental Loop (5)*</i> | | Business, Engineering, Green, Manufacturing | 10, 11 |
| | <i>Planning for Efficiency (6)</i> | | Business, Manufacturing | 10, 11 |
| | <i>Ensuring Quality (8)*</i> | Statistics | Business, Technology | 10, 11, 12+ |
| Data, Decisions, and Design | <i>From Data to Knowledge (9)</i> | | Business, Technology | 11, 12+ |
| | <i>Reverse Engineering (10)</i> | | Business, Engineering | 11, 12+ |
| | <i>Different by Design (11)</i> | | Business, Engineering | 11, 12+ |
| Living in a Global Economy | <i>The Wealth of Nations (13)</i> | Economics | Business | 11, 12+ |
| | <i>Markets Without Borders (14)</i> | Economics | Business | 11, 12+ |
| | <i>Global Citizens (15)</i> | | Business | 11, 12+ |
| Putting Math to Work | <i>Calculating Your Future: Personal Finance*</i> | Math (algebra, data analysis), Economics | Business | 11, 12+ |
| | <i>Planning for Business Success (Math-Enriched)*</i> | Math (algebra, data analysis) | Business, Technology | 11, 12+ |
| | <i>Ensuring Quality (8)*</i> | Statistics | Business, Technology | 11, 12+ |

Ford PAS Theme and Module Content

Theme Descriptions

Theme: Foundations in 21st-Century Skills

The modules in the theme Foundations in 21st-Century Skills engage students in developing and applying research, communication, and problem-solving skills to the study of work and the workplace. Students examine topics such as product development, advertising, market research, industrial relations, and careers through activities such as primary document and case study analysis, interviews, and worksite visits. By building academic skills in the context of investigating the world of work, students connect the importance of what they learn in the classroom to their future roles in the workforce.

In *From Concept to Consumer: Building a Foundation in Problem-Solving*, students learn about the manufacturing process—design, development, production, and marketing—and consider the role of problem-solving, decision-making, and teamwork in the process. Through simulations in which students enact the roles of company employees planning to launch a new product line, the module *Media and Messages: Building a Foundation of Communication Skills* facilitates students' practice of language and presentation skills for a variety of purposes and audiences. *People at Work: Building a Foundation of Research Skills* engages students in studying the history of working life in the United States and synthesizing what they have learned into Web sites they develop. And in *Careers, Companies, and Communities*, the focus on the workplace shifts to the present: Students examine how businesses respond to economic and technological changes, how companies interact with and affect the communities in which they reside, and how current career opportunities match up with their own career interests and aspirations.

Theme: Working Toward Sustainability

The modules in the theme Working Toward Sustainability engage students in investigating sustainability as an important concept for both people and businesses around the globe. The modules explore changes that businesses are making to have their products and processes be more sustainable, as well as the shift toward fuel sources and technologies that can serve as alternatives to fossil fuels. Students look at why people worldwide are considering alternative energy sources and learn about the importance of research on stable and practical sources of energy. Given the concerns over the impact we are having on our planet, individuals, governments, and companies all over the world are seeking alternative ways to meet their needs—alternatives that are cost-effective and sustainable and will not further damage the environment or unduly impact one group of people more than another.

These modules build students' knowledge of the key science concepts essential for understanding current global discussions about sustainability and energy needs. *We All Run on Energy* introduces the scientific concept of energy and how stored energy is released in order to fuel human activity—and also builds skills in reading scientific documents, interpreting data, and documenting research and experimentation. The three modules, *Energy from the Sun: Biomass, Is Hydrogen a Solution?*, and *The Nuclear Revolution*, each focus on a particular fuel source and its potential as a solution for global energy needs. In *Closing the Environmental Loop*, students examine the environmental impacts of different approaches to industrial production and waste disposal while redesigning a product to be more environmentally sustainable. *Energy for the Future* introduces students to innovative ways of using renewable energy sources and technologies, and asks students to consider the potential for these technologies to transform energy use in this century.

Theme: Getting Smart About Business

The modules in the theme Getting Smart About Business engage students in learning about the many components of successful businesses and understanding the skills needed to build and run a commercial enterprise. From bringing an idea to market and designing a promotional campaign to creating budgets, proposals, and projections, The modules in this theme develop students' knowledge of decision-making processes in the world of business, and the module activities encourage students to see themselves taking on business decision-making roles. The series emphasizes that the knowledge and skills taught have numerous applications for students, whether they are interested in starting a business, managing personal finances more effectively, or sharpening skills that will allow them to succeed in higher education or the workplace.

In *From Concept to Consumer: Building a Foundation in Problem-Solving*, students learn about the manufacturing process—design, development, production, and promotion—and consider the role of problem-solving, decision-making, and teamwork throughout the process. Through simulations in which students enact the roles of company employees planning to launch a new product line, the module *Media and Messages: Building a Foundation of Communication Skills* facilitates students' practice of language and presentation skills for a variety of purposes and audiences. In *Careers, Companies, and Communities*, students examine how businesses respond to economic and technological changes, how companies interact with and affect the communities in which they reside, and how current career opportunities match up with their own career interests and aspirations. *Calculating Your Future: Personal Finance* invites students to set personal financial goals, evaluate strategies for meeting those goals, and use algebra and data analysis to make short- and long-term financial decisions. In *Planning for Business Success*, students learn concepts in marketing and finance while developing plans for small businesses of their own; a math-enriched version of this module gives students the opportunity to use mathematics to complete analyses and make sound business decisions.

Theme: Manufacturing for Tomorrow

The modules in the theme Manufacturing for Tomorrow engage students in learning how products and services are created and brought to market and how such factors as quality, efficiency, and environmental sustainability are managed. Students develop an understanding of the connections between theory and practice in the field of business management and apply their understanding to solve real-world problems. The modules in this theme also demonstrate the importance of planning and extend students' knowledge of planning processes and tools, from flowcharts, PERT charts, and supply chain maps to a variety of data analysis and graphical display methods.

In *From Concept to Consumer: Building a Foundation in Problem-Solving*, students learn about the manufacturing process—design, development, production, and promotion—and consider the role of problem-solving, decision-making, and teamwork throughout the process. In *Closing the Environmental Loop*, students examine the environmental impacts of different approaches to industrial production and waste disposal while redesigning a product to be more environmentally sustainable. In *Planning for Efficiency*, students learn strategies for managing the efficient use of time, materials, and human resources in the workplace and conduct an efficiency analysis of an actual business. In *Ensuring Quality*, students investigate how companies measure and control for quality in the manufacture of goods and the delivery of services, and they are introduced to the use of data and statistics to analyze quality.

Theme: Data, Decisions, and Design

The modules in the theme Data, Decisions, and Design engage students in investigating two key aspects of modern business: how businesses track information and use it to make decisions, and how products are designed, engineered, and refined to meet the needs and desires of users. In their module projects, students carry out tasks essential to both these management and production aspects of industry. They

The Ford PAS Curriculum

learn methods for organizing and interpreting data in various business scenarios, explore how product design works within different industries, and conduct an analysis of product failure.

In *From Data to Knowledge*, students look at how information systems are used to manage, analyze, and share data needed to make informed decisions—such as a health diagnosis or a choice of colleges. Students learn how a physician used geographic data to investigate a cholera outbreak in the 1800s and how Geographic Information Systems guide business decisions today. They conduct a debate on the ethics of data-driven decision-making.

The other two modules, *Reverse Engineering* and *Different by Design*, focus on the importance of data in engineering and on design issues of the 21st century. Students begin *Reverse Engineering* by analyzing products from the perspectives of consumers and manufacturers, and then proceed to examine failed products to see how they might be improved. In *Different by Design*, students learn about the steps in the industrial design process, and then redesign an existing product to meet specific needs. Students keep records throughout each module: journals to describe, evaluate, and improve information systems, and, in the engineering modules, technical logbooks that document experiments and project work.

Theme: Living in a Global Economy

The modules in the theme Living in a Global Economy engage students in learning how decisions made by companies, countries, and transnational entities shape the ways in which money, goods, and services are produced, exchanged, and distributed throughout the world. Students gain familiarity with the complex interrelated systems that make up the global economy as they develop financial plans, interpret data on a country's economic performance, negotiate a trade agreement, and create a proposal for improving a company's social responsibility.

In *The Wealth of Nations*, students learn about the factors that determine a nation's economic well-being and research the economic indicators of several countries in order to identify viable new sites for an expanding business. In *Markets Without Borders*, students investigate the roles of such elements as trade policy, trade balance, currency value, cultural norms, and international regulations in determining how the world's economy functions in an era of globalization. In *Global Citizens*, students consider the meaning of corporate citizenship by studying how businesses respond to social and environmental concerns in the countries in which they both produce and sell goods, and by making recommendations about how a company can be a good corporate citizen.

Theme: Putting Math to Work

The modules in the theme Putting Math to Work engage students in exploring the numerous uses of mathematics in the worlds of business and finance. Students examine how algebra and statistics can enable them to compare sets of data, observe changes over time, and make reliable plans and predictions. The modules in this theme also enhance students' understanding of how information is converted into numerical data and how, in turn, data can inform both personal and business planning and decision-making.

Calculating Your Future: Personal Finance invites students to set personal financial goals, evaluate strategies for meeting those goals, and use algebra and data analysis to make short- and long-term financial decisions. In *Planning for Business Success (Math-Enriched)*, students learn concepts in marketing and finance; apply those concepts using graphing and formulas; analyze data; and develop plans for small businesses of their own. In *Ensuring Quality*, students investigate how companies measure and control for quality in the manufacture of goods and the delivery of services, and they are introduced to the use of data and statistics to analyze quality.

Module Descriptions

From Concept to Consumer: Building a Foundation in Problem-Solving (1)

From Concept to Consumer introduces students to various aspects of manufacturing, such as product design, product development, production planning, manufacturing processes, and quality assurance. Students learn about the historical context in which manufacturing occurs by investigating the evolution of everyday objects in relation to social and technological change. Students also attempt to solve a variety of problems similar to the problems people must solve in the various departments of manufacturing organizations. By the end of this module, students will know what it takes for a product to make its way from concept to consumer.

Students also learn that effective communication, collaboration, and compromise are essential aspects of work in manufacturing organizations. Throughout the module, students develop and practice these skills through role-playing, hands-on simulation, and team-based research activities. This module relies heavily on guided Internet research and requires that student teams develop and give several presentations, including one presentation that uses Microsoft® PowerPoint® software. In addition to developing oral presentation skills, students develop skills in communicating ideas graphically through process flowcharts and tables.

Media and Messages: Building a Foundation of Communication Skills (2)

Media and Messages engages students in addressing a variety of communication challenges encountered by a fictional food chain called Quick 'n Tastee—a company that is expanding its product line through a partnership with a company based in another country. As employees of Quick 'n Tastee, students select a new line of food, decide on the best locations for introducing their new line, prepare to interview potential employees, analyze styles of communication appropriate for different contexts, develop logos and slogans, and plan an ad campaign. In an ongoing assignment, students analyze advertisements to discover ways that the media communicate messages.

The goal of this module is to introduce students to communication issues in the workplace. The Quick 'n Tastee scenario provides the context in which students learn and apply a variety of written and verbal workplace communication skills, such as summarizing and organizing written and verbal information, giving and receiving feedback, writing and speaking persuasively, writing and then revising a short report, and making oral presentations. Students develop an awareness of issues of diversity in communication and the importance of shaping information for a specific audience and purpose. Students also practice developing communication skills using presentation software.

People at Work: Building a Foundation of Research Skills (3)

People at Work challenges students to trace changes in the workplace by looking closely at key periods in U.S. history. Students learn how such factors as immigration, the economy, technological innovation, and legislation have affected people's work experiences in the past, shape working conditions today, and will affect the workplace of tomorrow. Students research different historical periods by analyzing primary and secondary sources of information, including documents, art, and photographs, that portray work life from various perspectives. They also conduct interviews of present-day workers in order to collect information about today's workplace.

In this module, students learn and apply a variety of research and communication skills, including finding and evaluating sources, paraphrasing, and citing sources appropriately. In an ongoing project, students develop technology skills as they build a class Web site that explains how the workplace has changed throughout U.S. history.

Careers, Companies, and Communities (4)

Careers, Companies, and Communities introduces students to three interwoven themes. The first, “The Changing Nature of the Workplace,” is introduced through the Change in the Workplace assignments that students complete in each of the six activities. The second and third themes, “Interplay Between Industry and Community” and “Industry Clusters,” are explored through both in- and out-of-school activities as well as through a Career Exploration Journal. Students are given a Career Exploration Journal assignment in each of the first five activities, and they use those assignments, and their new understanding of both industry clusters and the interactions between industry and community, to create a career presentation.

In this module, students learn about the businesses and industries in their region, the range of positions companies may offer, and the changing nature of the workplace. They gain information through interviews, classroom speakers, a worksite visit, and other resources. Throughout the module, students develop technology skills: working with databases, creating and delivering presentations, and doing Internet research. By the end of this module, students will have a better understanding of careers they may want to pursue, places they may want to work or intern, and the ways that people and companies adapt to change.

We All Run on Energy

We All Run on Energy introduces students to energy and its role on Earth and in human life. Students learn that energy is not only a complex concept but one that is crucial to our daily lives and a central issue of the 21st century. Over the course of the module, they learn about energy, particularly the physical science that underlies how energy is stored and released for human use. At the same time, they learn why scientists and governments are working to find sustainable, renewable energy sources; why fossil fuels are no longer the best solution to meeting all of our energy needs; and why they, as members of the next generation to deal with the challenges of energy, need to understand and be engaged with the subject. Students also build literacy in science by learning how to read scientific information, interpret data sources, and write lab reports, and also keep science notebooks in which they record their research and lab notes.

Throughout *We All Run on Energy*, students are encouraged to take on the responsibility of becoming their generation’s leaders by designing an activity to teach younger students about the concept of energy—what it is, how we use it, and how we need to prepare for the future by finding new sources of energy to meet society’s needs. In order to do so, students themselves learn about energy, particularly the physical science that underlies how energy is stored and released for human use. They learn that various forms of energy are interchangeable and that converting energy from one form to another allows humans to use energy to do different kinds of work. Students also learn about atoms and molecules, the role of the carbon cycle in energy transfer, and the relationship between energy and Earth’s climate.

Energy from the Sun: Biomass

Energy from the Sun: Biomass introduces students to the use of biomass to meet human energy needs. Students take on the roles of staff members in a non-governmental organization (NGO) consulting for a developing country that is trying to promote the use of biomass-fueled stoves among its citizens. The government of the country also wants to explore ways that biomass can help to sustainably meet the country’s other energy needs. Students investigate the different stove designs available and look at the other ways that biomass is used for power generation, including biogas, which can be used to create electricity; biodiesel, which can be used to power vehicles; and ethanol, which can be used as a fuel to run engines and generators.

In *Energy from the Sun: Biomass*, students learn about how biomass stores solar energy from the perspective of biology and chemistry. They explore the concept of solar energy, learn how it is captured as chemical energy through photosynthesis, and investigate how this energy travels through ecosystems.

The Ford PAS Curriculum

Students learn how animals, including humans, use the chemical energy stored in food and how the breakdown of food in animals releases energy, which is used to do work. They learn how the chemical energy stored in biomass is used to do other kinds of work, such as cooking, heating water, and generating electricity. For their ongoing project, they develop educational materials to promote the use of biomass stoves in their project country, helping the country's citizens understand the benefits of these stoves. By the end of the module, students understand how biomass can be used as a sustainable alternative energy source.

Is Hydrogen a Solution?

In *Is Hydrogen a Solution?*, students explore the possibilities of using hydrogen to meet energy needs. Students take on the role of researchers (in Hydrogen Technology Research teams) working at NuEnergy, a venture capital firm specializing in renewable energy. The firm has asked the researchers to consider several start-up companies that are looking into or already implementing hydrogen energy technologies. The students consider this question as they learn what hydrogen is and what obstacles currently prevent us from using hydrogen as a fuel on a large scale. At the end of the module, student teams make their decisions about investing in the start-ups. Teams present their recommendations and describe the science and the reasoning behind their recommendations.

Throughout the module, students also conduct research and scientific investigations to learn how hydrogen gas is produced, how it can be stored, and how fuel cells extract energy from hydrogen. As students experiment, research, and explore, they learn about several fundamental concepts in chemistry: the chemical and physical properties of compounds, how substances change during chemical reactions, and the properties of gases at different temperatures and pressures.

The Nuclear Revolution

The Nuclear Revolution introduces students to the generation of power from radioactive elements found on Earth. For this module, students take on the roles of members of the Subcommittee on Nuclear Energy for the government of Kinetya, a fictional Eastern European country. Working in teams, students examine whether nuclear power could help the country to reduce carbon dioxide emissions, attain greater energy independence, and increase energy sustainability. Students investigate the advantages and drawbacks of nuclear power in order to make a recommendation as to whether their fictional country should build new nuclear power plants.

In this module, students learn about nuclear energy and how nuclear power measures up to other sources of energy. They learn about the properties that make elements radioactive, the way nuclear reactions work, and the concept of the half-life of radioactive elements. Students explore techniques used for indirect measurement and learn how these techniques have allowed scientists to build their understanding of atoms. They also learn about the potential risks of using nuclear power, the challenges of storing spent nuclear fuel, and the ramifications of past nuclear accidents. Students explore statistics related to nuclear energy production, and consider how perceptions and emotions can sometimes be a more powerful influence on people's decisions than factual information and data. Finally, students examine how nuclear fission is currently used as an energy source, what scientists' hopes are for nuclear fusion, and how nuclear energy might be used in the future.

Closing the Environmental Loop (5)

In *Closing the Environmental Loop*, students investigate how industry is changing in response to today's environmental issues and learn about a range of incentives for increasing the sustainability of products and processes. They first look at how every stage in the life cycle of everyday products affects the environment. Then, through video, case studies, and Web research, they learn how industries are redesigning products for easier remanufacture or recycling, changing their production processes,

The Ford PAS Curriculum

improving their facilities, developing eco-industrial parks, and “greening” their product supply chains.

This module introduces students to the use of data for monitoring progress toward sustainability goals. Through a role-play activity, students develop the negotiation skills needed to build financially and environmentally sustainable business partnerships. Throughout the module, students apply what they learn about products and companies to a product of their own choosing. In a final activity, they present proposals for making their chosen products more sustainable.

Planning for Efficiency (6)

Planning for Efficiency focuses on how companies can make the best use of time, materials, and human resources in the context of changing social, environmental, and market realities. Students learn about historical changes in the ways that people think about time and work, and explore how these changes, along with advances in technology, have shaped the ways in which businesses manage their resources. Through role-plays, simulations, and case studies, students try out and analyze various approaches to resource management and production planning.

In this module, students learn how to use resource management tools, including the critical path method and value stream mapping. Then they apply these tools to planning and scheduling tasks in their own lives and in several business settings. Students also develop skills for conducting effective meetings. In an ongoing project, teams research and observe a local business to see how it manages its time, materials, and human resources.

Planning for Business Success (7)

In *Planning for Business Success*, students take on the role of manager of NoNaymz, a local band trying to break into the national music scene, and, through case studies and a computer simulation, they learn about marketing and finance. Students apply their NoNaymz experience to create a realistic business plan for a small business of their own. In a closing activity, students present their plans to visitors from the community in an effort to recruit potential “investors.”

In this module, students develop a range of entrepreneurial skills. They identify a business’s target audience, design market surveys and analyze their results, develop a marketing plan to reach a particular audience, determine costs and revenues, calculate profits and losses, conduct a break-even analysis, and analyze the effect of supply and demand on prices. Students also debate ethical issues involved in marketing. The module utilizes Microsoft Excel as a financial management tool.

Planning for Business Success (Math-Enriched) is an alternate version of this module that presents students with the same scenarios and activities but also provides extensive practice with the use of algebra and data analysis, teaching students to use graphing and functions as they are applied in business decision-making.

Calculating Your Future: Personal Finance

In *Calculating Your Future: Personal Finance*, students learn the skills and knowledge needed to take ownership of their own finances. Students apply mathematical concepts to the making of short- and long-term financial decisions, such as how much to spend on a daily and monthly basis; how to create a budget; whether to apply for a credit card and, if so, which one; what to consider before making a major purchase, such as an automobile; how to pay for college; how to assess risk and choose among different investment options; and when and how to plan for retirement.

Students use critical-thinking and problem-solving skills to set financial goals and evaluate strategies for meeting those goals. Throughout the module, they use algebra and data analysis to study

financial situations. For example, students construct and explore functions that express relationships among the variables of principal, interest, and time in order to maximize their investments and minimize debts. Students also consider how personal values and other non-economic factors affect financial decisions, and they examine the short- and long-term effects of different financial decisions.

Ensuring Quality (8)

In *Ensuring Quality*, students face a series of challenges that show how business and industry use statistics and data analysis to improve the quality of products and services. The goal is for students to be able to apply statistical analysis in several business contexts in order to measure, analyze, and control quality. To do this, they take on the roles of members of various departments in Xavier Automotive Company (XAC) and use statistics to make business decisions that members of these departments would make. Students learn how companies measure and control for quality and about the role of data analysis in ensuring quality. In addition, students learn how data are used to make long-term business decisions.

In this module, students learn statistics concepts relevant to analyzing data and then apply these concepts to a final company scenario, in which they create a status report for one XAC division. Students also become familiar with a variety of ways to present statistical information visually. Using MINITAB® Statistical Software*, a statistical analysis software package, or Microsoft Excel, students analyze consumer information to inform design and marketing decisions, make personnel decisions based on data about employees' previous performance, and monitor production for the presence of defects.

From Data to Knowledge (9)

From Data to Knowledge introduces students to the purposes and uses of information systems, and gives students the opportunity to create their own information systems. Considering the health care industry as an example, students research ways that information systems, including geographic information systems, are used by businesses. Through observation, hands-on projects, and case studies, students find out how different types of information systems allow users to create, manage, and share information for a variety of purposes.

In this module, students develop a solid understanding of information systems. They learn skills that will help them analyze different kinds of data and make decisions using those data. They learn and apply skills in database development and learn the pros and cons of spreadsheets and databases. Students also grapple with ethical issues related to information systems as they consider the potential benefits of and drawbacks to using information systems in business and explore and evaluate new trends in the field.

Reverse Engineering (10)

In *Reverse Engineering*, students analyze products, determining how they can be designed to meet the needs of their intended users and considering other factors that influence product design. First, students focus on using reverse engineering to make good products for the consumer by analyzing features of existing products, considering design factors that determine the ease of product assembly, and looking at the manufacturing processes used to create products from different materials. Students then focus on reverse engineering from the perspective of product failure, and analyze communication failures in written and visual instructions. Students also test different materials as they explore engineering failures related to material choice. For their module project, students analyze a case study and role-play its situation.

As students explore the process of reverse engineering in this module, they develop a number of valuable skills. Students are introduced to logbooks and their use in scientific and technical fields, and make log entries of experiment results, team meeting notes, and sketches of products. In addition, students continue

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to develop their teamwork skills, focusing on meeting facilitation.

Different by Design (11)

In *Different by Design*, students take on the challenge of redesigning an existing product. They first consider how the features and functions of a product are directly related to consumer needs. They learn about the procedures that design teams use to develop products, including the screening and scoring of potential concepts to find the one that best matches the team's goal. Students then complete a basic cost analysis of a product, addressing the economic factors that affect a product's development. They learn basic principles of industrial design and consider how such factors as appearance and user-friendliness may influence both a company's image and a product's success. Students are also introduced to the idea of intellectual property rights, and they conduct searches for patents. Finally, students learn how to visually represent a design idea to different audiences, from tradespeople to consumers, using technical drawings and illustrations.

Throughout the module, students work in teams to apply the design tools they've learned to a product of their choice. Teams compare and contrast different brands and models of a similar product, exploring how the products meet customers' needs. At the conclusion of the module, teams present a complete plan for a redesigned product. This module teaches students how to think and work like engineers: They learn techniques used to turn customer feedback into useful design information and how the creative aspects of the design process can fulfill customers' needs in unique ways.

Energy for the Future (12)

Energy for the Future introduces students to innovative ways in which renewable energy sources and technologies are used to provide energy for society. Students become familiar with the different forms and sources of energy and learn about renewable and nonrenewable energy sources. They analyze case studies to determine the pros and cons of several energy sources and analyze the availability, practicality, safety, and environmental impact of different energy technologies. They construct simple energy systems and learn to calculate work, power, potential energy, and efficiency. They also learn about the principles of electricity and how to determine the energy needs of different systems, such as homes or schools.

In this module, student teams further develop their Internet research skills as they gather information about one energy-generation technology. Teams share their findings with one another and consider the merits and drawbacks of the different energy technologies for meeting the energy needs of a particular building. In a culminating project, students design a plan to meet some of the energy needs of their school with renewable energy sources.

The Wealth of Nations (13)

In *The Wealth of Nations*, students analyze the factors that affect the wealth of different countries and consider different ways to measure the health of an economy. They examine the consequences of declining natural resources and learn how investments in resources affect a country's productivity and the standard of living of its citizens. Students compare standards of living among countries and predict how current population trends may affect the workforce as well as the market for particular goods and services. Students also compare the way that resources are used in different countries and consider the potential economic, environmental, and social consequences of a declining natural resource base. In an ongoing project, students become familiar with CleanWater Tech, a fictional U.S. company that produces water filtration and disinfection technologies and is interested in opening a facility abroad. Students apply what they've learned about the country's economic health in order to justify their decision about whether to expand CleanWater Tech into their chosen country.

In this module, students analyze and interpret data such as real and nominal GDP, inflation rates, and unemployment rates to better understand how economists measure the health of economies. Students

The Ford PAS Curriculum

further develop their research and analytic skills in this module, using them as economists do to analyze a country's economic climate. Finally, students use their analyses of the various indicators they've learned about to develop their own economic indicator for analyzing the economic health of a country.

Markets Without Borders (14)

In *Markets Without Borders*, students become familiar with the interdependence of different countries in today's global economy. They examine the role of trade in the global economy and analyze the purposes and effects of quotas, tariffs, and trade agreements on businesses, governments, and individuals throughout the world. Students analyze the challenges of conducting intercultural business and trade, and they develop international agreements that balance the conflicting interests of different nations.

Throughout the module, students participate in Global Economic Exchange, a Web-based international relations simulation in which they take on the roles of policymakers for particular countries. In an attempt to serve the best interests of their project country's citizens, students propose and negotiate trade agreements, set trade policy, and cast their votes on international regulations. Students create a Country Briefing Handbook, a compilation of information about their project country's economy, trade relations, laws, and social and environmental issues related to globalization.

Global Citizens (15)

Global Citizens introduces students to the concept of corporate citizenship—the responsibility companies have to enact policies and practices that address emerging social and environmental issues around the world. Students also examine the effects these practices may have on the company's stakeholders, including shareholders and customers. Through case studies and role-plays, students learn about the different kinds of social and environmental issues—such as pollution, labor practices, and worker health—that arise in different business contexts around the world and look at how companies have addressed these issues.

Throughout the module, student teams take on the roles of employees in the corporate citizenship department of a company. Each team recommends how its company can responsibly manage one social or environmental issue in a particular country. As part of the module, students also examine the potential impact that individual citizens can have on a company's actions, and develop an experiment and survey to determine if and how corporate behavior affects consumer behavior.

Ford PAS in Action: Snapshots from the Classroom

Ford PAS can best be understood through vignettes showing students at work. Here are four vignettes, one each from the modules *From Concept to Consumer*; *Careers, Companies, and Communities*; *Closing the Environmental Loop*; and *Planning for Business Success*.

The ACME Soft Drink Company Business Simulation

From Concept to Consumer: Building a Foundation in Problem-Solving (1)

Students meet in teams representing key departments in the ACME Soft Drink Company: finance, marketing, production, and corporate citizenship. This manufacturing company is making some critical decisions about marketing a new soft drink and all four departments are involved in this decision-making. The teams discuss a document that describes their department's responsibilities and priorities and provides specific information about the new product. After students become familiar with the challenges facing their departments, each team develops proposals for the company to consider.

With their department proposals in hand, students reorganize into planning teams consisting of one member from each department. Each planning team pools the knowledge from all four departments to come up with a plan that maximizes opportunities for the company to profit from the new product. These teams develop formal presentations to make to the class, who represent the company's board of directors. After all of the presentations, the students decide whether to adopt one team's plan or create a new plan combining features from several of the plans.

This simulation teaches students how a business is organized and the kinds of Information that go into making important company decisions. Rather than reading about organizational structure and decision-making in a text, students gain this knowledge through active involvement and problem-solving. Students are required to read and synthesize complex information and prepare alternative plans. Effective communication skills, both speaking and listening, are essential: every student's input is required before the team can make a decision. Every decision requires making tradeoffs among important objectives. These are skills that students will need for success in higher education, work, and daily life.

This interdisciplinary activity addresses academic standards in English language arts, social studies, and business education. Learning goals are correlated with the relevant standards. Students are assessed directly on what their team accomplishes: the credibility of their production plan and the skill with which they present it to their classmates. On the module test, they answer questions that assess skills and concepts learned during the activity.

Building a Database of Local Companies

From Careers, Companies, and Communities (4)

In this module, students have been working in research teams to gather data about companies in their community. How large are they? Where are they located? Are they accessible by public transportation? What are their primary products or services? How do they contribute to the community? Now students are engaged in entering data into a computer database. They download a database template from the Ford PAS Web site. In addition to learning about the businesses in their communities, students learn the terminology and the mechanics of using a computer database: fields, records, categories, keywords, and queries. When students finish merging data from all the research teams, the class has a large, searchable database with practical information about companies in their community. They can use this database when they explore job shadowing opportunities, internships, and summer or after-school employment, and as they begin to think about future careers.

In this activity students are learning an important, transferable business and life skill: the use of a computer database. By entering the data themselves—and dealing with the inevitable errors—they also learn that the value of a database is no better than the quality of the data that went into it and the accuracy with which the data was entered. By querying the database, they learn both the power and the limitations of the tool. The learning goals for this activity address English language arts standards for comprehending and organizing information, business education standards related to information systems, and academic

standards for educational uses of technology. Students are assessed on their skill in designing fields and queries that allow for effective access to the information in a database.

Reducing Energy Consumption

From *Closing the Environmental Loop* (5)

Students take on the role of consultants to Tough Ride Jeans (TRJ), a clothing company that wants to lower its energy costs and, at the same time, reduce its dependence on fossil fuels in order to cut back on emission of greenhouse gases. An earlier analysis has shown that lighting technologies, along with heating, ventilation, and air conditioning, consume almost 95% of the energy at TRJ's conference facility. Students work in teams to investigate the energy savings possible with one of four alternative energy solutions. Students use spreadsheets to estimate the cost savings and reduction in fossil fuel use for each potential solution. They construct tables and graphs to compare the impact of the approach they are researching with TRJ's current energy costs and fossil fuel consumption. When they complete the detailed studies, members of each team will compare notes and recommend which technology or combination of technologies will best meet TRJ's energy and cost reduction goals.

This scenario focuses on shared decision-making, problem-solving, and communication in the context of designing for environmental sustainability. Students consider costs and benefits in order to make the necessary tradeoffs among possible alternatives. Information technology is a critical tool for organizing and representing data, making decisions, and crafting persuasive arguments. The learning goals are correlated with academic standards in mathematics, English language arts, social studies, business education, engineering, and technology. Teams are assessed on their use of spreadsheets to create accurate depictions of energy consumption and on their analysis of the effects of each energy-saving technology on costs and greenhouse gas emissions.

Rags to Riches, a Business Simulation

From *Planning for Business Success* (7)

In the opening activity of this module, students playing a computer simulation called Rags to Riches are trying to maximize their profits as managers of a small, up-and-coming rock band. Although they have not yet learned the formal language of business planning, most of them are quite comfortable making decisions in the informal setting of the simulation. The students will soon learn about the 4 Ps of marketing (product, place, promotion, and price), but for now, it's all play—serious play. Some things are already clear to them. If they lower ticket prices, they know they'll probably attract a larger audience. But they may not yet realize that before renting a larger hall or moving to a larger city, they'll need to spend more money for promotion if they hope to fill the hall or attract a new audience. Later students will reflect on factors that influence the success and failure of a small business venture. And they will begin to apply that knowledge as they make a realistic small business plan in order to apply to a panel of local businesspeople for \$25,000 of simulated venture capital.

The learning here is active, collaborative, and intensive. Some students work in pairs, while others prefer to try the challenge on their own before comparing strategies. In addition to realizing that business can be fun, students learn that they need to track their choices, costs, and income precisely in order to make effective decisions and maximize profits. The learning goals align with national standards in business education, and evaluation of the learning is immediate and practical. Students ask themselves, "Were we successful or not? What factors contributed to our success, or lack of it? How can we use what we've learned here in future business planning activities?" In the Math-Enriched version of *Planning for Business Success*, students also develop their algebra knowledge and skills, learning how to use linear functions and graphs to help them make more informed business decisions.

Promoting Sustainability

From Energy from the Sun: Biomass

Students take on the role of members of a non-governmental organization (NGO) consulting to a developing country that is trying to promote the use of biomass-fueled stoves among its citizens. Students learn the science—what biomass is, how it stores energy, and how much energy different types of biomass contain—and learn how biomass stoves work. They find out what makes various designs more or less efficient, and then build and test a biomass stove. At the same time, students research physical and cultural considerations important to developing educational materials for the country's citizens, such as their country's location, climate, population size, raw materials, what problems its people currently face, and whether biomass production would be sustainable. Based on their research, students create educational materials designed to explain the benefits of using biomass stoves and the drawbacks of the current ways biomass is used for cooking and heating in that country.

This scenario involves students in a mix of concrete, hands-on experimentation and active research into a complex interplay of national, cultural, and scientific factors. To develop their educational materials, student teams explore a range of perspectives, for example, from the scientific (which type of biomass contains the most energy) to the geographic (what biomass is available), and from the cultural (how people use energy now) to the environmental (what is sustainable for the population). As students seek a creative, yet practical way to use a simple ancient tool (fire) to solve a multifaceted modern problem—to which there is no one perfect solution, their experience mirrors the challenges of people and nations around the globe.

The learning in this project addresses national academic standards in science. Teams are assessed on the quality of materials they develop, the suitability of those materials for dissemination in the project country, and the team's presentation of the materials to the class.

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