Designing Multidisciplinary Integrated Curriculum Units

ConnectEd
The California Center for College and Career

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Welcome!

We're excited that you are incorporating curriculum integration into your school and are using this manual to support the process. We designed this manual for teachers who are new to curriculum integration and for those who want to enhance their current practice. Presented here is a roadmap for committed teams of teachers to work together in planning, developing, and implementing a multidisciplinary, career-focused, and integrated high school curriculum. We hope this manual will help you be successful.

Designing Multidisciplinary Integrated Curriculum Units

Introduction

Engagement is one of the most important keys to students' academic success. Every teacher knows that even teaching the right foundation skills is not enough to ensure that they will learn. Students need to be curious about new material, focused on what they are learning, and, of course, present in class. Why do so many students lack this high level of engagement? Today's high school students are demanding relevant coursework and they aren't getting it. Too often, by the time they reach high school, students have concluded that school has little connection to their current lives and even less to offer in preparing them for the future.

Many teachers have experienced, first hand, the disaffection of high school students who have turned away from learning because they don't connect with school. Survey data make a strong case for the importance of relevant coursework for students. In a 2006 survey of more than 3,000 at-risk, early high school students in California, more than 80 percent revealed that they would study more and work harder in school if they saw the relevance of their classes to their future education and careers (Peter D. Hart Research Associates 2006).

Applied learning theory can help us understand how to reverse this situation. According to researchers, students are more motivated to learn when they need to acquire knowledge (to accomplish something they care about), when they are curious (about an interesting and challenging problem), and when the material relates to their own lives (Svinicki 2002). As teachers, we can create this kind of motivation by linking rigorous academic content to students' personal lives and the community issues they care about.

One of the most powerful strategies teachers can use to make learning relevant is to place academics within the context of issues and problems from the world of work. Across the country, teachers, school administrators, and parents have seen students change their attitudes about school when they are solving exciting problems and working on projects that link their academic and technical courses to an authentic career-related theme.

Contextual instruction has proven to be the most powerful aspect of our small high school. Students believe in their lessons when every assignment adds meaning and creates understanding in all of their classes. I can speak for our school; we have truly made a difference in our students' hope for success—they feel empowered to dig deep and ask questions, and they are enthusiastic about sharing their research with the world.

Matt Perry, Principal
Arthur A. Benjamin Health Professions High School
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Curriculum Integration Requires a New Instructional Approach

Curriculum integration is taking hold in a wide variety of high school settings. In career-focused pathways, new small high schools, career academies, and even large traditional high schools, teachers are integrating academic and technical instruction by focusing on career-related themes. They are working across the usual boundaries of academic and technical fields to make course material more engaging, encourage once reluctant learners to enroll and succeed in higher-level academic courses, and give

students a running start at planning for college and their future careers.

The term "integrated curriculum" has many different, sometimes conflicting, meanings to educators. In this manual, integrated curriculum refers to the materials and pedagogical strategies used by *multidisciplinary* teams of teachers to organize their instruction so that students are encouraged to make meaningful connections across subject areas. English, mathematics, science, social studies, arts, world language, physical education, and career technical teachers can all collaborate to plan and present related lessons that center around a central, career–themed issue or problem.

What does a new multidisciplinary, integrated curriculum look like? It looks like the real, thorny, and exciting problem solving that engages professionals in their daily work lives. It brings authenticity to students' schoolwork, homework, and work-based learning situations. For example, in their mathematics and health sciences classes, Arthur A. Benjamin Health Professions High School students, in Sacramento, California, learn about the calculations that insurance underwriters make, while they ponder a highly relevant question: how do high-risk lifestyle decisions and behaviors affect access to and premiums for health insurance? While the students address this important question, their Spanish class provides a venue for studying differences in mortality rates and causes of death in many Spanish-speaking countries and across ethnic groups in the United States. Spanish becomes an important tool for researching and understanding national and cultural differences in rates of illness and injury and causes of death.

In another example, students in several states examine the connections among genetics, diet, and exercise to explore the rising rate of obesity. Instead of solving the usual math problems, algebra students in New York, Texas, and Utah apply their knowledge of algebraic equations in calculating their body mass index. They also debate the link between fast food consumption and the rise in obesity in their English, biology, Spanish, and health science courses. These subjects take on new relevance when students see that they are tools for addressing an important real-life issue.

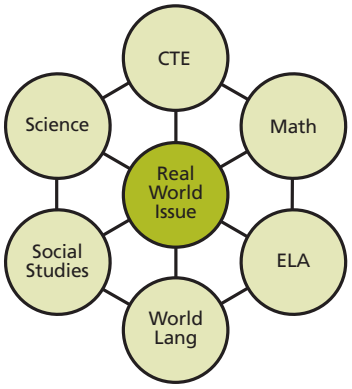
Integrating courses around career-related themes and making those themes relevant to teenagers—while also addressing state-mandated academic and technical content—requires a new model for designing instruction. This practical manual shows you how to create exciting and challenging curriculum units for high schools that use this integrated instructional approach.

The Goals of a Multidisciplinary Integrated Curriculum

Delivering a standards-based multidisciplinary integrated curriculum is a strategy that addresses many of our national, state, and local objectives around

What is Curriculum Integration?

1. Instruction centers around a concept, issue, problem, topic, or experience in a career-themed context.
2. Students explore a set of topics in several standards-based academic disciplines connected by a unifying concept that reinforces learning and brings the curriculum to life.
3. The concept that is being explored brings together various aspects of the curriculum in a meaningful way.



high school improvement. This approach is designed to reach high school students at all academic achievement levels, to facilitate learning for students with diverse learning styles, to replace academic tracking with placement based on students' interests, and to close the achievement gaps across groups of students. By focusing on mastering standards in technical and core classes, students can apply what they have learned and, therefore, remember more of it. Teachers, principals, and school district administrators who support this approach indicate that they have used it to accomplish the following:

- Shift classroom instruction from passive to active, thereby engaging more students in learning. Students become the center of the learning experience by collaborating in real-life, career-focused projects and problems that are connected to their current interests and future pursuits. The work is teacher-directed, not teacher-centered.
- Identify the specific skills and lessons that students are not mastering by having administrators and teachers review the test data. Then teachers can incorporate those skills into the projects for additional student reinforcement.
- Help students develop effective education and career planning skills. By participating in professional work and engaging with employees who address exciting and challenging problems in their jobs, students can recognize the need to perform well in high school, understand the educational pathways leading to a variety of rewarding careers, and pursue postsecondary education and/or training to achieve their personal career goals.
- Reach out to the diverse group of students who come to class with widely different backgrounds and levels of academic preparation. Students who participate in an integrated curriculum can express their own interests, demonstrate their unique skills, and master high-level academic and technical material by applying a variety of learning styles.
- Provide students with knowledge of a wide variety of career-related fields by creating research opportunities and career connections with professionals in many jobs within a career area.
- Build community support for improving high schools through partnerships with industry, postsecondary education, and local community representatives. By engaging key industry, education, and community-based stakeholders in their local communities, these educators are creating support for schools and proactive education improvement policies and are providing future employment opportunities for their students.

The Foundation of Multidisciplinary Integrated Curriculum Units

- Cohort scheduling of students
- Teacher professional development
- Standards-based, college-preparatory academic courses
- Challenging career-technical courses
- Supportive counselors
- Academic supports for struggling students

Teachers are the key to success in creating a multidisciplinary integrated curriculum, but they can't do it alone. Effective curriculum integration requires an infrastructure that is different from that found in the usual high school. Major pieces of this infrastructure include supportive administrators, class schedules that facilitate teacher collaboration, investments in finding and working with industry and postsecondary partners outside the high school and the district, sustained teacher enthusiasm and commitment, and a foundation of solid integrated curriculum material. Success also requires a clear road map. This practical manual offers teachers that road map.

Rest easy—designing a multidisciplinary integrated curriculum does not require creating an entirely new set of academic courses. This manual presents a strategy for teams of teachers to enhance their academic

and technical instruction by introducing multidisciplinary curriculum units into existing courses.

These integrated curriculum units are relatively large multidisciplinary projects that bring together academic and technical subject material around a common career- or industry-related issue or theme. Through immersion in an important problem faced by industry professionals, students experience their studies as more coherent and see how they connect with the real world. An effective integrated unit improves instruction because it helps teachers address important academic and technical standards in a new way. It arises out of students' needs and interests, provides real-world relevance and application, and prepares students for success in college and career.

Creating a successful interdisciplinary integrated curriculum starts with this short list of basic principles (the six A's) identified by Adria Steinberg (1997).

Why Invest the Time to Create and Use Integrated Curriculum Units?

For both teachers and students, incorporating integrated, career-themed curriculum units into a high school program offers a variety of potential benefits. Lipson et al. (1993) examined research on integrated curricula and student learning and described the following links between integrated curricula and positive student outcomes (cited in Lake 1994):

- Integrated curricula help students apply skills.
- An integrated knowledge base leads to faster retrieval of information.
- Multiple perspectives lead to a more integrated knowledge base.
- Integrated curricula encourage depth and breadth in learning.

- Academic and Technical Rigor - Projects are designed to address key learning standards identified by the school or district.
- Authenticity - Projects use a real world context (e.g., community and workplace problems) and address issues that matter to the students.
- Applied Learning - Projects engage students in solving problems calling for competencies expected in high-performance work organizations (e.g., teamwork, problem-solving, communication, etc.).
- Active Exploration - Projects extend beyond the classroom by connecting to internships, field-based investigations, and community explorations.
- Adult Connections - Projects connect students with adult mentors and coaches from the wider community.
- Assessment Practices - Projects involve students in regular, performance-based exhibitions and assessments of their work; evaluation criteria reflect personal, school, and real-world standards of performance.

- Integrated curricula promote positive attitudes in students.

In addition to these direct positive effects for students, there are also several benefits for teachers who collaborate to create integrated curriculum units and lessons. Designing and delivering a multidisciplinary integrated curriculum

- helps teachers engage in and establish a culture of professional dialogue about student work;
- offers a way to address and reinforce key state academic and technical standards through applications that are more interesting and engaging to students;
- provides fertile ground for high-quality student projects and presentations that encourage students to develop both academic and technical skills;
- establishes a meaningful vehicle for making connections across academic disciplines;
- encourages both teacher and student team building across technical and core departments and classes, which deepens camaraderie, and bonding;
- facilitates teacher collaboration, thus, reducing teacher "burn out";
- reduces classroom discipline problems because teachers from core and technical classes meet regularly to discuss students' performance, thereby allowing teachers to get to know individual students better;
- encourages higher expectations and student performance levels because industry partners participate in the classroom and judge the Culminating Event;
- fosters professional growth by encouraging teachers to go beyond the boundaries of their academic and technical fields; and
- brings coherence to the curriculum by providing a thematic focus for a school program, a small learning community, or a classroom.

Our work with students also suggests that engaging them in projects and having them investigate authentic problems from the world of work across several courses

- helps them make connections across academic disciplines;
- demonstrates the need to apply learning from several disciplines to solve real-world problems;
- introduces students to a wide range of career options and opportunities;
- connects students and their work to the larger community; and
- provides a better answer to the age-old question "why do I have to learn this?" than "because you need it to graduate or to go to college."

What Does It Take to Build a Successful Multidisciplinary Integrated Unit?

Creating a multidisciplinary integrated curriculum unit requires a true partnership. School leaders, teachers, students, and industry and postsecondary partners all play key roles in the curriculum design process. What exactly is needed from all of these partners?

From the school:

- A common intellectual mission and commitment to high achievement for all students
- Agreement to implement a common curricular focus that will cut across disciplines
- A flexible schedule that allows integrated, multidisciplinary project work and involvement with the world beyond school
- Common planning time allotted for teachers to formulate and coordinate the components of an integrated unit
- A funding model that supports the extra time, energy, and materials spent on developing and implementing the integrated units

- Master scheduling priorities that lead to cohorts of students being placed in the same technical and core academic classes
- Assistance and engagement with the goals and activities of the Advisory Board

From the teachers:

- Commitment and dedication to the common mission and focus
- Cooperation and teamwork among faculty and participating staff
- Shared responsibility in developing and implementing all aspects of the integrated units
- Agreement on core learning goals
- Agreement to build learning goals for the integrated curriculum unit by aligning it with existing academic and technical content standards
- Risk taking and flexibility
- Focus on deeper structures and understandings of their discipline
- Encouragement of student ownership
- A love of learning and understanding that teachers need to deepen their understanding and knowledge of the technical class and industry standards, professions, and practices
- Assistance in developing the Advisory Board and making it sustainable

From the students:

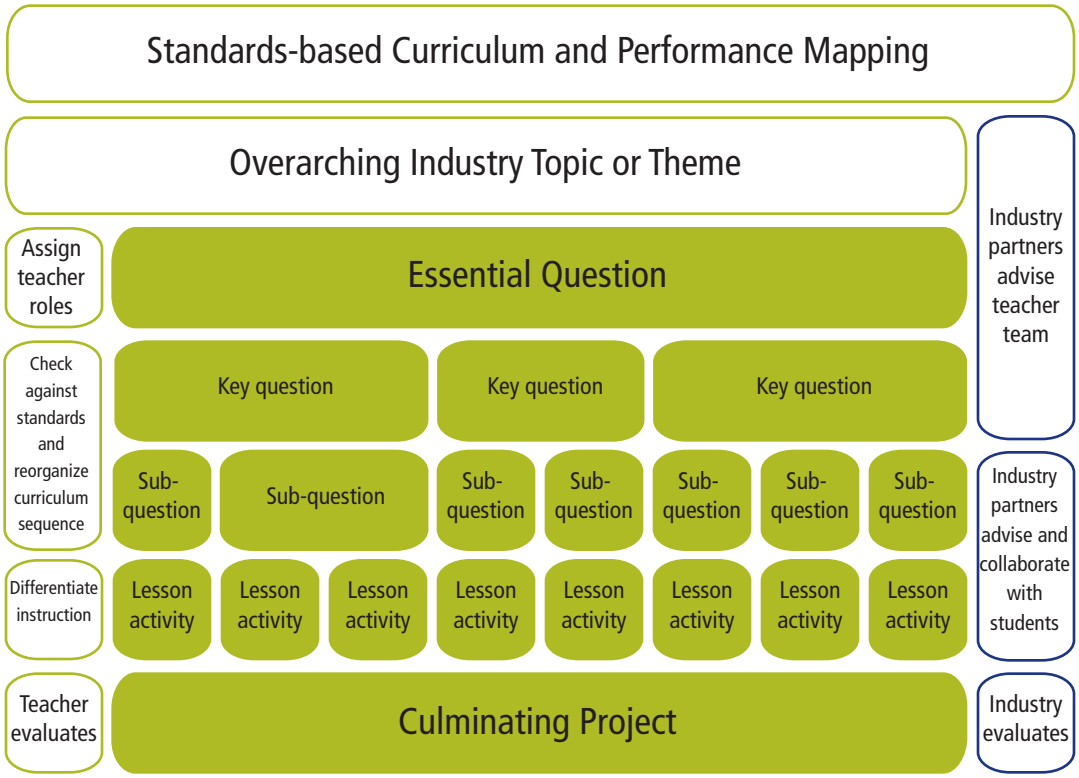
- Commitment and dedication to the common mission and focus
- Cooperation and teamwork with other students, faculty, and participating staff
- Shared responsibility throughout the entire process of designing the integrated unit, including active participation in the Culminating Event
- Willingness to pursue a deeper understanding of the material and its connections across disciplines
- Willingness to synthesize complex concepts into a cohesive whole and to engage with community and industry partners in the learning and assessment processes

From industry and postsecondary partners:

- Showing commitment and dedication to the common mission and focus
- Volunteering as guest speakers for topics that relate to the thematic unit
- Serving on and assisting with the development of the Advisory Board
- Supporting students in their research and project work
- Providing opportunities for field trips and job shadowing
- "Teaching the teachers" about industry standards, professions, practices, and issues
- Investing in the students by assessing their ongoing work, offering feedback, and evaluating their culminating projects
- Offering feedback to teachers on curriculum development and related activities and collaborating with teachers as they develop the integrated units
- Offering feedback to students regarding the accuracy and relevance of material presented in their projects
- Volunteering facilities as venues for showcasing students' work outside of class
- Providing student internships
- Introducing other industry partners to volunteer opportunities within the school
- Providing opportunities for summer teacher externships and other professional development to help teachers learn about authentic industry issues

Multidisciplinary Integrated Curriculum Model

In the remainder of this manual, we offer details on the major steps that teachers at 11 high schools across the United States have followed to design and deliver multidisciplinary integrated curriculum units. At a number of the high schools, teacher teams have tailored some of the steps to meet their unique needs, but all of them have followed the broad outlines of this model.



Major Steps to Design an Integrated Curriculum Unit

- ☐ 1 **Connect With Industry and Postsecondary Partners**
  Plan to consult with industry and postsecondary partners for help with identifying authentic connections, providing specialized instruction and mentoring, and evaluating student work.
- ☐ 2 **Creating and Sharing Curriculum and Performance Maps**
  Examine the existing scope and sequence of concurrent academic and CTE classes, then map out and share the performance measures for each class.
- ☐ 3 **Decide on the Topic of the Integrated Unit**
  Look across the performance measures to find connections between classes and then choose a topic of interest to students that allows for authentic integration of multiple subject areas.
- ☐ 4 **Craft the Essential Question**
  Set up a need-to-know learning opportunity for students by framing the unit and driving the instruction with an essential question.
- ☐ 5 **Identify Key Questions**
  Break down the overall concept of the essential question into smaller parts, often directly related to individual academic or CTE subjects.
- ☐ 6 **Allocate Responsibilities**
  Identify and assign the roles and responsibilities for each team member, particularly the team leader, to ensure that development and enactment of the integrated unit moves forward.
- ☐ 7 **Review and Revise the Instructional Sequence**
  Once the unit theme and general content has been chosen, revisit the curriculum map to identify potential sequence adjustments that might bring relevant topics closer together in the school year.
- ☐ 8 **Set the Learning Scenario**
  Plan to engage student interest by introducing the unit with an interesting example of the unit theme in a real-world setting, ideally with relevance to students' lives.
- ☐ 9 **Establish Student Assessments**
  Determine appropriate formative and summative student assessments, including the culminating project. Ideally, the culminating project would allow students to demonstrate multidisciplinary content knowledge mastery.
- ☐ 10 **Write Lesson Plans**
  After initial overall unit planning is complete, individual subject lesson plans and instructional materials should be written and/or assembled for enactment and future reference.
- ☐ 11 **Evaluate the Unit**
  Once the various pieces are finished, step back and re-evaluate the unit as a whole.

Connect With Industry and Postsecondary Partners

STEP 1

The first step in creating integrated curriculum units is to get to know your local industry or postsecondary partners. Partners are invaluable in helping to identify authentic applications for academic and technical course content, evaluate the quality of student work, and build students' education and career planning skills. Invite them to meet your teachers and students. The Work-Based Learning Coordinator, lead teacher, or another individual should be responsible for connecting with partners outside the school. This will ensure that there is one point of contact between the school and industry or postsecondary partners.

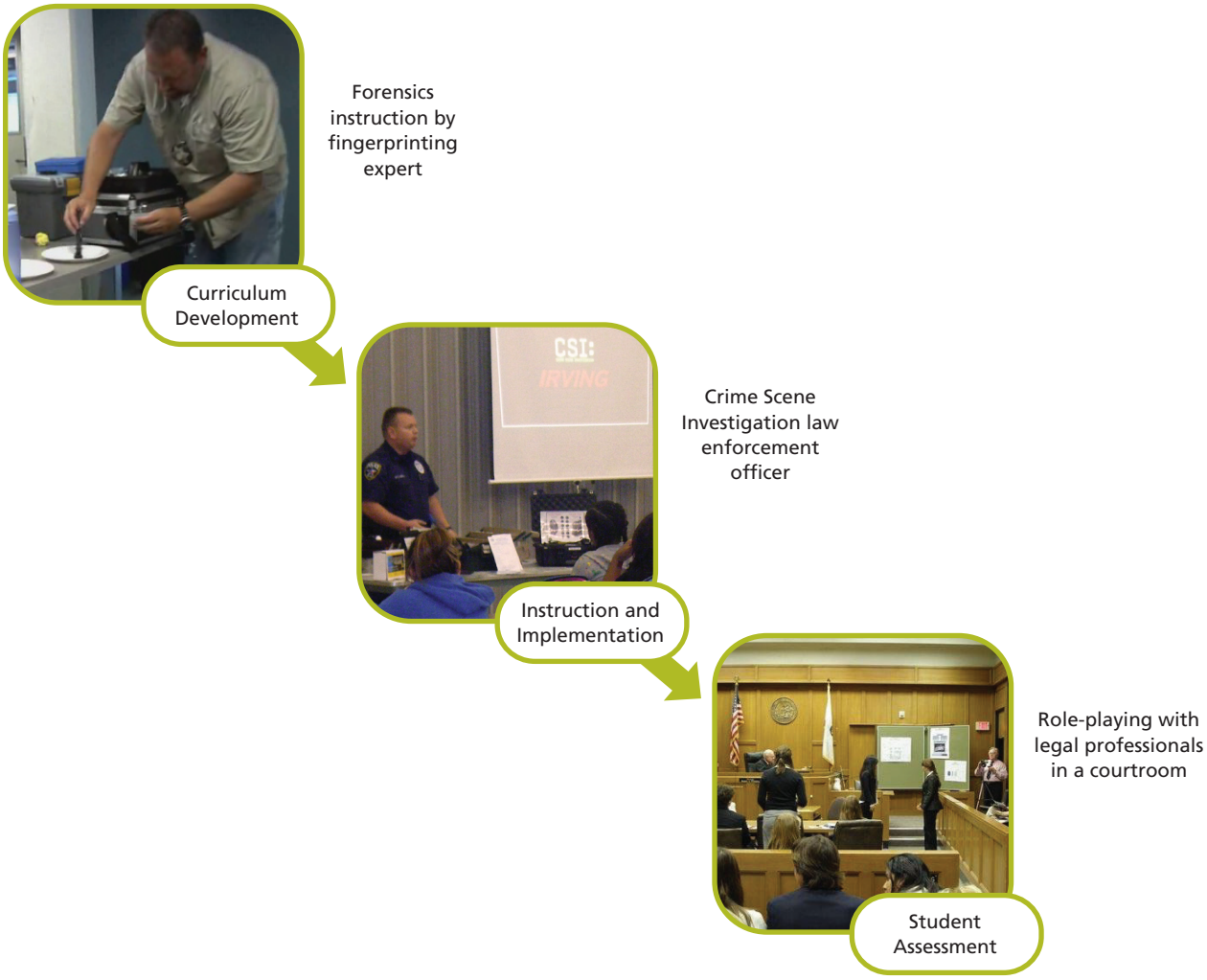
The following are major Coordinator responsibilities:

- Identify community resources, such as local industry professionals, businesses, educators, organizations, or libraries, that can assist students in their research and project work.
- Invite community/industry partners into the classroom for guest-speaking opportunities or team-teaching activities that relate to the integrated unit. These speakers can
  - "teach the teachers" about industry practices, projects, standards, and professions;
  - brainstorm about integrated curriculum unit projects and provide authentic props, templates, and tools;
  - personalize the topic of the integrated curriculum unit and provide additional local context;
  - discuss how knowledge and skills from specific academic disciplines are used in the workplace (e.g., "In our department we use algebra, statistics, or persuasive writing to…");
  - describe how they contribute to solving real-world problems in their jobs and the kinds of teamwork, communication, and problem-solving skills that are needed to do this work; or
  - provide information about the range of specific jobs and careers within their field and the kinds and levels of education and experience required.
- Assemble an "expert panel" of local professionals with experience related to the unit topic. Ask panelists to assist in assessing and evaluating student work.
- Establish a network of community partners, including colleagues from other schools, colleges, and universities, who can offer feedback on curriculum development and other activities. This expert panel can work as a steering committee or advisory board for your school or academy, helping to establish internships and do curriculum development, marketing, and fundraising. For more information, go to http://pearsonfoundation-naf.org/academydevelopment/index.html.
- Invite the professionals to review drafts of student work, mentor students, provide feedback online, and judge final work products.
- Work with local colleges and universities to expose students to college students and professors and opportunities for taking college classes in high school.
- Schedule visits to various local work sites, thus connecting students to the world of work.
  - Individuals at these sites should be prepared to speak about how their organizations can provide connections to the curriculum topic and to important academic and technical standards.
  - Individually or in small groups, students can "job shadow" professionals at these sites for a day to understand how the technical skills they are learning relate to work.

Students must also have a comprehensive and effective work-based learning experience that matches what they are learning in the classroom. This expo-

sure helps sharpen students' desire to increase their knowledge and develop skills that are relevant to their career interests. These work-based learning opportunities can take several forms: job shadowing, intensive internships, virtual apprenticeships, and school-based enterprises. Ideally, this work-based learning is incorporated into students' sequential technical program of study. Possible models include guest speakers and field trips in 9th grade, mentoring in 10th grade, job shadowing in 11th grade, and internships in 12th grade.

Multiple Roles for Industry and Postsecondary Partners in an Integrated Forensics Unit



Create and Share Curriculum and Performance Maps

STEP 2

One major goal of multidisciplinary integrated curriculum is to give students an opportunity to connect the content covered in various academic subject areas to authentic applications in the world of work through standards-based curriculum. Many school districts require pacing guides and conduct benchmark testing, so it is important to take these into consideration when creating integrated units. Even highly technical and difficult material can be much more engaging when students see it in the context of an interesting real-world problem that arouses their curiosity. And the standards that underlie this material can be addressed through well-planned and implemented integrated units.

Therefore, the second step in developing an integrated curriculum unit is to look at the important topics, standards, and performances across the existing curriculum. By taking this global view, teams can eventually see where authentic connections can be made across academic disciplines and blended into an engaging and relevant career-related theme. This process begins with creating curriculum and performance maps.

- Individually, subject area teachers should map out the existing scope and sequence of topics covered in their courses. This information is often determined by the district office in the form of pacing guides or other course outline documents. This mapping can be done by week or by month, as shown in tables 1 and 2.

Table 1: Topic Curriculum Map for Biology by Week

	SEPTEMBER				OCTOBER				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	
Topic	Cell membrane	Cell types and viruses	Organelles	Photosynthesis	Cellular respiration	Macro molecules and Krebs cycle and cytoskeleton	Meiosis	Fertilization and chromosome segregation	and so on…

Table 2: Topic Curriculum Map for Algebra by Month

SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Real numbers	Solving and graphing linear equations	Writing linear equations		Solving and graphing linear inequalities	Systems of equations	Exponents and exponential functions	Quadratic equations and functions		Polynomials and factoring

Table 3: Topic and Standards Curriculum Map for Biology by Week

SEPTEMBER				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4
Topic	Cell membrane	Cell types and viruses	Organelles	Photosynthesis
Standards	1a. Students know that cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.	1b. Students know that enzymes are proteins and catalyze biochemical reactions without altering the reaction equilibrium and that the activities of enzymes depend on the temperature, ionic conditions, and pH of the surroundings. 1c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	1d. Students know that the Central Dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm. 1e. Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.	1f. Students know that usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

- Next, teachers should align their course outline topics to the state standards. This information is also sometimes provided by the district office, so topic and standards mapping can often be done in the same step. Table 3 shows a topic and standards curriculum map for one month of Biology.
- The final and most important step in curriculum mapping is to unpack the topics and standards into performances that students are expected to master and demonstrate. With state standards, the objective is to set priorities for what students need to know and be able to do, but it is often necessary to break standards down into a more usable, measurable form. There are many different ways to "unpack the standards," but generally it involves distinguishing both the content (nouns) and skills (action verbs) that are incorporated in the standard and then identifying the underlying performances expected of students. An example of standard unpacking is provided in table 4. The fourth step of this process is to identify the student performance measures that go into the final performance map. Table 5 provides a sample performance map of one month of Biology.

Table 4: Legal and Government Service Pathway

List the standard	**Public Services B9.2** Know the basic elements of all aspects of trial procedures.
1. What is the content/application?	Trial Procedures: Pretrial motions, objections, opening and closing statements, direct questioning, cross-examination, redirection examination, roles of prosecutor, defense attorney, judge
2. What skills (action verbs) do the students need to master?	Define and describe the basic elements of trial procedure.
3. What patterns of thinking are required?	Persuasion; Organize and structure ideas and arguments
4. How would a student demonstrate mastery of the standard	**1. Present a pretrial motion at a mock trial pretrial hearing.** **2. Assume the role of a prosecutor or defense attorney at a mock trial.** **3. Raise appropriate objections when assuming an attorney role.** **4. Assume the role of a presiding judge.** **5. Write effective opening and closing arguments.**
5. What work product could be produced to demonstrate mastery?	In a cooperative learning group, students conduct a mock trial of a criminal case, applying their knowledge of proper courtroom procedure and rules of evidence. Students will illustrate their ability to formulate precise questions and present convincing arguments.

Source: Career Technical Education Framework for California Public Schools Grades Seven Through Twelve, 2007, pp. 417–418.

Table 5: Performance Map for Biology by Week

SEPTEMBER				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4
Topic	Cell membrane	Cell types and viruses	Organelles	Photosynthesis
Standards	1a. Students know that cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.	1b. Students know that enzymes are proteins and catalyze biochemical reactions without altering the reaction equilibrium and that the activities of enzymes depend on the temperature, ionic conditions, and pH of the surroundings. 1c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	1d. Students know that the Central Dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm. 1e. Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.	1f. Students know that usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

Performance Measures	• Describe how phospholipids are organized to form a fluid mosaic cell membrane.
	
	• Describe the functions of proteins in the cell membrane.
	
	• Explain the difference between diffusion and osmosis.
	
	• Compare and contrast passive and active transport.
	
	• Explain how large particles get into and out of cells.
		• Show that enzymes function as biological catalysts. They speed up spontaneous reactions by lowering the activation energy without being consumed.
		
		• Illustrate how protein shapes create the lock-and-key model of enzymes.
		
		• Illustrate the induced fit model of enzymes.
		
		• Show how H+ and OH- ions relate to the pH scale and where this is important in biological systems.
		
		• Demonstrate that the activity of enzymes depends upon temperature, ionic conditions, and the pH of the surroundings.
		
		• Describe five properties shared by all living organisms.
		
		• Explain why viruses cannot be considered as living organisms.
		
		• Distinguish prokaryotes and eukaryotes.
		
		• Describe how each organelle performs a task essential to the life of the cell.
		
		• Describe the composition of the nucleus.
		
		• Compare and contrast the structure of an animal cell with that of a plant cell.
		
		• State the three basic concepts included in the cell theory.
			• Describe the DNA in the nucleus as the template code from which proteins are made.
			
			• Explain that parts of the DNA contain codes for specific proteins.
			
			• Explain that when proteins are needed, their part of the DNA is copied (transcribed) into messenger RNA (mRNA).
			
			• Explain that mRNA carries the code to ribosomes out in the cytoplasm, where it is converted (translated) into the protein originally coded by the DNA.
			
			• Recall that this process is considered the Central Dogma.
			
			• Identify two types of endoplasmic reticulum (ER): smooth and rough.
			
			  • Recall that rough ER synthesizes proteins.
			
			  • Recall that smooth ER modifies or detoxifies lipids.
			
			• Explain that proteins that are to be sent outside the cell are moved to the Golgi apparatus where they are modified, packaged in vesicles, and moved to the cell membrane to be secreted.
				• Explain that photosynthesis is a complex process that converts visible light energy into chemical energy in carbohydrate molecules.
				
				• Recall that the processes of photosynthesis take place within chloroplasts, which can be seen under a microscope in plant cells and photosynthetic protists.
				
				• Explain that photosynthesis occurs in two reactions: one light-dependent and the other light-independent.
				
				  • Diagram the light-dependent reaction within the thylakoid membrane where water is oxidized and light energy is first converted into chemical bond energy generating ATP, NADPH + H+, and O2.
				
				  • Diagram the light-independent reaction (Calvin cycle) with the stroma where carbon dioxide, ATP, and NADPH + H+ react to form phosphoglyceraldehyde, which is then converted into sugars.

Performance maps provide a useful tool for looking at your own class and the ways in which you might address the relevancy of the topics you teach and students' motivation. These maps also provide a tool for looking across a student's program to find natural connections from which to build projects. Individual teachers or departments can create performance maps, which can also help teachers to identify areas where students may need remediation.

Sharing Maps

Once the individual curriculum and performance maps are completed, it is important to take some significant time to share maps with the whole teacher team. It is a good idea to have physical maps printed or written out so that the entire team can see them. This may seem unwieldy at first because the maps contain a lot of information and typically span many pages; however, it will be helpful not only for visual purposes but also during the next step when searching for a unit theme.

In a group meeting and beginning with the career and technical education (CTE) teacher, each member of the instructional team should present a brief overview of the scope and sequence of his or her course to the rest of the team and a detailed description of the performance measures. Having the CTE class teacher begin this discussion helps the academic teachers start thinking about career-themed applications that may be relevant to the major topics and concepts they cover. For example, references to cigarette smoking (described as part of the Health Sciences course unit on the respiratory system) may lead an English teacher to think about an expository or persuasive writing assignment or help a social studies teacher to visualize a lesson on the role of tobacco and other commodities in economic development. For a law class focusing on a crime-scene investigation, the English teacher may think about incorporating narrative report writing and using the active voice in the police reports.

At this time, academic teachers can also identify concepts in their disciplines that are very important but difficult for students to grasp and address them through an integrated curriculum unit. Ideally, teachers can use the integrated unit to reinforce students' learning by having them explore these challenging concepts through multiple applications in a variety of contexts.

Now that everyone on the team is familiar with the content and performance measures of each subject area, it is time to brainstorm the various connections that can be made across the academic subject areas, linking them to the CTE class.

Decide on the Topic of the Integrated Unit

STEP 3

Once the team is familiar with the content and performance measures of each class, review all the performance maps together. Remember that the integrated unit is designed to place important academic content in the context of meaningful, real-world problems without burdening teachers with additional material to cover in an already busy school year. Teacher teams should ensure that they are not adding unnecessary content to their teaching load by adhering closely to the existing performance map when choosing a topic for the integrated unit.

Record or make note of the natural connections identified among the classes. Look for connections between the content that students are learning and the skills that students are expected to master.

For example, in the map below, a natural content connection exists between writing persuasive compositions in the English class and courtroom testimony in the Law class. Similarly, a content connection exists between deductive reasoning in Geometry and criminal investigation in Law.

In fact, real-world issues that arise in the career and technical education (CTE) class can often provide a context that allows seemingly unrelated content in multiple subject areas to be integrated. For example, Biology (DNA structure/technology) and Algebra (circle geometry) can be integrated through the context of a criminal investigation and prosecution. Students need to understand DNA structure and sequencing in order to conduct DNA fingerprinting activities, and students need to be able to calculate the area and perimeter of a circle when determining the search area surrounding a center point—i.e., the scene of a crime.

Subject Area	AUG	SEPT	OCT	NOV	DEC
English	Biographies Character traits and motivation	Short stories Time and sequence Foreshadowing Flashback	Universal themes Literary devices Imagery, allegory, symbolism	Creative writing Interviews	Evaluating credibility Writing persuasive compostions
Algebra II	Numbers and fractions	Solving systems of linear equations	Solving and graphing quadratics	Exponential equations Logarithms	Polynomial functions
Biology	Scientific method	Cell biology Photosynthesis Cellular respiration	Central dogma DNA structure and technology Protein synthesis	Meiosis Inheritance	Cloning Stem cell research
Geometry	Definitions Geometric reasoning	Induction vs. deduction Construction of lines, angles, shapes	Circles Properties of triangles Congruence	Quadrilaterals Polygons	Area, and surface area Sectors and segments
Law and Justice	Ancient legal systems Early laws	Sources of law Bill of Rights Amendments	Codes Criminal investigation	Courts Courtroom testimony	Mediation Arbitration Conflict resolution

*Due to limited space, this example is a **topic** curriculum map for a semester. Remember that this map represents the much larger **performance** map used in the actual development process.*

Subject Area	AUG	SEPT	OCT	NOV	DEC
English	Biographies Character traits and motivation	Short stories Time and sequence Foreshadowing Flashback	Universal themes Literary devices Imagery, allegory, symbolism	Creative writing Interviews	Evaluating credibility Writing persuasive compostions
Algebra II	Numbers and fractions	Solving systems of linear equations	Solving and graphing quadratics	Exponential equations Logarithms	Polynomial functions
Biology	Scientific method	Cell biology Photosynthesis Cellular respiration	Central dogma DNA structure and technology Protein synthesis	Meiosis Inheritance	Cloning Stem cell research
Geometry	Definitions Geometric reasoning	Induction vs. deduction Construction of lines, angles, shapes	Circles Properties of triangles Congruence	Quadrilaterals Polygons	Area, and surface area Sectors and segments
Law and Justice	Ancient legal systems Early laws	Sources of law Bill of Rights Amendments	Codes Criminal investigation	Courts Courtroom testimony	Mediation Arbitration Conflict resolution

Many connections and possible topics may emerge from the performance map. Select a topic that: reflects the career focus of the program; supports the major learning goals of the school and the participating teachers; can be addressed through multiple disciplinary lenses; advances instruction related to key disciplinary content standards; and includes local industry professionals or colleges if possible. The topic should be drawn from real-world issues associated with professional work in the career/industry sector. You may wish to include industry professionals when brainstorming this part of the project as they can provide valuable feedback and resources.

Topic

A good topic will have the following characteristics:

- Is relevant to students' lives and interests.
- Reinforces content standards and skills.
- Reflects important contemporary or historical issues in a broad career area.
- Is general enough to include all major academic disciplines.
- Cuts across all disciplines and may be addressed from various disciplinary perspectives.
- Lends itself to student investigation and research.
- Can be linked to community issues and needs.

The following are examples of broad topics that teams of teachers have used for multidisciplinary integrated curriculum units in Health Science and Engineering programs of study:

Health Science

- Bioethics
- Communicable diseases
- Complementary and alternative medicine
- Forensics
- Global health issues: HIV/AIDS
- Healthcare careers
- Health insurance
- Nutrition and health
- Smoking
- Workplace injuries

Engineering

- Ship hull design
- Reverse engineering
- Bridge building
- Catapult design and use
- Autonomous rovers
- Electronic voting machines
- Green commercial buildings
- Energy efficient house renovation

After deciding what the final topic for the integrated curriculum unit will be, discuss the following questions in a team meeting:

- What do you want students to understand?
- What do you want students to be able to do?
- What resources have students accessed to complete their work?
- What interdisciplinary connections have students made?
- What connections have students made with the community?
- How have students demonstrated their learning?

It is a good idea to use a standardized format to record a summary of the different parts of an integrated unit, both for a team's current discussion and evaluation, and for future reference. A sample project template and an example can be found in the Appendix.

Summarize and Record Your Work

Once the team has identified the integrated unit topic, record the performances that students will demonstrate in each subject, the essential question, and a brief project/unit description. The template shown in Appendix 1 is a convenient one-page format for presenting this information to students, parents, community/industry partners, and others at your school.

Performance mapping has become a regular part of integrated curriculum design work at Digital Media & Design High School in San Diego. To view a video of this process, go to www.ConnectEdCalifornia.org.

Craft the Essential Question

STEP 4

The next step is to develop the Essential Question for the integrated curriculum unit. Be sure to consider the learning outcomes and the key academic and technical standards your team has identified as you craft your Essential Question.

An Essential Question is the fundamental query that directs and drives the search for understanding across all participating subject areas. Everything in the integrated curriculum unit is studied with the goal of understanding and answering the Essential Question. Because the Essential Question is central to the design of the unit, it is important to consider the characteristics of a good Essential Question.

- The question reflects a problem that engages students in learning because it is interesting and relevant. Students want to figure out an answer.
- It relates to an open-ended problem with multiple solutions (not a "yes" or "no" answer).
- There is no single correct answer or course of action. Students may arrive at a variety of answers. And, they may not all agree about the best answer.
- The question is often controversial. The controversy heightens students' interest and causes them to raise their own questions.
- The question challenges students to solve real-world problems. The nature of the problem creates a natural bridge to professional work and industry and postsecondary partnerships.
- The complexity of the problem requires collaboration and thinking beyond recall. Students need to work in teams and build upon each other's skills and experiences.
- The question applies to more than one discipline, and full understanding requires learning in more than one discipline.

The following are examples of Essential Questions that high school students are addressing through integrated curriculum units in Health Sciences and Biomedical programs of study:

- *How can we balance personal freedoms and society's need to provide accessible, affordable healthcare?*
- *How can workplace injuries be reduced and who is responsible for implementing these reductions?*
- *What role should government play in regulating biomedical research?*
- *How can medical science prevent worldwide disease epidemics in the future?*
- *Who should decide who gets medical care?*
- *What is the best way to reduce cigarette smoking? Should smoking be criminalized?*

The following are examples of Essential Questions that students are addressing through Engineering programs of study:

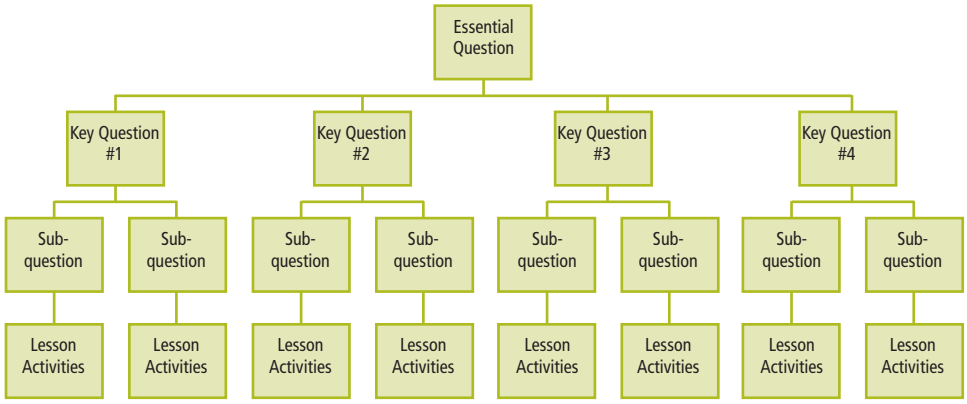
- *How can we balance technology, growth, and preserving the environment?*
- *How can we balance society's needs for resources and their limited availability?*
- *How will we survive in a world without oil when we run out of our primary fuel source?*
- *What is the price of going green? What is the price of not going green?*
- *What are the personal, collective, and ethical responsibilities of weapons development?*

Identify Key Questions

STEP 5

Essential questions are designed to be "big" questions. They address the kinds of issues that drive professional work, public policy, scientific research, and often legislation. Answering the Essential Question requires students to address a variety of smaller, more targeted questions called "Key Questions." These smaller Key Questions break up the large, overarching Essential Question into more manageable parts, and they relate disciplinary content and standards back to the Essential Question. Sometimes Key Questions are broken down even further to sub-questions. The Essential Question continues to be broken into series of smaller and smaller parts until the questions are subject-specific and can be addressed completely by one or two teachers.

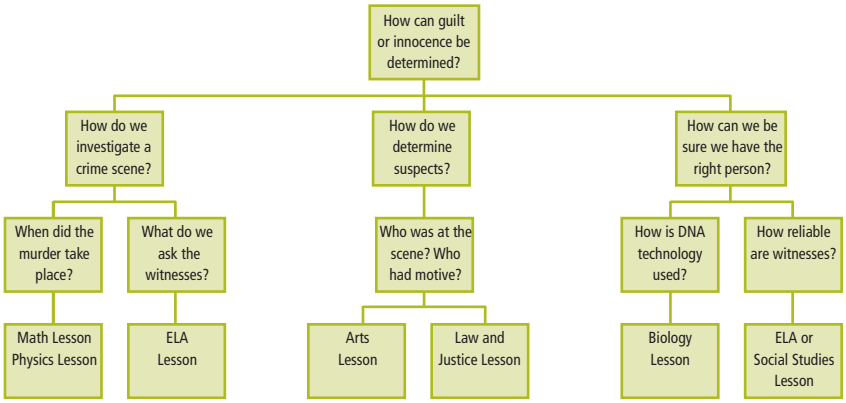
Unpacking the Essential Question into Key and Sub-questions



- Key Questions are derived from the Essential Question, but are subject specific.
- Answers to the entire set of Key Questions should provide the information necessary to answer the larger Essential Question.
- Key Questions focus attention on an issue that is authentic to a specific academic or technical discipline or a couple of disciplines.
- A Key Question may apply to more than one discipline, or it may be specific to a single discipline.
- Key Questions provide the vehicle for addressing specific curriculum content standards and demonstrating student performance.
- Each Key Question is typically addressed by one or two lessons within the larger integrated curriculum unit.

The diagram below illustrates the breakdown of a sample Essential Question from a unit on forensics into smaller Key and sub-questions. Keep in mind that not all the Key and sub-questions from the unit are represented on the diagram.

Forensics Unit Sample



Presented below are some additional examples of Key Questions that relate to Essential Questions in other pathway themes.

Topic: Health Insurance

Unit Title: Risky Business

Essential Question

How can we balance personal freedoms and society's need to provide accessible, affordable healthcare?

These Key Questions are discipline specific:

- How do we pay for health insurance? (Health Science)
- Why is healthcare so expensive and where does the money go? (Health Science and Economics)
- What roles do governments play in promoting national health? (U.S. History, World History, and Government)
- How do mortality and illness rates vary in different parts of the world? (Health Science and World Languages)
- How does genetics account for individual differences in various personal characteristics and health outcomes? (Biology and Health Science)
- What factors are used—and how—to calculate the health insurance premiums individuals pay? (Algebra and Economics)
- What role might a fitness program play in helping individuals reduce their insurance premiums? (Physical Education)

Topic: Environmental Protection Marketing Campaign

Unit Title: Making W.A.V.E.S.

Essential Question

What does it take to produce a professional marketing campaign for an authentic client?

These Key Questions are discipline specific:

- As citizens, how can we effect change in our communities? (English, Media Arts)
- Through the study of natural phenomena, how can the scientific process be applied to figuring out

how the world works? (Chemistry, Marine Science, Math)

- What are the controversial issues associated with environmental conservation regarding freshwater issues, plastics, or storm drains? (Chemistry, Marine Science, U.S. History)
- What is expected of consultants when working for a client? (Media Arts)
- How do we identify the needs of the client? (Media Arts, English)
- What information does an expert provide to support or negate the need for an environmental protection initiative? (Foundations of Law)
- How is scientific evidence collected? (Chemistry, Marine Science)
- How can we use evidence to communicate findings about the environment? (Math, English, Media Arts)
- What are the critical elements necessary for an initiative to become a law? (U.S. History)

Topic: Workplace Injuries
Unit Title: Safety First

Essential Question

How can workplace injuries be reduced, and who should be responsible for reducing them?

These Key Questions are discipline specific:

- What body systems are most affected in workplace injuries? (Health Science and Biology)
- Are high school students susceptible to injuries at school? Which injuries occur most often, and how can they be prevented? (Health Science and Physical Education)
- How can we demonstrate the cost effectiveness of an injury prevention program to the owner of a local business or the principal of a school? (Algebra and Economics)
- What is the history of workplace safety laws, and how do these laws differ in various countries? (U.S. History, World History, and World Languages)
- How can we communicate to diverse audiences the dangers, available treatments, and ways to prevent specific workplace injuries that are prevalent in a particular industry or occupation? (English Language Arts)

After Identifying the Essential Question and Key Questions

Now that your team has identified an Essential Question and appropriate Key Questions for each participating subject area, revisit the performance measures that you identified in Step 2. Evaluate whether students will be able to achieve and demonstrate these outcomes by investigating the Essential and Key Questions. If not, revise the questions accordingly.

After identifying the Essential Question and the subject-specific Key Questions, your team may want to brainstorm activities that link two or more academic subjects to create cross-curricular lessons (e.g., students in Chemistry and Geometry learn that one way to describe molecular bonding involves the angles of molecular formations).

Allocate Responsibilities

STEP 6

Since integrated curriculum units are designed to show students how subjects are interconnected—i.e., how one subject builds upon and supports another—it is essential that teachers work collaboratively so that each may refer to related work in classes that address other subject areas. Selecting a Team Leader for each integrated curriculum unit helps to ensure that important coordination tasks are performed. Identifying the roles and responsibilities of every team member from the start helps to ensure that there will be harmony within the team and that the curriculum unit will be a success.

The Team Leader

The team leader has the following roles and responsibilities:

- Monitors the team's progress in developing and implementing the integrated unit.
- Leads the Culminating Event for the curriculum unit.
- Serves as the liaison among faculty members as questions arise or issues need to be discussed.
- Communicates deadlines and instructions for producing the curriculum materials.
- Works with the Integrated Curriculum Coordinator to deliver instruction, establish deadlines based on curriculum mapping, and communicate this information to the rest of the faculty.
- Works with the Work-Based Learning Coordinator or another designated individual to contact industry partners to brainstorm about the unit, provide feedback on curriculum development, advise students on project drafts, "teach the teachers," become a guest speaker or co-teacher, or serve on the assessment panel for the Culminating Event.
- Schedules integrated unit meetings and evaluates the progress of the unit.
- Prepares the forms and rubrics for evaluating student work.

All Team Members

All team members have the following roles and responsibilities:

- Attend meetings set by the Team Leader in collaboration with the Integrated Curriculum Coordinator.
- Complete their assigned work in a timely manner.
- Complete the curriculum- and performance-mapping components related to their subject to ensure that instruction in all courses in aligned to pacing guides, benchmark tests, and project requirements.
- Complete the necessary templates and lesson plans for submission.

Review and Revise the Instructional Sequence

STEP 7

Now that the team has decided on the content that will be covered in the integrated unit, it may be necessary to consider reorganizing course outlines (where possible), in relation to pacing guides and testing schedules. The goal is to create a logical sequence for the learning and activities of the integrated unit across the participating courses, while still maintaining an appropriate instructional sequence within each individual course. To do so, consider following these guidelines:

- Review the curriculum map constructed in Step 2. For this purpose, you can return to using the more abbreviated topic-level curriculum map.
- Highlight the topics covered in the integrated unit for each subject area. Table 6 below shows topics that might be covered in an integrated curriculum unit on risky behaviors and health insurance.
- Discuss whether any topics must occur early or late in the unit (e.g., some lessons will only make sense if they precede or follow other lessons).

Table 6. Highlighted topics covered for each subject from original Scope and Sequence

Subject Area	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Health Science I	Integumentary System	Skeletal/ Muscular System	Cardiovascular System		Respiratory System	Nervous System	Endocrine/ Reproductive System		Immune System	Public Health/ Insurance
Biology	Introduction	Biochemistry	Cell Biology		Photosynthesis and Cellular Respiration	Genetics	Evolution		Ecology	Diversity
Algebra I	Real Numbers	Solving and Graphing Linear Equations	Writing Linear Equations		Solving and Graphing Linear Inequalities	Systems of Equations	Exponents and Exponential Functions		Quadratic Equations and Functions	Polynomials and Factoring
English Language Arts	Grammar	Technical Writing	Research Project		Literature Themes in Short Stories	Persuasive Essay	Literature Themes in Novels		Analytical Essay	Oral Presentations
Spanish	Family and Friends	School	Food and Fun		The House	Shopping	Traveling		Experiences	Communication
Physical Education	Fitness Fundamentals	Safety Features	Diet		Cardiovascular Fitness	Flexibility Training	Strength Training		Team Sports	Designing an Exercise Program

Table 7. Reordered topics for Health Science, English Language Arts, and Physical Education

Subject Area	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Health Science I	Integumentary System	Skeletal/ Muscular System	Cardiovascular System		Respiratory System	Public Health/ Insurance	Nervous System		Endocrine/ Reproductive System	Immune System
Biology	Introduction	Biochemistry	Cell Biology		Photosynthesis and Cellular Respiration	Genetics	Evolution		Ecology	Diversity
Algebra I	Real Numbers	Solving and Graphing Linear Equations	Writing Linear Equations		Solving and Graphing Linear Inequalities	Systems of Equations	Exponents and Exponential Functions		Quadratic Equations and Functions	Polynomials and Factoring
English Language Arts	Grammar	Literature Themes in Short Stories	Literature Themes in Novels		Persuasive Essay	Research Project	Technical Writing		Analytical Essay	Oral Presentations
Spanish	Family and Friends	School	Food and Fun		The House	Shopping	Traveling		Experiences	Communication
Physical Education	Fitness Fundamentals	Safety Features	Diet		Cardiovascular Fitness	Flexibility Training	Strength Training		Designing an Exercise Program	Team Sports

- As a team, decide where the various curricular sequences can be reordered to support the flow of instruction without disrupting the logical sequence of the subject matter. In table 7, topics in Health Science, English Language Arts, and Physical Education have been reordered to support the timeline of the integrated unit.
- Topics in Mathematics classes are typically the most difficult to reorder, so it may be best to begin by discussing their topics. However, remember that topics can be reviewed later in the year after the original instruction. In this example, the Algebra teacher can teach linear equations early in the year and review the topic later when students use these skills to address a problem related to health insurance.
- Projects can be designed for a week, a month, a quarter, or for an entire semester. If your district requires pacing guides, you may select longer projects because they allow for more flexibility.

Set the Learning Scenario

STEP 8

The learning scenario is the "hook" that will engage students in the problem. Through the scenario, the students can see a real-life application of the academic and technical knowledge and skills they will be mastering and applying to answer the Essential Question.

Learning Scenario Examples

Essential Question

How can we balance personal freedoms and society's need to provide accessible, affordable healthcare?

Learning Scenario— Risky Behaviors and Insurance

The Ski Club's annual trip to Lake Tahoe is just around the corner. In a triumph of planning and lucky timing, the club managed to schedule the trip on the very same weekend that Squaw Valley was offering a packaged workshop on extreme aerials by a member of the U.S. Olympic Ski Team. The members of the club were ecstatic. Enthusiasm had reached a fever pitch when, two days before the trip, the principal announced that participating in the aerials workshop was forbidden. Despite student protests, Mr. Perry explained that the district office had informed him that the school's field trip liability insurance could not cover such a high-risk activity. If anything happened, the district's insurance premiums would rise. The district's budget was already stretched to the limit, and they could not afford additional insurance. Though it might be possible to pass the insurance costs on to individual students, the trip was already very expensive and not everyone could afford it. The club had been fund raising for weeks to cover all the costs, and it seemed unrealistic to come up with more money at this late date. The club president thinks the district is exaggerating the risk. A district official has agreed to meet with representatives of the club to discuss the situation. What should be done? What arguments can the club present that will convince a skittish district? What is the relationship between risky behaviors and the cost of liability insurance?

Essential Question

How can guilt or innocence be determined?

Learning Scenario— Forensic Investigation

Mr. Diaz, a popular former teacher, has been found murdered in the school auditorium! Questions are swirling around the school? What was Mr. Diaz doing there? How could this have happened on campus? Who would have wanted to harm him? Who is responsible for this terrible crime, and how can the perpetrator be brought to justice?

Essential Question

How can work-related injuries be reduced, and who should be responsible for efforts to reduce them?

Learning Scenario—
Workplace Injuries: Who Is at Fault?

A construction worker falls off scaffolding while building a new high school and breaks his arm. How could this have been prevented, and who is responsible for this unfortunate event?

Essential Question

How can students develop professional work for an authentic client?

Learning Scenario—
Environmental Initiative Marketing Campaign

The local chapter of the Surfrider Foundation has approached the school's arts pathway program and requested that a student-produced multimedia ad campaign be developed that would include the materials necessary to promote their organization and their latest environmental awareness initiative. A typical multimedia package includes video production, web design, and graphic design (poster, pamphlet, flyer, bumper sticker, etc.). Only professional quality work will be accepted and used by the Surfrider Foundation.

Essential Question

What roles should various government and other agencies play in regulating performance-enhancing drugs? Should amateur and/or professional athletes be banned from using these drugs?

Learning Scenario—
Lessons From a Zero-Tolerance Drug Policy

Our high school has a zero-tolerance policy against the use of non-prescribed steroids and other performance-enhancing drugs. One student club on campus wants to invite a well-known professional athlete to the school as a motivational speaker, but the administration does not support this invitation because the athlete has allegedly used performance-enhancing drugs. How should the student group proceed? What arguments can be made for and against the invitation?

Establish Student Assessments

STEP 9

Integrated curriculum units offer teachers many opportunities to move beyond traditional paper-and-pencil tests. Teacher teams can design engaging and challenging performance-based formative and summative student assessments that are well matched to authentic teaching strategies. To create these assessments, it is valuable to work backwards. Begin thinking about the summative Culminating Event and then design the formative student work products that demonstrate students' learning and help them prepare for it.

Summative Evaluation: The Culminating Event

The Culminating Event is the place where students summarize and present their conclusions about the Essential Question, synthesizing their learning and research across all of the disciplines in the unit. At the Culminating Event, teachers, community representatives, and industry partners can also assess and evaluate student learning in relation to many of the discipline-specific content standards that were the basis for the Key Questions. This summative evaluation is an ideal opportunity for students to display their higher-order thinking skills, problem-solving abilities, effective teamwork, written and oral communication skills, and ability to integrate and apply knowledge gained across several academic and technical disciplines. Often, students reach higher levels and work harder when they know that their work will be seen and evaluated by community members and industry professionals, along with their teachers.

Whenever possible, teachers are encouraged to incorporate technology into their Culminating Events and use it to support project-based learning in the classroom. Our goal is to encourage schools to "power up" and tap into the digital literacy and engagement of today's high school students.

The following are some considerations that have helped teachers design effective and memorable Culminating Events:

- Encourage students to link their presentations to a real-world setting, ideally in the workplace; the setting will further reinforce career development goals identified for the curriculum unit.
- Involve the community and industry partners; participation at the Culminating Event will reinforce community and industry support for innovative high school improvement strategies and education that incorporates career themes.
- Allow students to present in groups or individually, depending on their strengths and learning styles; use these alternatives as a way for students at all achievement levels to participate.
- Ask students to reflect on what they have learned and share their observations; explicitly tie results of these meta-cognitive activities back to the academic and technical content standards that were used to design the curriculum unit.

Many different formats are appropriate for the Culminating Event in a multidisciplinary integrated curriculum unit. The first time students engage in one of these comprehensive Culminating Events, teachers usually assign this major activity to the class. Subsequently, students who have participated in a Culminating Event can choose among several event formats or even design their own, thereby becoming more engaged in the learning process.

The following are several possible formats for a Culminating Event:

- Create and deliver a PowerPoint presentation.
- Hold a Science Fair with students presenting trifolds and visual displays.

- Invite parents to view presentations (PowerPoint or trifolds) at a Back-to-School night.
- Demonstrate a lesson or activity to industry partners, a community group, or a municipal agency.
- Develop a practical manual addressing the topic of the unit and proposing a resolution or plan of action.
- Create a website focused on answering the Essential Question.
- Hold a debate on the Essential Question.
- Develop policies and procedures that address the topic of the unit.
- Propose legislation addressing the topic, write letters to the editor, and attend local legislative events.
- Bring students to a middle or elementary school where they can teach a lesson on the unit topic.

These kinds of Culminating Events require considerable preparation and practice on the part of students and preparation and collaboration on the part of teachers. Consequently, it is essential for teachers to establish and communicate expectations and deadlines well in advance for key classroom activities leading up to the Culminating Event. This will allow students sufficient time to synthesize their research, prepare materials, and get ready for the presentation. Well-crafted rubrics are key to communicating performance expectations to both students and industry partners that serve as evaluators of student work. Rubrics should incorporate both the standard and detailed criteria describing different levels of competence.

Formative Evaluation: Student Work Products for Feedback and Assessment

Integrated curriculum units also lend themselves to a variety of performance-based and standard formative assessments. Teachers can use these assessments to give students ongoing performance feedback and also to avoid having too much of a semester's final grade rest on a single Culminating Event. This is particularly important as many of the Culminating Event formats rely on group activities and presentations and may include limited opportunities to assess and provide feedback to individual students.

The following are several examples of work products that help groups of students prepare for the Culminating Event and offer opportunities for individuals and groups to receive formative feedback:

- A written project outline, work plan, and schedule or a classroom presentation on the team's project objectives and work plan.
- A selection of readings (with an annotated bibliography) that individuals or teams recommend for outside reviewers who will later evaluate the Culminating Event.
- A scoring rubric for outside evaluators to use in grading the team's Culminating Event.
- A research paper on one of the Key Questions addressed in a specific discipline.
- A set of drawings, designs, graphic representations, or portfolio of photographs that are related to the Essential Question or one of the Key Questions.

See Appendix 2 for a sample rubric that combines elements of formative and summative assessment in an integrated Forensics unit.

Another useful tool for monitoring student learning is the Student Progress Map. (See template and sample in Appendixes 3 and 4.) Progress maps are used to help students understand what skills and content they will be expected to demonstrate in each of the classes associated with the integrated unit. Progress Maps are handed out and the Skills and Content section is reviewed on the first day of the integrated unit. Students mark their current level in each skill/content and answer Reflection 1 in journals or as a warm-up. In the middle of the unit, students review the Skills and Content section, and reevaluate their progress by marking the Skills and Content section with a different colored pencil, and answer Reflection 2. At the end of the unit, students review the Progress Map a final time, and answer Reflection 3.

- Progress Maps are useful for the reflection and revision of work by students, teachers, and outside professionals.
- Teachers should keep samples of each Culminating Task for the following year.
- Progress maps and samples can be used during team collaboration for evidence of successes and opportunities for revision, and to see what standards may need to be revisited.
- Keeping a portfolio of Progress Maps in classrooms and with administration can provide valuable evidence of classroom instruction, curriculum integration, and standards mastery during site visits, and various certification and accreditation protocols.
- If ESLRS (Expected Schoolwide Learning Results) are used, evidence of their integration is provided at the bottom of the Unit Maps.

Samples of Integrated Units Showing Formative and Summative Assessments (Student Work Products and Culminating Events)

Below are some examples of various assessments within integrated units.

Topic: Health Insurance

Unit Title: Risky Business

Essential Question

How can we balance personal freedom and society's need to provide accessible, affordable healthcare?

Learning Scenario—School ski trip

Discipline-Related Formative Assessment Assignments:

- Art and English—Create business cards and brochures for an insurance company.
- English—Read excerpts from Shattered Air by Robert Madgic (about a tragedy at Yosemite National Park's Half Dome) and debate risky behaviors.
- Algebra—Calculate entries for actuarial tables and mortality rates for leading causes of death.
- History and English—Explore the history of medical insurance and write an expository essay on the issue of universal healthcare insurance.
- Geography and English—Research and write about the geographical distribution of genetically linked diseases.
- Science—Chart biological pedigrees.
- Information Technology—Use appropriate computer software to prepare written reports, brochures, statistical tables, and presentations.
- World Languages and English—Research foreign insurance and medical information and write up the results in both English and another language.
- Health Science and English—Research medical insurance and risky behaviors and write up the results of your research.
- Physical Education—Create a Wellness Program/Prevention Plan for an insurance company.

Culminating Event: Small groups of students form their own insurance company. They prepare Science Fair trifold presentations where they present their insurance companies' programs and policies, including their decisions about insuring individuals who engage in risky behaviors. Community healthcare professionals use a rubric designed with student input to grade the student presentations.

Topic: The Environment and Health

Unit Title: Save the Planet; Save Yourself

Essential Question

How can we preserve the environment and enhance the quality of life for future generations?

Learning Scenario: Profile of a physician who finds a cure for an environmental illness.

Discipline-Specific Formative Assessment Assignments:

- Art—Paint a mural about an environmental issue.
- English and Art—Create a brochure that teaches members of the community about "eco-friendly" habits and their health benefits.

- Mathematics (statistics)—Survey students about their attitudes toward environmental issues; compile results and interpret the data.
- History—Evaluate and write about the environmental quality of life across historical periods.
- Geography—Research and present findings to the class about environmental standards in developing countries.
- Science and English—Research and write about air and water pollution and acid rain and their effects.
- Information Technology—Build a website on environmental issues.
- World Language—Research environmental issues in Spanish-speaking countries.
- Health Science—Research technological advances in the medical field and their impact on the environment.
- Physical Education and Biology—Study pollution in the air and how it affects the respiratory and cardiovascular systems during exercise.

Culminating Event: Create a website that focuses on environmental and health issues.

Topic: Catapults

Unit Title: Bombs Away

Essential Question

How have ballistics and ballistic weapons influenced the course of history?

Learning Scenario: Planning an aerial supply drop to a devastated region.

Discipline-Related Formative Assessment Assignments:

- Principles of Engineering—Design and build a ballistic ping-pong device based on a design brief. Mount their devices on "battleships" and then compete against each in pairs and teams.
- Algebra or Geometry—Apply the formulas for projectile motion to determine angle, distance, or initial force at launch in order to hit a target with given parameters. Use basic trigonometry to determine the range of ballistic missiles, accounting for the curvature of the Earth.
- World History/U.S. History—Evaluate the controversial decision to bomb the city of Dresden in Germany in 1945, analyzing the reasoning behind the bombing and its aftermath. Assume the role of a key figure during the Cuban Missile Crisis and analyze the various strategies and likely consequences under consideration during the event.
- Language Arts—Write a biography a major historical figure. Debate a series of resolutions regarding the use of bombing near civilian populations in conflicts including and since World War II.

Culminating Event: Design an adjustable ballistic device and compete against other teams in a battleship scenario.

Topic: Creating Sustainable Housing

Unit Title: Green Design

Essential Question

How can we expand housing while understanding that there might be a lack of oil resources in the future?

Learning Scenario: Commercial client wants to build a new, "green" headquarters.

Discipline-Related Formative Assessment Assignments:

- Civil Engineering and Architecture—Research construction materials, including how the most common materials are produced and harvested, their renewable and/or recycled alternatives, and their various costs and benefits. Design an energy-efficient commercial building.
- Science—Research the common ways that energy is produced and harnessed in the United States and around the world. Compare the advantages and disadvantages of using available renewable versus nonrenewable resources, including water conservation. Determine the thermodynamic principles that govern heat flow and transfer.

- English Language Arts—Research the space needs of the school (or community) by designing and conducting survey interviews with key stakeholders within the school and summarize their findings in a written report.
- Social Studies—Research the growth of U.S. and world energy production and consumption during the past 50 years, compare and contrast the causes and effects of the oil crises of 1973 and 1979 to the events of today, and anticipate the impact that the rising economies of Asia, South America, and Africa will have on the energy market.
- Mathematics—Learn how lightshelves and sloped ceilings can be used to reduce light differentials in interior spaces while reducing glare and solar heat gain. Students calculate optimal lengths and angles for exterior shading, optical lightshelves, and ceilings given the location of their site.

Culminating Event: Present the design of "green" commercial building to the "client" and industry experts.

Topic: Cultural Differences in Healthcare

Unit Title: Second Opinion

Essential Question

How can we ensure the safety and effectiveness of complementary and alternative medical practices?

Learning Scenario: Excerpt from The Spirit Catches You and You Fall Down (a book by Anne Fadiman contrasting Hmong and Western medicine's interpretations and responses to epilepsy)

Discipline-Related Formative Assessment Assignments:

- Art, English, and Health Science—Design the lesson plan format and content for a lesson on cultural competency.
- English—Read an excerpt from The Spirit Catches You and You Fall Down; complete an expository writing assignment.
- Mathematics and Chemistry—Measure the bond angles of molecular compounds created in chemistry class.
- History—Write the script for an "elevator pitch" to a physician about why he or she should be culturally sensitive to patients from different countries.
- Geography and English—Research and write an expository essay about alternative healing practices, including their distribution and how they are spread around the world.
- Chemistry—Create a model of the molecular structures of medicines and research the differences in drugs.
- Computers—Provide web-based research support for all classes included in the curriculum unit.
- World Language—Research and write about healing practices in Spanish-speaking countries.
- Health Science and English—Study and write an essay about cultural difference in healing practices.
- Physical Education and English—Research and write about cultural differences in levels of and attitudes toward physical activity.

Culminating Event: Students present a culturally competent lesson plan to representatives from various state agencies and professional organizations. These individuals use a scoring rubric designed with student input to assess the lesson plan.

Write Lesson Plans

STEP 10

Finally, it is time to start writing lesson plans. Each lesson plan should address one or more of the Key Questions relevant to your subject area. Lesson plans should include a complete set of instructions and materials for conducting a lesson: a time estimate, materials list, description of lesson activities, ideas for differentiated instruction, and so on, as shown in the example below. The lesson plan should also include any relevant student worksheets or other teacher resources. When possible, incorporate technology and create your lesson plan so that it addresses students' individual learning styles, learning abilities, and language abilities.

It is important to remember that lessons from each discipline should result in knowledge and products (student assessment artifacts) that contribute to mastering state content standards and answering the Essential Question as well as contribute to the Culminating Event.

Lesson Title Goes Here

Subject

Time
minutes

Materials
Equipment
- First piece
- Second piece
- Third piece

Resources
- First piece
- Second piece

Prior Student Learning
Prior student knowledge necessary for this lesson should be described here.

Essential Question for This Unit
What is the essential question (it should go here)?

Objectives
Students should be able to
- First objective here
- Second objective here

Lesson Activities
Lesson Springboard
Introduction to the lesson goes here. This portion of the lesson serves as a "hook," an engaging introduction to the upcoming content.

Lesson Development
Activity Type
(e.g., Direct Instruction, Lab, Class Discussion, Small Group Work)
A description of the first activity should go here. Include ideas for differentiated instruction whenever possible.

Activity Type
(e.g., Demonstration, Guest Speaker, Simulation, Role-Play)
A description of the second activity should go here.

Lesson Closure
A description of the lesson's wrap-up should go here. This portion of the lesson should provide students with an opportunity to reflect on what they have learned and provide teachers with a means to formally or informally assess the learning that has taken place.

Possible Prior Misconceptions (if applicable)
Common misconceptions that students hold regarding this lesson's content should be provided here for teacher reference. Include correct information where necessary.

Student Assessment Artifacts
First student artifact (e.g., report, worksheet, paper, pamphlet, lab report, model, quiz)
Second student artifact

Variations and Extensions
Describe possible extensions or variations on the lesson here, such as possible guest speakers, additional labs, or lessons.

NATIONAL AND STATE ACADEMIC CONTENT STANDARDS

NATIONAL
Authoring Agency and Standards Title
List of relevant standards go here

STATE
Standards Title
List of relevant standards go here

NATIONAL AND STATE CAREER TECHNICAL STANDARDS

NATIONAL
Authoring Agency and Standards Title
List of relevant standards go here

STATE
Standards Title
List of relevant standards go here

Competencies and Skills for Today's Workplace

Because the world of work is changing, the U.S. Departments of Labor and Education formed the Secretary's Commission on Achieving Necessary Skills (SCANS) to study the kinds of competencies and foundation skills that workers must possess to succeed in today's workplace. Integrated curriculum incorporates these competencies and skills and changes learning from being passive (where the teacher lectures as a "sage on the stage") to active.

According to the SCANS report (1991, June), employers seek workers who have these five competencies:

1. Resources: Identifies, organizes, plans, and allocates resources;
2. Interpersonal: Works with others;
3. Information: Acquires and uses information;
4. Systems: Understands complex relationships; and
5. Technology: Works with a variety of technologies.

The three-part foundation skills are as follows:

1. Basic skills: Reads, writes, performs arithmetic and mathematical operations, listens, and speaks;
2. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons; and
3. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, integrity, and honesty.

Today's Technology in the Classroom: Digital Natives and Digital Immigrants—Why Are My Students' Attention Spans so Short?

Some teachers wonder why their students are bored in class, but are happy to text message or spend hours on their iPhones© and laptops. Mark Pensky has commented on this generational divide. According to Pensky (2001, October), those born after 1980 are "digital natives" and those born before 1980 are "digital immigrants." He states that "our students have changed radically. Today's students are no longer the people our educational system was designed to teach." He also believes that today's students "have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age." He states that college students have spent twice as much time playing video games (10,000 hours) as they have spent reading (5,000 hours).

Using the author's model, most teachers are "digital immigrants": they grew up with lectures, logic, and step-by-step serious instruction, so they tend to teach using that method. Pensky says that "digital natives" use a different language: they receive information very quickly. "They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards." He notes that some students think that they have to "power down" when entering the classroom and that school has no relevance to the outside world. Pensky believes that the more we can incorporate technology into our curriculum, the more our students will speak our language and remain engaged.

A Note on Differentiated Instruction and Integrated Curricula

Students bring a variety of learning styles and needs to our classrooms. We can acknowledge and accommodate these differences and maximize each student's growth and success by differentiating instruction. According to an English teacher who writes and lectures on making students better thinkers by using language, differentiated instruction "refers to a variety of classroom practices that accommodate differences in students' learning styles, interests, prior knowledge, socialization needs, and comfort zones. On the secondary level, it involves a balance between the content and competencies expected on the mandated assessments and various pedagogical options to maximize durable learning" (Benjamin 2002).

A multidisciplinary, integrated, and career-themed curriculum combined with differentiated instruction is one effective pedagogical approach that creates learning with deep understanding and enhances all students' academic achievement. The integrated curriculum model described in this manual offers abundant opportunities for teachers to motivate students at varying academic performance levels, meet the needs of English language learners, and teach effectively in classrooms with students who have multiple abilities.

Differentiated instruction within an integrated curriculum aims to meet every student's needs and increase their chances of durable learning by

- supporting a student-centered learning approach;
- offering diverse ways to explore core concepts;
- providing multiple opportunities to apply core concepts in varying situations;
- allowing variation in projects so that students' multiple intelligences and learning styles are challenged;
- helping students examine how they learn and connecting that knowledge to what they learn; and
- nurturing students' interests in mastering rigorous academic content and exploring challenging careers by demonstrating that they can achieve academic success.

Forms of Differentiated Instruction

There are several forms of differentiated instruction that teachers can use within a multidisciplinary integrated curriculum. According to Tomlinson (2001), Oaksford and Jones (2001), and Hall (2002), teachers can differentiate instruction in terms of content, process, or products.

- Content differentiation offers variety in the ways that students can access information. Teachers have long used one traditional form of content differentiation: students select among topics for a homework assignment. Teachers can also give students options about the ways they access information, such as viewing a video, doing individual research, or working within a team to complete a research assignment. Finally, teachers often provide direct instruction while also using other methods for delivering content.
- Process differentiation gives students alternative ways to make sense of ideas. For example, students can select which classroom team they will join based on the approaches that various teams will be using to conduct their research. One team may use library and Internet research; a second may conduct interviews with working professionals; and a third may make systematic observations during a field trip or site visit. Students reflect on their preferred learning style and choose a team based on what works best for them. Teachers can also form teams that encourage students to explore other learning styles or ways of delivering products.

- Product differentiation provides students with multiple ways to express what they know. Teachers frequently use this form of differentiation by using several assessment modes, such as written reports, short-answer tests, and class presentations by individuals or groups. Teachers can also offer students choices about how to present the results of their research: they can construct statistical tables, create graphical models, write up narrative case studies, or present a dramatization.

How Does Differentiation Apply Directly to Integrated Curriculum Units?

Below are some examples of how teachers can differentiate instruction in an integrated unit and also engage students in learning by offering them choices:

- Individual students or groups of students may select a research topic related to the unit's Essential Question.
- Students may select among various modes of data collection to address Key Questions in a particular class: library and Internet research, surveys, interviews, field observations, or laboratory work.
- Students may choose the mode of assessment that will be used to evaluate their Culminating Event. Among students who have been working as a team, some may choose to complete a research paper; others may produce a video; and still others may create a PowerPoint presentation. Together, all of the products will make up the Culminating Event for the team—and contribute to a team grade—but individual students also will be assessed in different ways on their particular pieces of the project.

Evaluate the Unit

STEP 11

After all the pieces are in place, it is time to step back and evaluate the entire integrated unit. It is helpful to consider the following questions.

Engagement

- Is there a definable student voice in this project?
- What impact will this project have beyond the classroom? For the student? For the community?
- Are the connections to the real world relevant to the students?
- Are there multiple connections that will work for students with different interests and backgrounds, and at different academic achievement levels?

Essential Question and Key Questions

- Is the Essential Question important to students?
- Do the students understand the Essential Question?
- Will researching and answering the set of Key Questions allow students to answer the Essential Question?
- Are the Key Questions subject specific? Do they address subject-specific content standards?
- Do these questions have value beyond the student and also address broader community issues?
- Do the Essential Question and the Key Questions drive investigation?
- Is the Essential Question applicable across disciplines?
- Is the language of the Essential Question broad enough for students to make connections across several disciplines?

Standards

- Are the Essential Question and the project aligned with both academic and technical standards?
- Are all lesson plans aligned to content and technical standards?
- Do the students understand, and can they articulate, how the standards are aligned with and influence the project?
- Does the unit include multiple assessment opportunities that are aligned to standards?

Lessons and Activities Around Processes and Content

- Do all lessons contribute to addressing the Essential Question?
- Do the class activities allow students to answer the Key Questions?
- Does each subject contribute a final product to the Culminating Event?
- Do the lessons and activities provide students with the necessary skills and information to produce the Culminating Event?
- Does the Culminating Event challenge students with content that is complex, ambiguous, provocative, and personally challenging?
- How is each lesson/activity of value to the project and in developing deeper understanding of the Essential Question and Key Questions?
- Do the lesson plans include strategies for differentiated instruction?
- Do the lessons, activities, and assessments include opportunities for students to reflect on what they have learned?

Community Stakeholders (e.g., industry professionals)

- Do community stakeholders have a genuine interest in the product/performance/topic?
- Are the community stakeholders properly informed on the project and assessment methods?
- Do the community stakeholders represent the cultural make-up of the students?

The template provided in Appendix 5 is a convenient format for teacher teams to summarize their thoughts when evaluating the quality of the integrated unit.

Integrated Unit Logistics

Addressing a variety of logistical issues at the start of the curriculum design work and throughout the year will help make the process go smoothly. One of the most important logistical tasks is to identify the individuals who will be responsible for each activity. The **Curriculum Integration Action Plan** template found in Appendix 6 can be used to record these responsibilities.

Logistics That Apply Throughout Work on the Integrated Unit

- Establish and record important dates, deadlines, and timelines.
  - Set date for the kick-off of the curriculum unit—in which class?
  - Create timelines for curriculum-related lessons in each class.
  - Set date for meetings of the integrated curriculum team.
  - Set dates for periodic check-ins to assess progress and make adjustments.
  - Set due dates for discipline-specific assessment artifacts.

    Final products in discipline-specific classes: Final products due in classes should be completed at least 2 weeks before the Culminating Event to allow time for last minute adjustments.
  - Set date of the Culminating Event.
- Identify and prepare for in-school and off-site activities with industry and postsecondary partners.
  - Identify and schedule guest speakers.
  - Identify and schedule experts for classroom team teaching.
  - Identify and schedule lunch speakers.
  - Establish locations and schedule visits to off-site facilities.
    - Invite experts to participate in assessments (formative assessments and the Culminating Event).
  - Schedule computer laboratory and library use.

Culminating Event Logistics

- Create a schedule of what the day will look like—bell schedule and agenda.
- Identify the evaluation audience—what kind of audience will hear the presentation?
- Create an invitation list—who is invited to attend presentations?
- Plan for childcare—if this will be a family event, childcare needs to be provided.
- Plan to provide refreshments—who are we serving, and what will we serve; how will this be funded?
- Make room arrangements—where are groups presenting and how are students being dispersed?
- Create assessment rubrics for evaluators.
- Identify teacher responsibilities—floaters, room assignments, etc.
- Arrange for coverage by substitute teachers.
- Identify needed materials—tri-folds, LCD projectors, memory sticks, etc.
- Plan the transportation—is off-site transportation needed?—pick-up/drop-off times and locations (3 weeks prior to the event).

  Don't forget to provide permissions slips for all students if going off site.
- Arrange for additional staff if necessary—are chaperones needed?—will classes be covered by substitutes or other teachers (3 weeks prior to the event)?

Integrated Unit Evaluations: Teacher, Student, and Industry/Postsecondary Partners

After the Culminating Event is over and all students have completed their work, teachers can meet as a team to reflect on the integrated unit, identify what went well, and determine what could be done differently the next time around.

Some Ideas for Evaluating the Integrated Curriculum Unit

Teachers

1. What links did you make between the subject areas?
2. What links did you make with the community?
3. What aspects of the integrated unit engaged and inspired the students?
4. How effectively did your lesson plans incorporate academic content and career and technical standards?
5. What will you do differently the next time you deliver this unit?
6. What ideas and suggestions do you have for improving the integrated unit process?
7. Most importantly, how did the integrated unit enhance student learning?

Students

1. What skills have you developed in the course of this integrated unit?
2. What would you say is the major lesson you have learned about the theme of this integrated unit?
3. How would you apply the knowledge you learned to help your community?
4. What connections did you make with industry partners related to your integrated unit?
5. What career opportunities have you discovered?
6. What would you do differently if you designed this unit?

Industry and Postsecondary Partners

1. In what capacity did you help the students with their integrated unit projects?
2. How does the theme of the integrated unit relate to your field of work?
3. How in depth was the research the students presented?
4. What components would you add or remove from the Culminating Event?
5. What suggestions do you have for improving the integrated unit?

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Appendices

Integrated Curriculum Unit Template

TOPIC:

STUDENT PERFORMANCES

SUBJECT:	SUBJECT:	SUBJECT:	SUBJECT:	SUBJECT:

ESSENTIAL QUESTION:

PROJECT DESCRIPTION:

PERSONALIZATION OPTIONS

PROJECT ACTIVITIES AND TIME LINES

Activity	Staff responsible	Timeline	Product/result
Culminating Activity:			

Topic: Forensic Investigation

DEER VALLEY LAW HIGH SCHOOL
DEER VALLEY LAW ACADEMY
ANTIOCH, CA

STUDENT PERFORMANCES

Foundations of Law:

1. Understand specialized investigative techniques, devices and equipment to enhance investigation regarding compliance with laws and regulations.
2. Conduct interviews and interrogations with individuals using proper procedures to ensure the protection of individual rights and information gathering.
3. Apply active listening skills to obtain and clarify information.
4. Analyze and interpret nonverbal communication cues to discern facts from fabrication.

Biology:

1. Explain how the coordinated structures and functions of organ systems allow the internal environment of the human body to remain relatively stable (homeostatic) despite changes in the outside environment.
2. Compare the general structures and functions of DNA, RNA and protein. Know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation and transformation) is used.
3. Conduct blood typing on a blood sample through antigen testing.
4. Identify the differences between blood types.

Language Arts:

1. Analyze interactions between main and subordinate characters in a literary text and explain the way those interactions affect the plot.
2. Analyze and trace an author's development of time and sequence, including complex literary devices (e.g., foreshadowing, flashbacks).
3. Apply appropriate interviewing techniques: prepare and ask relevant questions; make notes of responses; compile and report responses; evaluate the interview's effectiveness.

Algebra I:

1. Solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.
2. Graph a linear equation and compute the *x*- and *y*-intercepts.
3. Verify that a point lies on a line, given an equation of the line.
4. Derive linear equations by using the point-slope formula.

Geometry:

1. Construct and judge the validity of a logical argument and give counterexamples to disprove a statement.
2. Prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.

World History:

1. Describe events and explain the issues associated with war crimes and crimes against humanity, and identify the role forensic science plays in bringing war criminals to justice.

ESSENTIAL QUESTION: How can innocence or guilt be determined?

PROJECT DESCRIPTION:
Students will take on the role of crime scene investigators to solve a murder that has occurred at the school. They will integrate math, science and language arts into the study of forensic science and associated careers such as law enforcement officers and district attorneys. Students will secure the crime scene, conduct a law enforcement investigation, conduct interviews, interrogate witnesses and suspects, write up a narrative police report with witness statements, including scientific lab report attachments, and present their findings. The culminating assessment will be a presentation to the District Attorney of the written report, and an oral report with a multimedia PowerPoint of the evidence. The goal is to persuade the DA of the suspect's guilt and the charges to be brought.

PERSONALIZATION OPTIONS FOR AN INTEGRATED FORENSICS UNIT

Project options:

1. Students can extend the multimedia components of the evidence collection to use scenes from videotaped witness interviews.
2. Students can conduct additional investigations with CSI professionals.

PROJECT ACTIVITIES AND TIME LINES

Activity	Staff responsible	Timeline	Product/result
Establish project activities and timeline	Law Teacher and team	09/10	Project plan
Scenario and evidence collection	Law Teacher, Math Teacher, Biology Teacher, Law Enforcement Experts	10/30	Crime Scene Blood typing report Math scenarios report DNA Report
Instruction on conducting interviews and interrogations with law enforcement expert	English Teacher, Law Enforcement Expert	11/02	Notes, handouts, students interview each other
Instruction on writing interviews	English Teacher	11/04	Notes, handouts, students interview each other
Conducting interviews.	Law Teacher and witnesses	11/06	Students interview witnesses and suspects
Draft Report #1 with expert input	Law Teacher, English Teacher	11/11	Draft narrative police report
Draft Report #2 with expert input and multimedia component	Law Teacher, English Teacher	11/20	Draft narrative police report with attachments
Culminating Activity: Present persuasive written and oral report with multimedia presentation to industry mentor (District attorney) and defend during oral interview.	All teachers and industry mentor (District Attorney)	12/11	Narrative written report, oral report, multimedia presentation

Sample Rubric for an Integrated Forensics Unit

	Performance Task/*Standard*	Above Standard 4	Standard 3	Below Standard 2	Not Met 0-1
Foundations of Law	**Identify and demonstrate knowledge of assigned role and rules of evidence for presentment to district attorney.** ***(Public Service – Law B9.2)***	Student completes all requirements of assigned role on time and with accuracy, is able to handle unforeseen obstacles deftly, and maintains and fulfills role throughout the process. Student demonstrates complete knowledge of all rules of evidence.	Student demonstrates knowledge of role and completes all tasks associated with that role. Student demonstrates adequate knowledge of rules of evidence.	Student demonstrates some knowledge of role but cannot work independently. Student understands enough of the rules of evidence to complete role.	Student plays role but does not understand how role fits into the development of the case and lacks understanding of rules of evidence OR student does not play any role in the presentment.
	Identify and apply major procedures used in conducting a crime scene investigation, including creating a crime scene sketch, and searching for, preserving and processing evidence. Take accurate fingerprints. ***(Public Service – Law B4.1)***	Student investigates every photo, marker, evidence and uses measurement tools properly. Student compiles complete and accurate information and drawings on the crime scene sketch. Takes accurate fingerprints.	Student selects and investigates most evidence and properly uses measurement tools. Student records information and drawings on the crime scene sketch. Fingerprinting process is accurate.	Student has minor difficulty in investigating and using some evidence and measurement tools. Records and fingerprinting process are minimal and/or inaccurate.	Student improperly and/or inadequately investigates evidence and misuses measurement tools. Records are absent and/or inaccurate.
	Present a multimedia PowerPoint presentation of the evidence to the district attorney. ***(Public Service – Law B6.2; PS 4.5)***	Student develops and delivers a multimedia classroom presentation persuading or dissuading the filing of criminal charges against a suspect. Presentation analyzes research information from at least three sources, done in PowerPoint format.	Students develop and deliver multimedia classroom presentation. Presentation includes research information from at least two sources, done in PowerPoint format	Students develop and deliver multimedia classroom presentation. Presentation includes research information from at least one source, done in PowerPoint or overhead slide format.	Students develop and deliver multimedia classroom presentation Presentation includes information and is presented in overhead slide format
English Language Arts	**Observe and record field notes in field notebook. Accurately prepare drafts and final documents of narrative police report.** ***(Writing 1.2, 2.6)***	Student structures ideas and arguments in a sustained and logical fashion. All facts are completely and accurately conveyed in the field notes. The report is chronological, logical, use active voice, and contains all necessary information.	Student writes clearly, adequately phrasing central points. All facts are completely and accurately conveyed in the field notes. The report is logical and contains all necessary information.	Student adequately communicates the information in the field notes and report in a manner that is plagued by inconsistencies and inaccuracies.	Student's writing is poorly structured, not presented in a chronological or logical fashion, or filled with inconsistencies. Some facts are inaccurate. The report is difficult to follow. Significant information is lacking.
	Conduct field interviews and take notes during interviews. Write witness statements. Use open questions. Evaluate witnesses' answers for accuracy. ***(Listening and Speaking 2.3)***	Student conducts an in-person interview and asks more than ten relevant questions of the interviewee. Student's notes are legible and provide a good record of questions asked and responses. Questions are well phrased, show evidence of research, and are designed to elicit useful information. The written report evaluates the effectiveness of the interview and summarizes information succinctly and clearly.	Student conducts an in-person interview and asks five to eight relevant questions of the interviewee. Student's notes are legible but incomplete or slapdash. Questions are not always well phrased, and some do not show evidence of research or elicit useful information. The written report evaluates the effectiveness of the interview.	Student conducts an interview and asks fewer than five questions or does not conduct an interview. Student's notes are illegible or extremely limited. Questions are poorly phrased and do not show evidence of research or elicit useful information. The written report does not sufficiently describe or evaluate the interview. Or the written report is incomplete or missing.	Student conducts an interview and asks fewer than five questions or does not conduct an interview. Student's notes are illegible or extremely limited. Questions are poorly phrased and do not show evidence of research or elicit useful information. The written report does not sufficiently describe or evaluate the interview. Or the written report is incomplete or missing.
	Deliver an oral presentation to the district attorney regarding the filing of criminal charges. ***(Listening and Speaking 2.5)***	Student delivers narrative presentation that clearly communicates the significance to the audience, supports an opinion, and accurately and coherently conveys information.	Student delivers narrative presentation that communicates a clear picture to the audience and supports an opinion.	Student narrates a sequence of events with some inconsistency. Demonstrates a basic knowledge of the subject. Provides basic descriptions, with minimal concrete details.	Student does not clearly narrate a sequence of events. Presents inadequate or no evidence in support of the opinion. Includes no concrete details in descriptions.
Biology	**Complete DNA fingerprinting lab and analyze the results of an electrophoresis gel. Determine the type of a blood sample through testing, and describe blood type differences.** ***(Biology 5.d; Cell Biology 1, Physiology 9)***	Student accurately analyzes DNA Fingerprinting lab and completes worksheet to narrow down suspect list. Student examines blood samples to accurately determine the victim's and suspect's blood types.	Student analyzes DNA Fingerprinting lab and accurately completes 80% of the worksheet to narrow down suspect list. Student examines blood samples to determine the victim's and suspect's blood types.	Student analyzes DNA Fingerprinting lab and accurately completes 70% of the worksheet to narrow down suspect list. Student examines blood samples to determine at least one person's blood type.	Student improperly and/or inadequately investigates DNA fingerprints and blood samples. Records are absent and/or inaccurate.
Geometry	**Use data and calculations to determine the maximum distance from the crime scene a suspect could move to; formulate the equation of the suspect circle and graph the circle on the school map to provide evidence on suspects.** ***(3, 17)***	Student accurately measures the speed at which a person would walk the school using a timer and yardstick. Student precisely predicts the maximum suspect circumference using the distance formula. Student accurately graphs data on a school map. Using evidence, student limits or expands suspect list.	Student measures the speed at which a person would walk the school. Using a timer and yardstick, student predicts the maximum suspect circumference using the distance formula. Student graphs data on a school map with 80% accuracy. Student applies data to the suspect list.	Student improperly measures the speed at which a person would walk the school using a timer and yardstick. Student predicts the maximum suspect circumference using the distance formula with 70% accuracy. Student graphs 70% of the data on a school map. Student has difficulty with suspect list.	Student improperly and/or inadequately investigates speed and data. Records are absent and/or inaccurate.

Student Progress Map
<Place Unit Title Here>

Participating Classes: *Insert subject area/courses that are included in the integrated unit here.*

Essential Question(s): *Write the unit's Essential Question here. You may also wish to include the Key Questions and sub-questions, if appropriate.*

Culminating Assessment: *Identify the culminating assessment here.*

In order to complete the assessment, students will be able to…

Exceed	Meets	Approaches	Does not approach	Skill and Content
				Provide students with concrete, student-friendly skills and content they are expected to master over the course of the integrated unit. Include the appropriate standard number.

Students will complete three reflections and review the skills/content at the beginning, middle and end of the unit.

Reflection 1: Where do you currently fall on the EMAD rubric for each skill? (Fill that out in colored pencil for now.) Looking at the above skill-set, what are your strengths and weaknesses? What do you think will be "easiest" to learn and what will be the "hardest" and why? What practices and habits do you need to use or improve on to be successful this semester? How will you achieve success in this course? (Please list specific actions.)

Reflection 2: Where do you currently fall on the EMAD rubric for each skill? (Using a different color, fill in the rubric again. You may fill that out in pencil for now.) What do you see as your biggest achievement so far in the course? What skill areas do you still need to practice and/or learn? What resources could the teacher provide to help you learn these skills? What do you need to do in order to be successful from now until the end of the course?

Reflection 3: Have you met the standard for most skills in this unit? (Using a third color, fill in the rubric again.) If so, how did you achieve this? If not, why weren't you more successful? What is your biggest achievement? What mistakes or bad habits do you need to work on to be even more successful in the future? Describe in detail one moment when you discovered something, learned a new skill, or helped someone else do either of those things? What could you do in the future to have even more "learning-moments" like that one?

ESLRS:

- *If Expected Schoolwide Learning Results (ESLRs) are identified for the school and are used in the unit, list the relevant ESLRs here.*

Student Name _____

Student Progress Map
Presidential Election Unit

Participating Classes: U.S. Government, Expository Composition, Constitutional Law

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Essential Question(s): How does the voting public learn about policy issues?

Key Questions: How do we determine our political representation? How should we participate in these processes as citizens? How do we decide which candidate to pick? Where do you stand individually on the political spectrum?

Culminating Assessment:
Portfolio and multimedia presentation on a presidential platform issue including 15-20 slide PowerPoint presentation; 7-10 minute oral presentation in class; artistic and visually appealing tri-fold display board; quiz on topic presentation; and a research paper with multiple perspectives, complete with note cards.

In order to complete the assessment, students will be able to…

Exceed	Meets	Approaches	Does not approach	Skill and Content
				Discuss the meaning and importance of each of the rights guaranteed under the Bill of Rights and how each is secured (freedom of religion, speech, press, assembly, petition, privacy). *12.2.1, PS B9.1*
				Evaluate issues regarding campaigns for national and state elective offices, especially focusing on how a president gets elected and major California propositions. *12.6, Reading 2.1, PS B1.0, PS B9.4*
				Analyze the origin and development of political parties by watching a PowerPoint presentation, and participating in on-line quizzes to help students understand which political party most closely represents them. *12.6.1, PS B3.1*
				Watch and analyze three presidential debates and one vice-presidential debate, carefully evaluating each candidate's positions and writing in-depth reflections on the candidates' opinions, presentational skills and how each debate differed in format (i.e., town hall format) for effectiveness. *12.8, Listening and Speaking 1.11, 1.12*
				Create a 15-20 slide PowerPoint presentation on your topic and present it to the class in a 7-10 minute oral presentation. Have your PowerPoint available as a teaching tool at the teach-in. *Writing 2.6, PS B6.2, PS B1.4*
				Create a short multiple-choice and fill-in-the blank quiz for your fellow students, and grade it. *Foundation 9.0*
				Understand different opinions on controversial topics, such as abortion and gay marriage. *12.3, PS B2.1*
				Create a visually appealing tri-fold display containing information on your topic, major parties' opinions, your background and solutions, as well as your opinion. *12.7.6, Foundation 3.6, 11.0*
				Write a well-organized research paper using quotes and facts from different sources to support your opinion. *Writing 1.1, 1.2, 1.3, 1.4, 1.5, 1.6*
				Revise your writing to make it sound more formal and professional. *Writing 1.9*
				Combine (synthesize) different authors' ideas and other facts to support your opinion. *Writing 1.6, Foundation 5.2*
				Write a thesis statement. *Writing 1.0*

Exceed	Meets	Approaches	Does not approach	**Skill and Content**
				Use MLA Style Guidelines to reference quotes and paraphrases in a research paper. *Writing 1.7, 2.4.e*
				Create a Works Cited page (using MLA style) that cites each reference in the research paper. *Writing 1.7, 2.4.3*
				Develop and support an opinion based on/using reliable information. *Writing 1.6*
				Use the internet and other research tools to discover reliable information related to this topic. *12.10, PS B4.2*
				Evaluate media to decide which sources are reliable. *12.8, PS B2.0*
				Evaluate media to decide what biases they contain. *12.8, PS B1.1*
				Examine the steps toward the presidential election and evaluate the accessibility of each process for the common voter. *12.4.1, PS B9.1, PS B9.6*

Reflection 1: Where do you currently fall on the EMAD rubric for each skill? *(Fill that out in colored pencil for now.)* Looking at the above skill-set, what are your strengths and weaknesses? What do you think will be "easiest" to learn and what will be the "hardest" and why? What practices and habits do you need to use or improve on to be successful this semester? How will you achieve success in this course? *(Please list specific actions.)*

Reflection 2: Where do you currently fall on the EMAD rubric for each skill? *(Using a different color, fill in the rubric again. You may fill that out in pencil for now.)* What do you see as your biggest achievement so far in the course? What skill areas do you still need to practice and/or learn? What resources could the teacher provide to help you learn these skills? What do you need to do in order to be successful from now until the end of the course?

Reflection 3: Have you met the standard for most skills in this unit? *(Using a third color, fill in the rubric again.)* If so, how did you achieve this? If not, why weren't you more successful? What is your biggest achievement? What mistakes or bad habits do you need to work on to be even more successful in the future? Describe in detail one moment where you discovered something, learned a new skill, or helped someone else do either of those things. What could you do in the future to have even more "learning-moments" like that one?

ESLRS: *Students will be…*

Critical Thinkers

- *who use collaboration and diplomacy to solve problems.*
- *who challenge themselves by setting rigorous goals.*
- *who make carefully analyzed and evaluated decisions.*
- *who are able to collect, analyze, and use data in their personal and professional lives.*
- *who understand and participate in the democratic process.*
- *who advocate to improve and enhance their communities.*
- *who are environmentally responsible and socially aware.*

Articulate Writers, Readers, Speakers

- *who effectively communicate their needs and ideas using multiple abilities.*
- *who use literacy, numeracy, media and technology to participate in and examine the world.*

Integrated Unit and Project Evaluation Criteria

Lesson/project title:

Level of integration:

Criteria	Yes	No	Not sure	Comments
Embeds challenging standards and student performances from multiple subjects				
Addresses standards that benefit from alternative instructional methods				
Has a well framed essential question in an authentic context				
Requires a product, performance, service or solution realistic to career area				
Embeds SCANS or 21st Century skills				
Time required is proportional to standards and performances addressed				
Demonstrates appropriate level of mastery of the embedded performances				
Exposes students to authentic situations, environments and requirements of the workplace				
Provides an authentic audience or result				
Community stakeholder needs and interests are well represented				
Overall ranking (circle)	**Model**	**Good**	**Needs work**	

Curriculum Integration Action Plan

Pathway/Academy & High School		Curriculum Unit	

Action Items	**Goal**	**Start Date**	**Due Date**	**Point person(s)** Who will keep this activity on track?	**Status/Notes**	**Done**
Identify/contact industry partners	Find and contact relevant industry partners; decide what roles they can play.					☐
Individual scope and sequencing	Each teacher maps out instructional scope and sequence for the year.					☐
Team Curriculum Mapping	Team meets to share sequences and rearrange as necessary and if possible.					☐
Essential and Key Questions	Design the questions that will drive instruction for each class					☐
Culminating project	Choose and write up description of the culminating project for the unit.					☐
Other assessments	Decide (and create) assessments aligned with learning goals.					☐
Lesson plan revisions	Each teacher reviews and revises relevant lesson plans.					☐
Work-based learning	Identify and plan possible work-based learning opportunities (e.g. relevant site visits).					☐
						☐
						☐
						☐
						☐
						☐

ConnectEd
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Transforming today's education
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ConnectEd's mission is to support the development of Linked Learning and the pathways by which California's young people can complete high school, enroll in postsecondary education, attain a formal credential, and embark on lasting success in the world of work, civic affairs, and family life.

Designing Multidisciplinary Integrated Curriculum Units

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