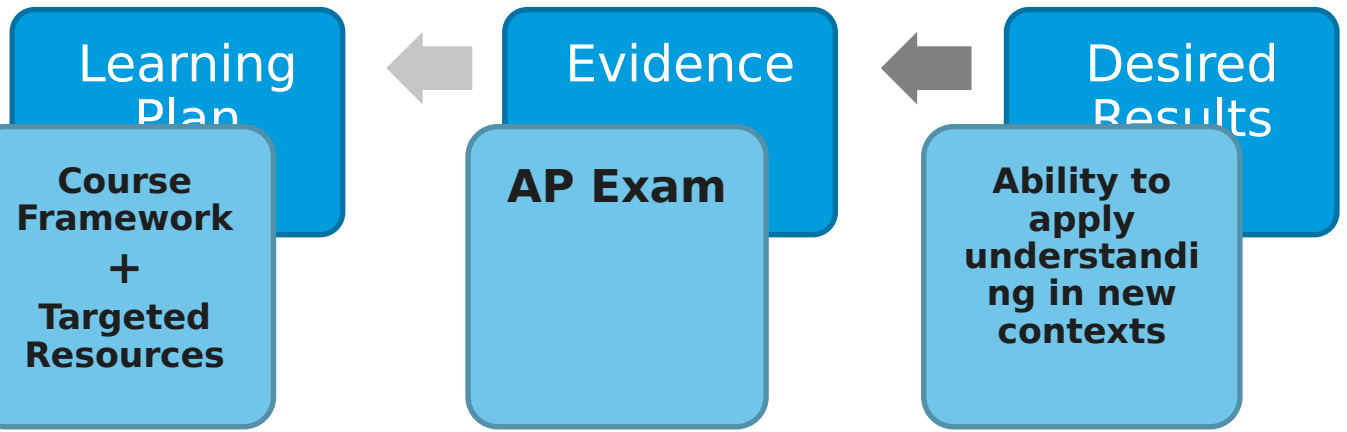
What is Understanding by Design®?

Understanding by Design (UbD) is a way of thinking purposefully about curricular planning by transforming content standards and learning goals into concrete elements of instruction and assessment.

A “UbD approach” means that curriculum is “planned backward” from long-term desired results through a three-stage process:



Source:

The Understanding by Design Guide to Creating High-Quality Units by Grant Wiggins and Jay McTighe

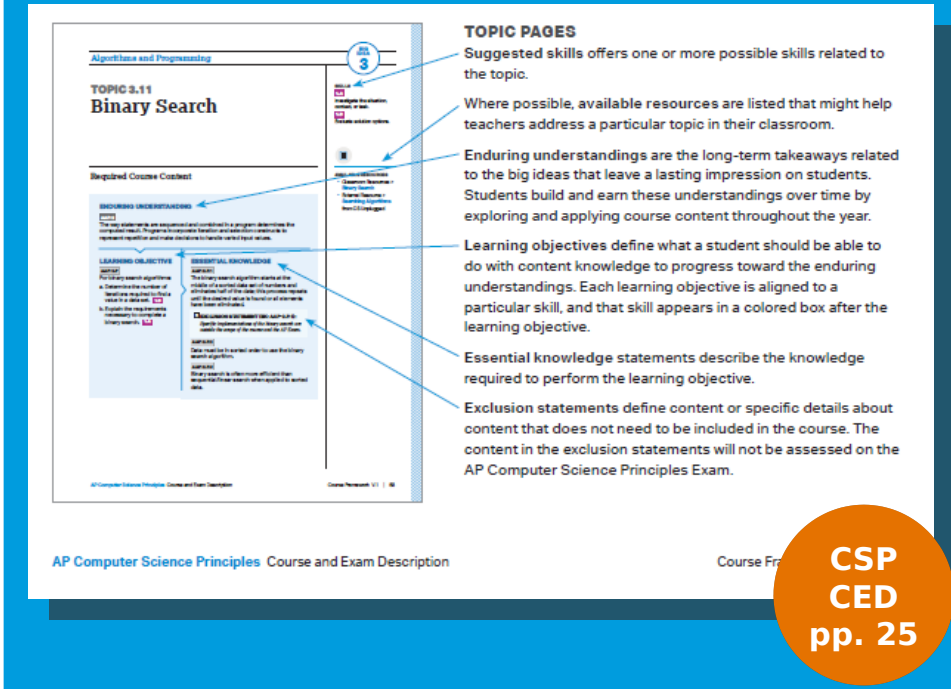
Helps to avoid:

- ✓ “textbook coverage”
- ✓ “activity-oriented teaching”

Understanding by Design

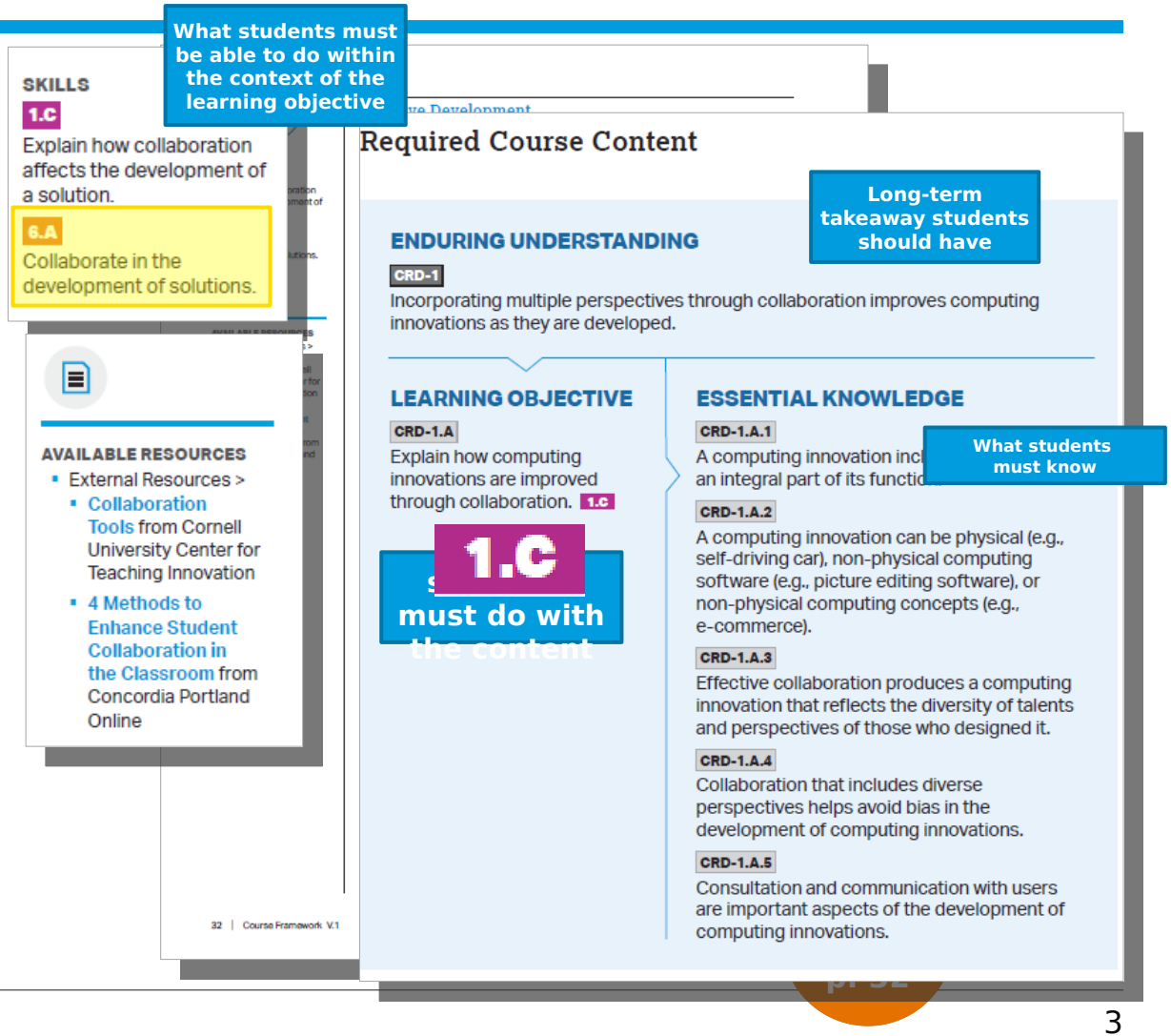
Turn to page 25 of the *AP Course and Exam Description*. Define each of the following terms.

- Essential Knowledge (EK) –
  - Essential knowledge statements describe the knowledge – including facts, definitions, etc. – required to perform the learning objectives.
- Learning Objectives (LO) –
  - Learning objectives define what a student should be able to do with content knowledge in order to progress toward the enduring understanding.
- Enduring Understanding (EU) –
  - Enduring understandings are the long-term takeaways related to the big ideas that leave a lasting impression on students. They build and earn these understandings over time by exploring and applying course content throughout the year.
- Big Idea (BI) –
  - The big ideas serve as the foundation of the course and develop understanding as they spiral throughout the course. The big ideas are the recurring themes that are present in the course. They are crosscutting concepts spiraled throughout the curriculum.



Topic Pages

- **Required course content** is listed in the center of the page, in a blue box.
- The **skill** for each learning objective is listed in the upper corner. Teachers are encouraged to have students engage with this skill while learning the content of the topic.
- Skills from **Practice 6** are not explicitly aligned with a set of learning objectives and can be paired with any content to be taught across the course.
- **Optional resources** to help teach the topic are listed in the side margin. These are hyperlinked in the online version of the CED.



BIG IDEA 1 Creative Development

10–13% AP Exam Weighting

- 1.1 Collaboration
- 1.2 Program Function and Purpose

BIG IDEA 2 Data

17–22% AP Exam Weighting

- 2.1 Binary Numbers
- 2.2 Data Compression
- 2.3 Extracting Information from Data
- 2.4 Using Programs with Data

Topic Questions
Multiple-choice: ~20 questions

BIG IDEA 3 Algorithms and Programming

30–35% AP Exam Weighting

- 3.1 Variables and Assignments
- 3.2 Data Abstraction
- 3.3 Mathematical Expressions
- 3.4 Strings
- 3.5 Boolean Expressions
- 3.6 Conditionals
- 3.7 Nested Conditionals
- 3.8 Iteration
- 3.9 Developing Algorithms
- 3.10 Lists
- 3.11 Binary Search
- 3.12 Calling Procedures
- 3.13 Developing Procedures
- 3.14 Libraries
- 3.15 Random Values
- 3.16 Simulations
- 3.17 Algorithmic Efficiency
- 3.18 Undecidable Problems

BIG IDEA 4 Computer Systems and Networks

11–15% AP Exam Weighting

- 4.1 The Internet
- 4.2 Fault Tolerance
- 4.3 Parallel and Distributed Computing

BIG IDEA 5 Impact of Computing

21–26% AP Exam Weighting

- 5.1 Beneficial and Harmful Effects
- 5.2 Digital Divide
- 5.3 Computing Bias
- 5.4 Crowdsourcing
- 5.5 Legal and Ethical Concerns
- 5.6 Safe Computing

Topic Questions
Multiple-choice: ~20 questions

COMPUTATIONAL THINKING PRACTICES

Practices spiral across big ideas.

1. Computational Solution Design
2. Algorithms and Program Development
3. Abstraction in Program Development
4. Code Analysis
5. Computing Innovations
6. Responsible Computing

Topic Questions

Multiple-choice: ~90 questions
Performance Task: ~20 prompts

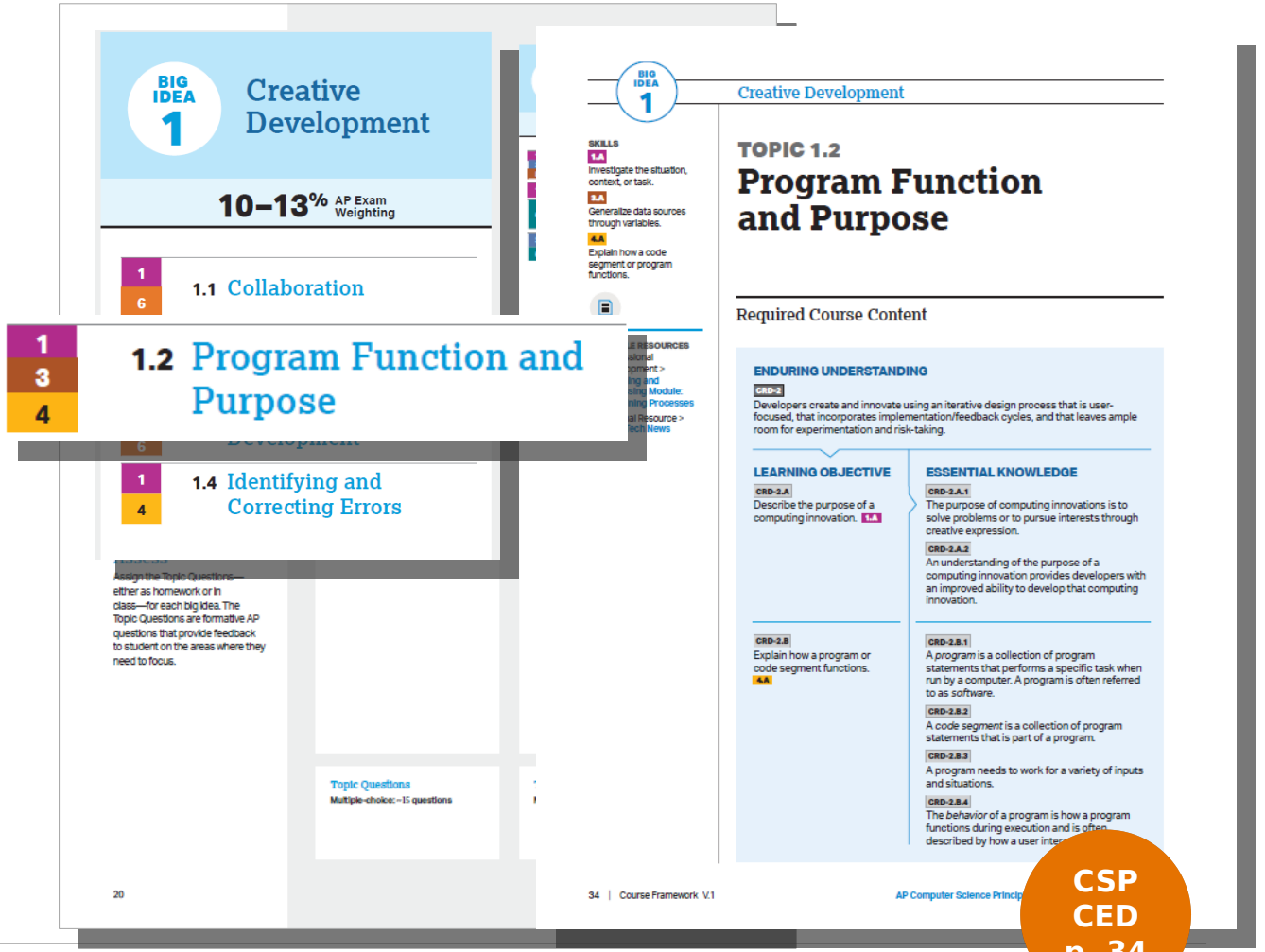
CSP CED pp. 20 - 21

Activity: Topic 1.2 Program Function and Purpose

Each page is intended to represent a teachable "chunk" of content – a chunk that will require teachers to plan which unit / module it will be taught in.

THINK PAIR SHARE

- What are the most valuable pieces of information portrayed on the topic page?
- What parts of the topic page represent required course content or skills?
- What parts of the topic page represent suggested or non-required content?



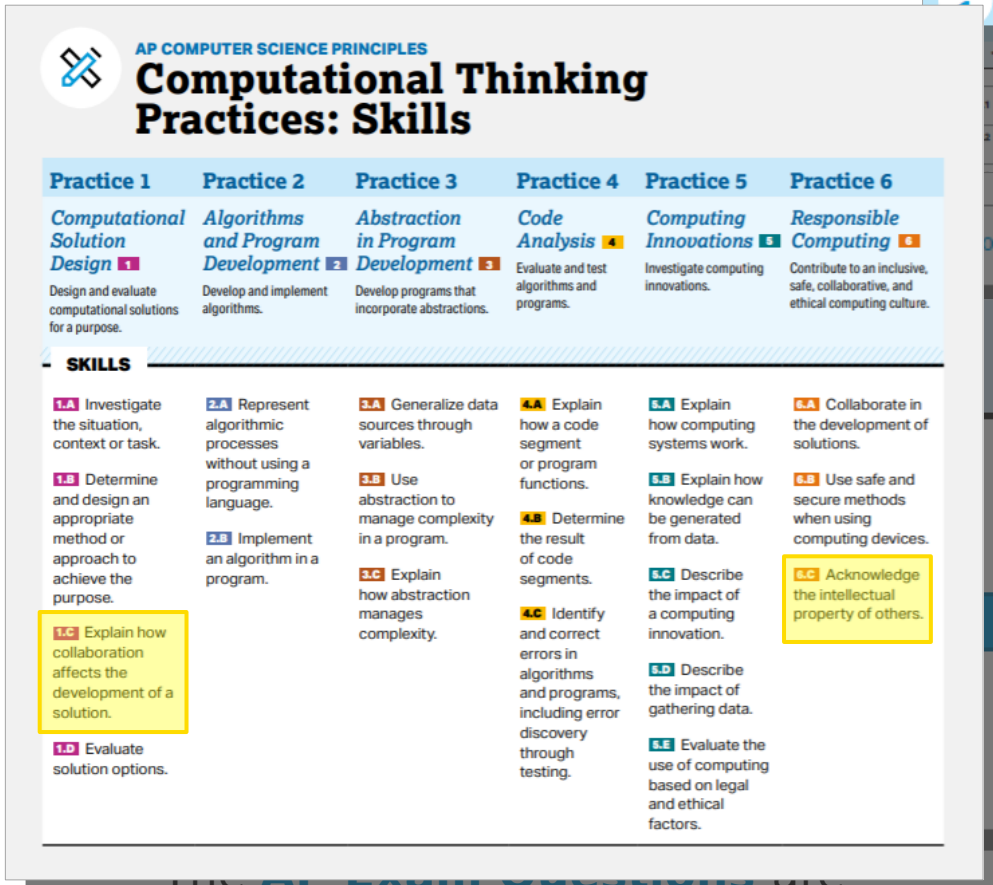
CSP CED p. 34

Big Idea Opener

- **Developing Understanding** provides an overview that contextualizes and situates the key content of the big idea within the scope of the course.
- The **Building Computational Thinking Practices** section describes specific aspects of the skills that are appropriate to focus on in that big idea.
- The **Preparing for the AP Exam** section provides helpful tips and common student misunderstandings identified from prior exam data.
- The **essential questions** are thought-provoking questions that motivate students and inspire inquiry.

CED pp. 31, 33

Big Idea at a Glance



AP COMPUTER SCIENCE PRINCIPLES

Computational Thinking Practices: Skills

Practice 1	Practice 2	Practice 3	Practice 4	Practice 5	Practice 6
Computational Solution Design 1	*Algorithms and Program Development* 2	*Abstraction in Program Development* 3	*Code Analysis* 4	*Computing Innovations* 5	*Responsible Computing* 6
Design and evaluate computational solutions for a purpose.	Develop and implement algorithms.	Develop programs that incorporate abstractions.	Evaluate and test algorithms and programs.	Investigate computing innovations.	Contribute to an inclusive, safe, collaborative, and ethical computing culture.

SKILLS

Practice 1	Practice 2	Practice 3	Practice 4	Practice 5	Practice 6
1.A Investigate the situation, context or task.	2.A Represent algorithmic processes without using a programming language.	3.A Generalize data sources through variables.	4.A Explain how a code segment or program functions.	5.A Explain how computing systems work.	6.A Collaborate in the development of solutions.
1.B Determine and design an appropriate method or approach to achieve the purpose.	2.B Implement an algorithm in a program.	3.B Use abstraction to manage complexity in a program.	4.B Determine the result of code segments.	5.B Explain how knowledge can be generated from data.	6.B Use safe and secure methods when using computing devices.
1.C Explain how collaboration affects the development of a solution.		3.C Explain how abstraction manages complexity.	4.C Identify and correct errors in algorithms and programs, including error discovery through testing.	5.C Describe the impact of a computing innovation.	6.C Acknowledge the intellectual property of others.
1.D Evaluate solution options.				5.D Describe the impact of gathering data.	
				5.E Evaluate the use of computing based on legal and ethical factors.	

Creative Development

10–13% AP Exam Weighting

1 Collaboration

2 Program Function and Purpose

oration

BIG IDEA 1 — Creative Development

BIG IDEA AT A GLANCE

Learning Objective	Topic	Skills	Unit/Module
CRD-1.A, CRD-1.B, CRD-1.C	1.1 Collaboration	1.C Explain how collaboration affects the development of a solution.	
		6.A Collaborate in the development of solutions *(not assessed)*.	
CRD-2.A, CRD-2.B, CRD-2.C, CRD-2.D	1.2 Program Function and Purpose	1.A Investigate the situation, context, or task.	
		3.A Generalize data sources through variables.	
		4.A Explain how a code segment or program functions.	

Skills | Unit/Module

1.C Explain how collaboration affects the development of a solution.

6.A Collaborate in the development of solutions *(not assessed)*.

Skill

ify and address any student misunderstandings.

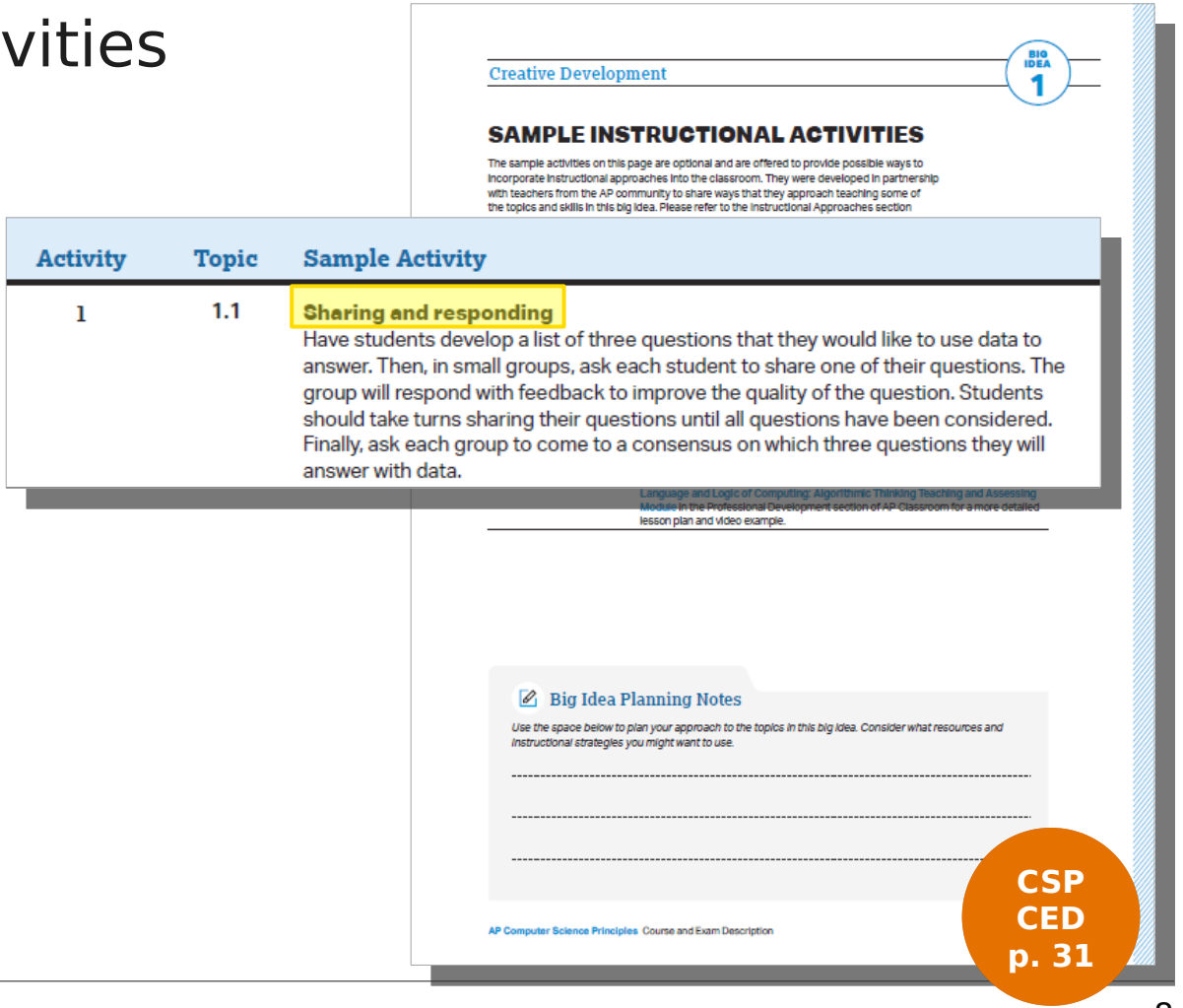
30 | Course Framework V.1 AP Computer Science Principles Course

CSP CED p. 30

The AP Exam questions are based on the learning objective-skill pairing.

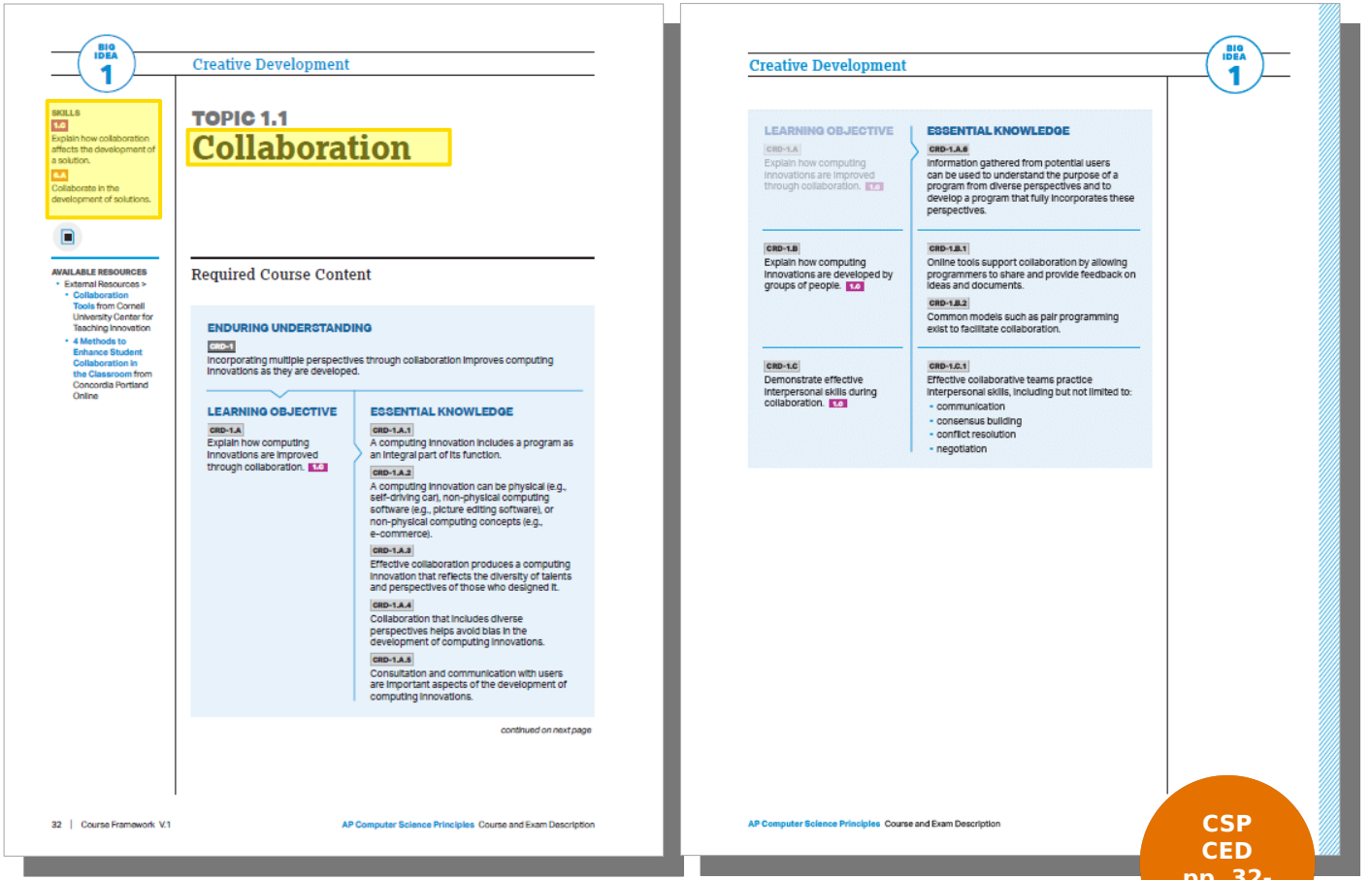
Sample Instructional Activities

- The Sample Instructional Activities page includes **optional activities** that can help tie together the content and skills of a particular topic.
- The activity descriptions are not meant to serve as prescriptive sets of steps; rather, **teachers should feel free to modify the activities** in ways that would best suit the needs of their students.
- The sample activities listed use common **instructional strategies**, all of which are listed in the Instructional Approaches section of the CED.



Topic Pages

- Each topic page represents **a teachable “chunk” of content and skills**. This chunk might take anywhere from slightly less than a single class period to several class periods.
- Teachers and endorsed providers will need to scaffold the **content** and **skills** found in each topic across their units / modules.



BIG IDEA 1

Creative Development

SKILLS
1.C Explain how collaboration affects the development of a solution.
4.A Collaborate in the development of solutions.

AVAILABLE RESOURCES
- External Resources >
  - Collaboration Tools from Cornell University Center for Teaching Innovation
  - 4 Methods to Enhance Student Collaboration in the Classroom from Concordia Portland Online

TOPIC 1.1
Collaboration

Required Course Content

ENDURING UNDERSTANDING
CRD-1 Incorporating multiple perspectives through collaboration improves computing innovations as they are developed.

LEARNING OBJECTIVE
CRD-1.A Explain how computing innovations are improved through collaboration. 1.C

ESSENTIAL KNOWLEDGE
CRD-1.A.1 A computing innovation includes a program as an integral part of its function.
CRD-1.A.2 A computing innovation can be physical (e.g., self-driving car), non-physical computing software (e.g., picture editing software), or non-physical computing concepts (e.g., e-commerce).
CRD-1.A.3 Effective collaboration produces a computing innovation that reflects the diversity of talents and perspectives of those who designed it.
CRD-1.A.4 Collaboration that includes diverse perspectives helps avoid bias in the development of computing innovations.
CRD-1.A.5 Consultation and communication with users are important aspects of the development of computing innovations.

continued on next page

Creative Development BIG IDEA 1

LEARNING OBJECTIVE
CRD-1.A Explain how computing innovations are improved through collaboration. 1.C

ESSENTIAL KNOWLEDGE
CRD-1.A.6 Information gathered from potential users can be used to understand the purpose of a program from diverse perspectives and to develop a program that fully incorporates these perspectives.

CRD-1.B Explain how computing innovations are developed by groups of people. 1.C

CRD-1.B.1 Online tools support collaboration by allowing programmers to share and provide feedback on ideas and documents.
CRD-1.B.2 Common models such as pair programming exist to facilitate collaboration.

CRD-1.C Demonstrate effective interpersonal skills during collaboration. 1.C

CRD-1.C.1 Effective collaborative teams practice interpersonal skills, including but not limited to:
- communication
- consensus building
- conflict resolution
- negotiation

CSP CED pp. 32-33