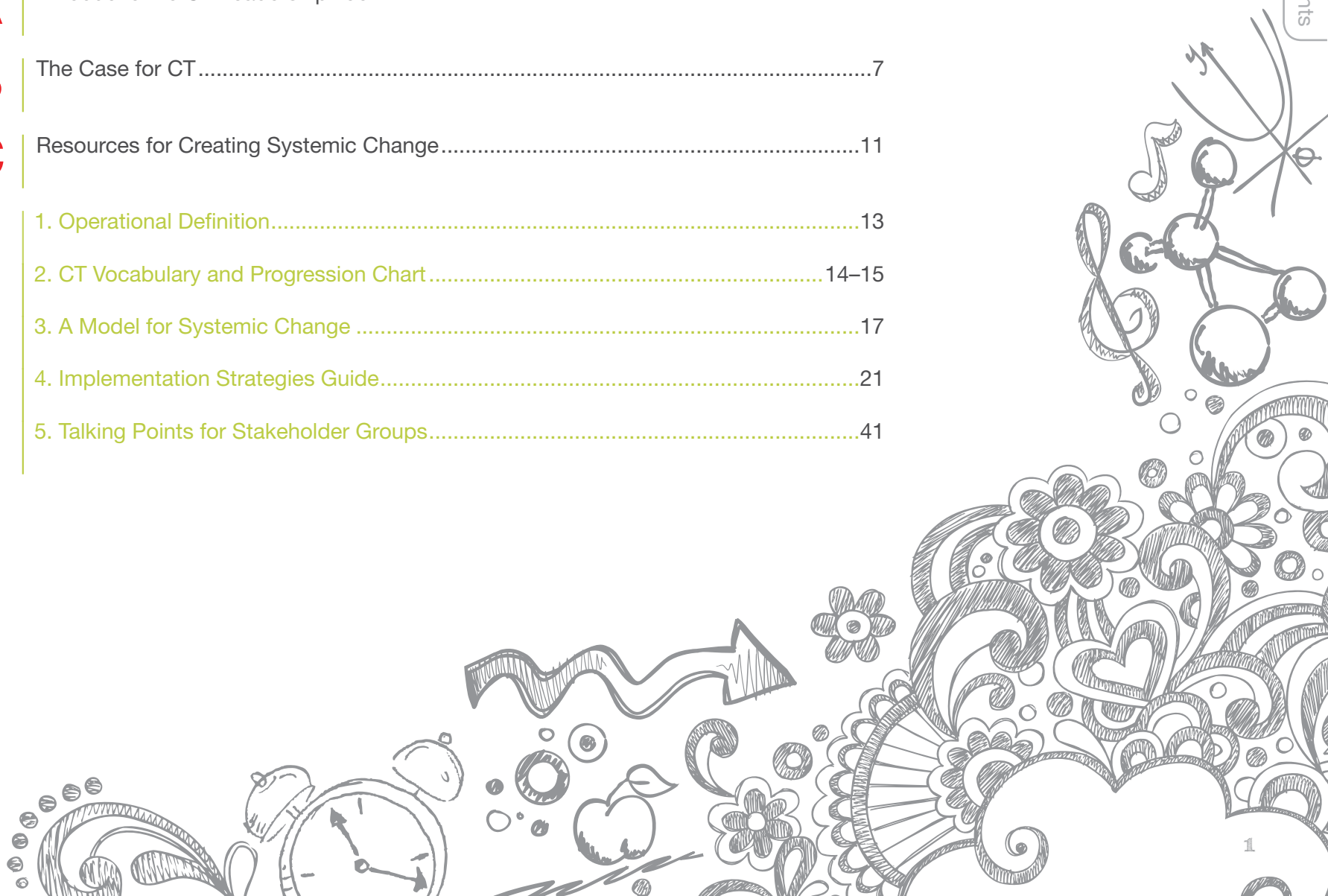
COMPUTATIONAL THINKING leadership toolkit

first edition


Innovative

Computational Thinking in K–12 Education

leadership toolkit first edition



Special Thanks

The International Society for Technology in Education (ISTE) and the Computer Science Teachers Association (CSTA) thank the National Science Foundation (NSF) for its generous support of this work, with a special thanks to NSF program officers Joan Peckham and Harriet Taylor.

We also want to thank the people who engaged with us to define *computational thinking* for a K–12 audience and contributed to the development of resources to help educators understand, value, and implement computational thinking in K–12 education.

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This material is based on work supported by the National Science Foundation under Grant No. CNS-1030054.


Laughter

A | Introduction to Computational Thinking Leadership Toolkit

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Computing, because of its ubiquity and role in innovation, has become an essential tool for competition in the increasingly global knowledge economy. As a result, industry, government, and thought leaders have become increasingly alarmed that the United States is beginning to lose its innovative and competitive edge (International Technology Association of America, 2003; Sargent, 2004). Policy makers took action. They prioritized science, technology, engineering, and mathematics (STEM) education to help reverse the shortfall of students who are well trained in STEM disciplines. The National Science Foundation (NSF) funded programs to increase the number of high school graduates taking computer science classes. Organizations focused on engaging more nontraditional students in computing.

In 2006, Jeannette Wing wrote a seminal article on computational thinking that said it "represents a universally applicable attitude and skill" for everyone. Her vision helped to inspire pockets of innovation across the country that could serve as models for achieving the goal, but nationwide adoption required a more systemic approach. The NSF called on ISTE and CSTA for assistance.

Both CSTA and ISTE had the reach, the K–12 experience, and the complementary expertise and capacity to design and develop a comprehensive approach. ISTE and CSTA started with an unwavering principle that *all* students should demonstrate competency in the basic skills of computational thinking by the time they graduate from high school. This would bring computational thinking into formal education and require teachers at every grade level and within all content areas to contribute to building their students' computational thinking skills. The goals of the project, titled Leveraging Thought Leadership for Computational Thinking in K–12 Curriculum, were to:

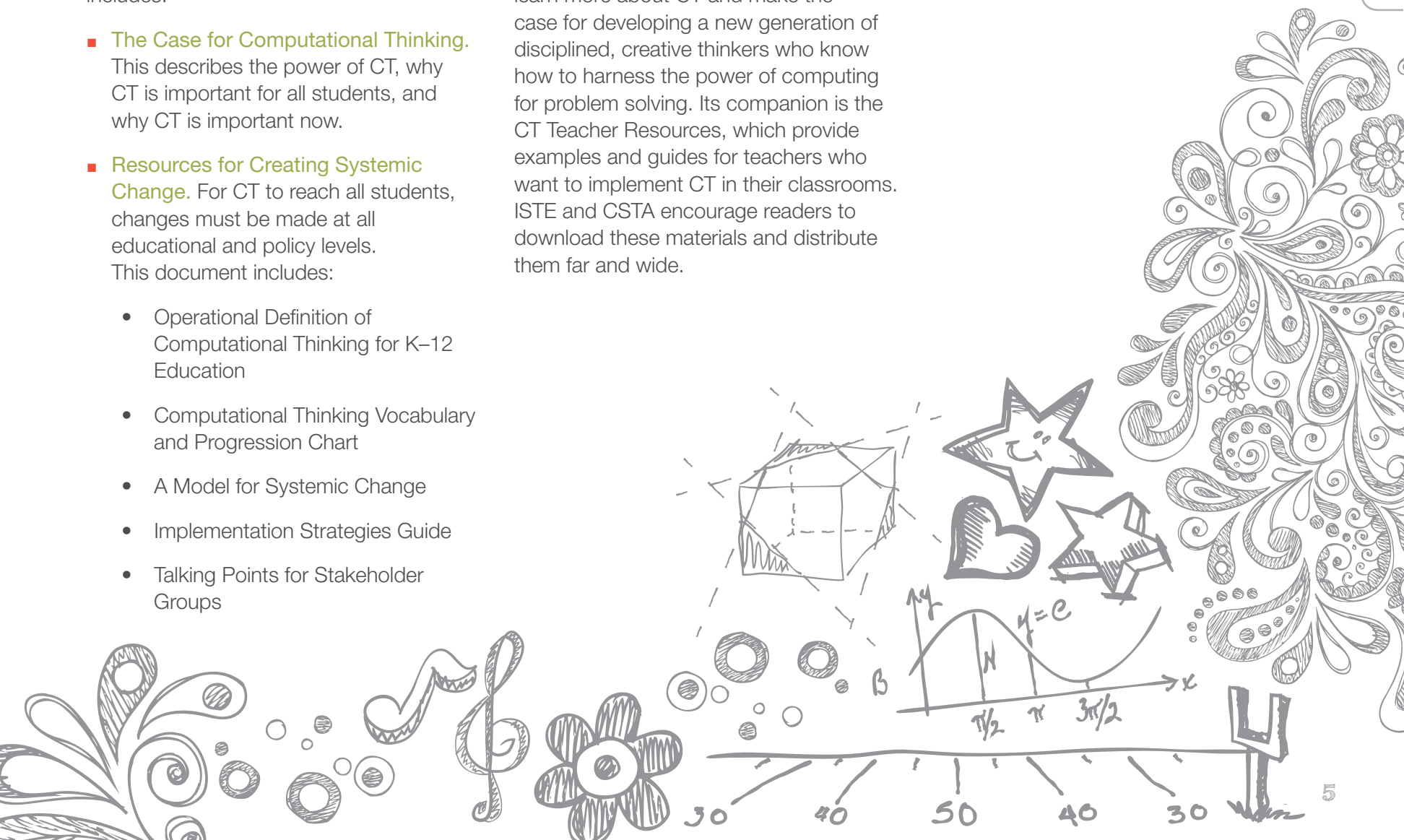
- Build consensus for an operational definition of computational thinking (CT) that would be meaningful to an educator audience
- Develop prototype crosscurricular CT learning experiences and curriculum support materials
- Create a toolkit that makes the case for CT for all
- Prioritize strategies that build traction for CT in primary and secondary education

In April 2010, we brought together leaders from divergent schools to forge a consensus operational definition for *CT* in K–12 education. We corroborated this operational definition through surveys to teachers, computer scientists, teacher educators, education leaders, and researchers. We received overwhelming affirmation that this definition carved out a foundational CT domain for K–12 education. In November 2010, we brought together practitioners to draft crosscurricular CT learning experiences and develop a prioritized set of strategies for ensuring all students have the opportunity to learn these concepts in the course of their K–12 schooling.

Because CT is essential for all students, we have developed this Computational Thinking Leadership Toolkit, which includes:

- The Case for Computational Thinking. This describes the power of CT, why CT is important for all students, and why CT is important now.
- Resources for Creating Systemic Change. For CT to reach all students, changes must be made at all educational and policy levels. This document includes:
    - Operational Definition of Computational Thinking for K–12 Education
    - Computational Thinking Vocabulary and Progression Chart
    - A Model for Systemic Change
    - Implementation Strategies Guide
    - Talking Points for Stakeholder Groups

The materials contained in the CT Leadership Toolkit are meant to help educational and community leaders learn more about CT and make the case for developing a new generation of disciplined, creative thinkers who know how to harness the power of computing for problem solving. Its companion is the CT Teacher Resources, which provide examples and guides for teachers who want to implement CT in their classrooms. ISTE and CSTA encourage readers to download these materials and distribute them far and wide.




Inspire

B | The Case for CT

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Not long ago, it would have been hard to imagine a mobile device with the speed and power of a desktop computer in the hands of administrators, teachers, and students. Only the most forward-thinking of us could envision the potential of the World Wide Web in its earliest days of static webpages. Back then, the web was more reminiscent of brochures than what it is today—the place for information and primary resources, communication and publishing, collaboration and learning, creating, and socializing.

These innovations and many more are made possible by computing technology and were brought to us by computer scientists, computer engineers, and designers.

Computational thinkers are the creators, designers, and developers of the technology tools and systems that are now contributing to major advances in almost every field of human understanding and endeavor. Profound leaps of innovation and imagination have led to the decoding of the human genome, translations of ancient languages, and systems to track and warn citizens of dangerous weather systems. Pioneering students are creating their own applications and online games for fun. Those with an entrepreneurial spirit are creating new technologies and services (e.g., Mark Zuckerburg's Facebook, is one of the most widely known, with more than 250 million users). Computing's potential for innovation and creative, new designs is limitless.

The promise of CT is that it can improve problem solving and critical thinking by harnessing the power of computing. It will help expand our capacity to solve problems at a scale never before imagined, using strategies that have not yet been available to us. Students will need to learn and practice new skills—CT skills—to take full advantage of the revolutionary changes that the rapid changes in technology have brought about and to make their contributions for solving the "grand challenges of the 21st century," as the Obama administration calls them. Former World Bank Vice President Jean-Francois Rischard includes global warming, biodiversity, poverty, and infectious diseases among other global problems in his book *High Noon: 20 Global Problems, 20 Years to Solve Them*. Empowering students with CT skills will help bring CT to bear on these challenges and others and get us closer to solving some of the most intractable problems of our time.

Our goal is to prepare young learners to become computational thinkers who understand how today's digital tools can help solve tomorrow's problems. Our current task must be to find better ways of envisioning the potential for CT across all disciplines and find ways to facilitate learning across and between these disciplines so that we can provide students with the skills they need to solve our current and future challenges.

"We are currently preparing students for jobs that don't yet exist, using technologies that haven't been invented, in order to solve problems we don't know are problems yet."

—From Did You Know? by Karl Fisch, Arapahoe High School, Colorado
(http://theclosetentrepreneur.com/karl-fischs-did-you-know-presentation-remix)

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CT in K–12 Education.

Who Uses CT?

- A writer who researches a topic on the internet and stores his notes in a laptop database
- A hobbyist who designs custom bicycle gears, then has a local shop produce them with computerized machining tools
- An entrepreneur who uses online U.S. Census data to estimate the market potential of a new product
- A movie director who plans the opening ceremony for the Summer Olympics, incorporating the same control system used in space missions (an LED screen with 44,000 elements) and 3,000 disciples of Confucius
- A student who is writing a paper and starts with her high-level thesis, articulates what she plans to argue in the paper, makes an outline, and refines her work repeatedly
- A computer scientist who develops models and simulations to represent complex biological systems

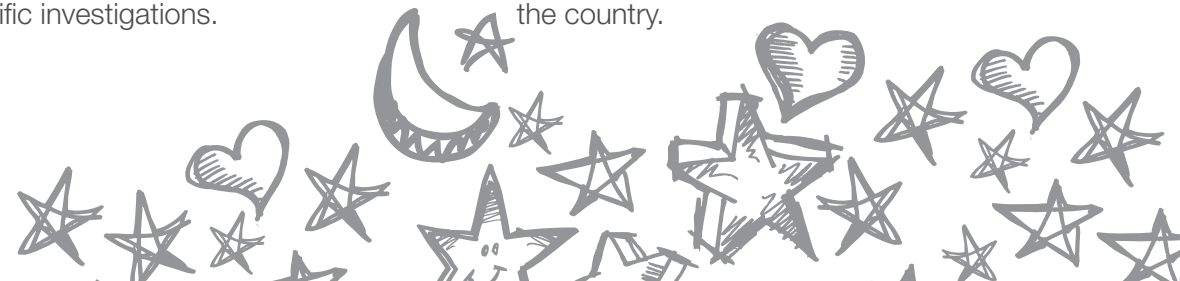
CT is an approach to solving a problem that empowers the integration of digital technologies with human ideas. It does not replace an emphasis on creativity, reasoning and critical thinking, but it re-emphasizes those skills while highlighting ways to organize a problem so that a computer can help. It extends and refocuses human creativity and critical thinking by allowing the computer to extend and refocus one's problem-solving capacity.

CT undergirds state standards in all subjects to enhance a learner's ability to solve problems and engage in higher-order thinking. Students engage in CT when they use algorithms to solve problems and enhance problem solving with computing. They engage in CT when they analyze text and construct complex communications. They engage in CT when they analyze large data sets and identify patterns as they conduct scientific investigations.

Why Is CT Important?

It is difficult to find an occupation or avocation where workers and technology do not interact. We all need to understand how, when, and where computers and other digital tools can help us solve problems, and we all need to know how to communicate with others who can assist us with computer-supported solutions. CT can help students realize that computers can automate solutions that solve problems more efficiently and extend their own thinking.

Educating students in CT is not primarily meant to lead to jobs in the field of computer science, but those students who do follow that path will be much better prepared for their college courses when the CT skills and dispositions are engrained as habits. With computer science enrollments declining, a pipeline into this high-paying, in-demand occupation will benefit students, the institutions of higher education, and the country.



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What Can I Do?

Because we can expect that every student will rely on computing in some way to amplify his or her skills, we must ensure that all students have the opportunity to learn the basics of CT during their K–12 education. Indeed, in her groundbreaking article Jeanette Wing argued "Ubiquitous computing was yesterday's dream that became today's reality; computational thinking is tomorrow's reality."

As a Leader, You Can Help Make CT a Reality.

If you are a teacher, you know that students already learn many elements of the set of CT skills, but they are not delivered in a uniform vocabulary or within a unified framework. For example, middle school algebra students learn to move from solving specific problems to deriving general formulas. Adding a CT component to the middle school algebra curriculum would make the abstraction involved in formula creation more apparent by using the term and by showing how a spreadsheet uses this same abstraction as a formula in a cell. Similarly, a student who learns how to create and use styles in a word processing document is using an abstraction of formatting options. Using that term will help the student see that creating a formula in mathematics is conceptually similar to creating styles in writing.

We can begin to introduce CT into the classroom immediately. Teachers who include critical thinking in their projects can adopt the CT vocabulary where appropriate and add those skills that are unique to CT where they can. Most important, they should shine a light on how computers are increasing the capacities of their students.

As a district leader or principal, know that CT can be integrated across the curriculum and at every age without creating and implementing a whole new curriculum. CT can be embedded in the current curriculum. As a leader at the state level, know that CT enhances other educational reform efforts, such as STEM, NETS, Common Core, and 21st century skills, and it complements critical-thinking skills. As a parent, know that the world our children inherit will be vastly different than the one bestowed on us, with new opportunities and challenges. CT skills will help them compete and succeed in the digital age.


Beauty

C Resources for Creating Systemic Change

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As a leader who recognizes the value of CT, these materials will help you introduce CT to colleagues, parents, and the community. The following components are meant to help develop an understanding of CT and provide a context for the systemic change that will need to happen to make CT for all a reality. They include prioritized strategies and talking points for important stakeholder groups: teachers, principals, school district staff, state, and federal-level policy makers, students, parents, school boards, the general public, media, schools of education, and industry.

1 Operational Definition of CT for K–12 Education

ISTE and CSTA achieved consensus among educators in the field around core skills and dispositions that describe what CT skills all students should have when they graduate from high school.

2 CT Vocabulary and Progression Chart

This chart "unpacks" the operational definition by listing CT concepts implicit in the operational definition, as well as "bite-sized" examples at each grade band and in multiple content areas. While not a scope and sequence of skills, the chart shows a progression of CT activities that grow more sophisticated as students progress through their education.

3 A Model for Systemic Change

CT skills are vital to all students as we work to raise the level of achievement, prepare students for global competitiveness, and blend academics with real life. Successful adoption and integration of CT requires positioning it to meet the needs of K–12 school improvement initiatives as well as higher education teacher preparation and graduate programs that can prepare a globally competent and competitive workforce.

4 Implementation Strategies Guide

For each of the actions from the list of strategies, we describe the activities, outcomes, and indicators for each group of stakeholders. It includes short-term, mid-term, and long-term strategies as well as potential partners for each activity.

5 Talking Points for Stakeholder Groups

This includes targeted messages to advocate for CT among various groups.


Strength

Operational Definition of CT for K–12 Education

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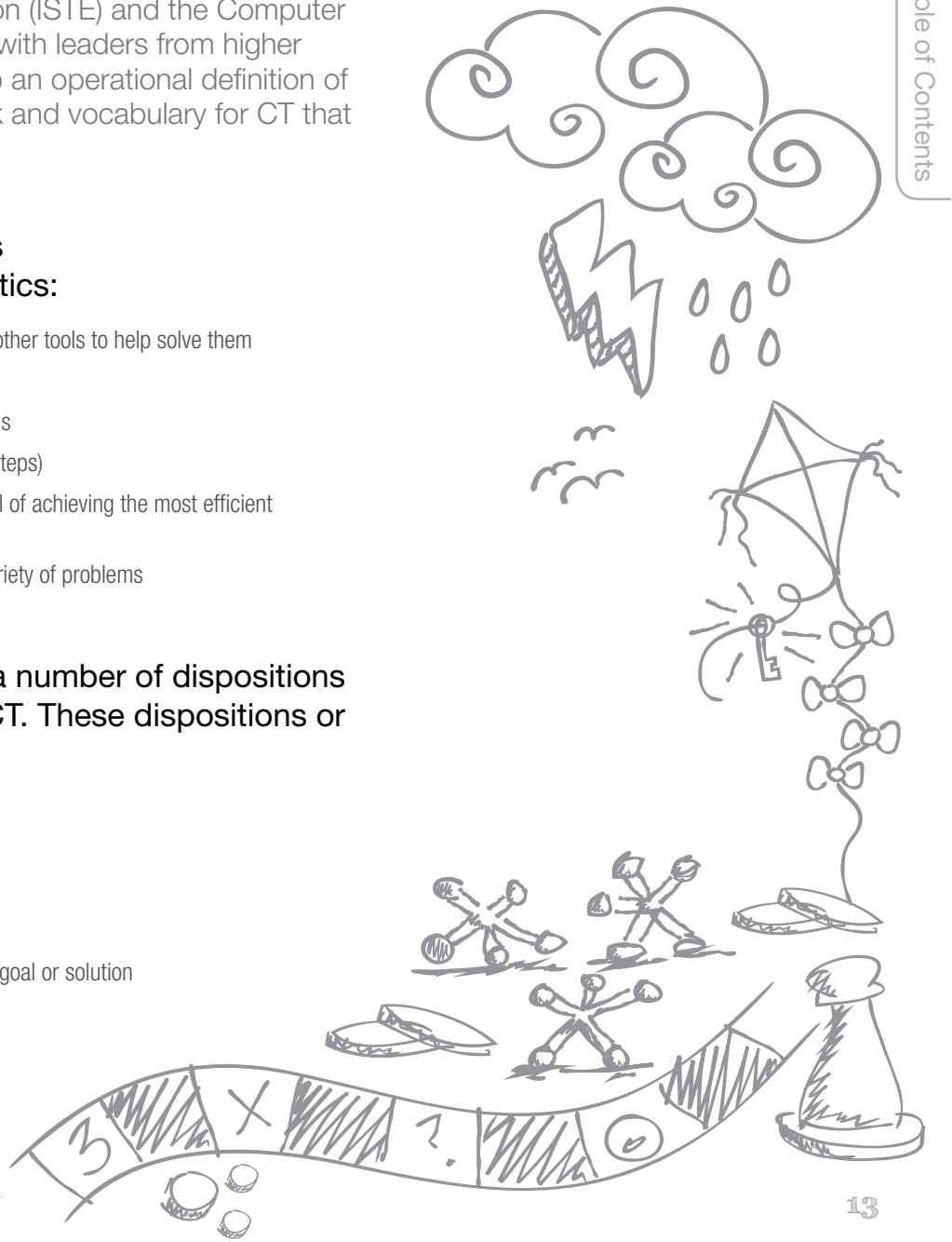
The International Society for Technology in Education (ISTE) and the Computer Science Teachers Association (CSTA) collaborated with leaders from higher education, industry, and K–12 education to develop an operational definition of *CT*. The operational definition provides a framework and vocabulary for CT that will resonate with all K–12 educators.



CT is a problem-solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions, such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems

These skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT. These dispositions or attitudes include:

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open-ended problems
- The ability to communicate and work with others to achieve a common goal or solution

This material is based on work supported by the National Science Foundation under Grant No. CNS-1030054.

2 CT Vocabulary and Progression Chart

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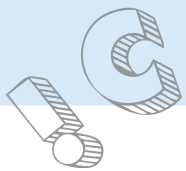
	Definition	Grades PK to 2	Grades 3 to 5	Grades 6 to 8	Grades 9 to 12
Data Collection	The process of gathering appropriate information	Conduct an experiment to find the fastest toy car down an incline and record the order of cars across the finish line in a chart.	Review examples of writing to identify strategies for writing an essay.	Design survey questions to gather appropriate information to answer questions (e.g., asking fellow students if they were absent from school in the past month and whether they were suffering from the flu).	Students develop a survey and collect both qualitative and quantitative data to answer the question: "Has global warming changed the quality of life?"
Data Analysis	Making sense of data, finding patterns, and drawing conclusions	Make generalizations about the order of finishing a toy car race based on the characteristics of the car with a focus on weight. Test conclusions by adding weight to cars to change results.	Categorize strong and weak examples of writing samples to develop a rubric.	Produce and evaluate charts from data generated by a digital probe and describe trends, patterns, variations, and/or outliers represented in the chart.	Use appropriate statistical methods that will best test the hypothesis: "Global warming has not changed the quality of life."
Data Representation	Depicting and organizing data in appropriate graphs, charts, words, or images	Create a chart or a line drawing that shows how the speed of a toy car changes when its weight is changed.	Match each writing sample to the rubric and create a chart showing which example best fits in each category of the rubric.	Plot data using different charting formats and select the most effective visual representation strategy.	Groups of students represent the same data in different ways based on a position relating to the question: "Has global warming changed the quality of life?" Different representations may result in varying conclusions.
Problem Decomposition	Breaking down tasks into smaller, manageable parts	Create directions to a location in the school by breaking the directions down into smaller geographical zones. Join the sections of directions together into a whole.	Develop a plan to make the school "green." Separate strategies such as recycling paper and cans, reducing use of electricity, and composting food waste.	In planning the publication of a monthly newsletter, identify roles, responsibilities, timeline, and resources needed to complete the project.	Consider the large-scale problem: "What does it take to become a rock star?" Break it into smaller parts. Discuss what variables are within a student's control and what variables are determined by outside factors.
Abstraction	Reducing complexity to define main idea	With many sizes and colors of three-sided shapes, the abstract is a triangle.	Hear a story, reflect on main items, and determine an appropriate title.	After studying a period in history, identify symbols, themes, events, key people, and values that are most representative of the time period (e.g., coat of arms).	Choose a period in politics that was most like the current one by analyzing the essential characteristics of the current period.



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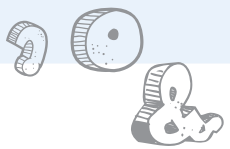
	Definition	Grades PK to 2	Grades 3 to 5	Grades 6 to 8	Grades 9 to 12
Algorithms & Procedures	Series of ordered steps taken to solve a problem or achieve some end.	Create a set of directions from the school to the major landmarks in the neighborhood.	Design a board game and write instructions to play. Test instructions on peers trying to play the game. Refine instructions with feedback from peers who played the game.	Program a robot to find its way out of a maze such that given any maze, the robot could exit successfully within a specified time period.	Discuss the decision-making process for choosing a college, then create an algorithm that describes that process. The algorithm will be able to handle unknown variables, such as where friends are attending, availabilty of financial aid, and admission success, to come to an unambiguous decision.
Automation	Having computers or machines do repetitive or tedious tasks.	Converse with a classroom in another state or country to learn about their culture using Internet-based tools to replace writing letters.	Investigate what automation is through real-world examples, like barcodes, teller machines, and library bar codes.	Program a sensor to collect pollution data (set timers with probes) and then use a computer program to sort the readings from maximum to minimum CO_2 levels.	Debate the merits of learning skills and information that are rarely necessary today because of automation. These skills might include long division, deriving square roots, spelling, statistical formulas, memorizing historic dates, etc.
Simulation	Representation or model of a process. Simulation also involves running experiments using models.	After a set of directions has been created, act out the steps to be sure they are correct.	Create an animation to demonstrate the understanding of a process.	Use a model of a simple ecosystem to conduct experiments that answer what happens to the ecosystem if some percentage of the producers die. The user controls the percentage that dies off.	Create a spreadsheet to simulate the "Birthday Problem" (How many people must be in a room for there to be at least a 50% chance that at least two have the same birthday?). Use the same model to answer the question for three people having the same birthday.
Parallelization	Organize resources to simultaneously carry out tasks to reach a common goal.	Based on a set of criteria, break the class into two groups. Have one group read aloud while the other group provides humming background music. The goal is reached, but the whole is better than the individual parts.	Teachers facilitate in planning team project timelines, roles, and assignments and working together to complete components (how do we break up the tasks, what tasks have to be done sequentially and others simultaneously, check ins, meeting deadlines?).	Student teams plan production of a video, including script, props, and roles of the team in producing the video. Identify tasks that will be carried out simultaneously, and milestones where they check in, and plan, and put things together.	Describe the sequence of activities by each of the armies leading to the Battle of Waterloo. Include both physical activities (e.g., recruit troops) and intellectual activities (e.g., pick troop positions).



This material is based on work supported by the National Science Foundation under Grant No. CNS-1030054.


Play

3 A Model for Systemic Change

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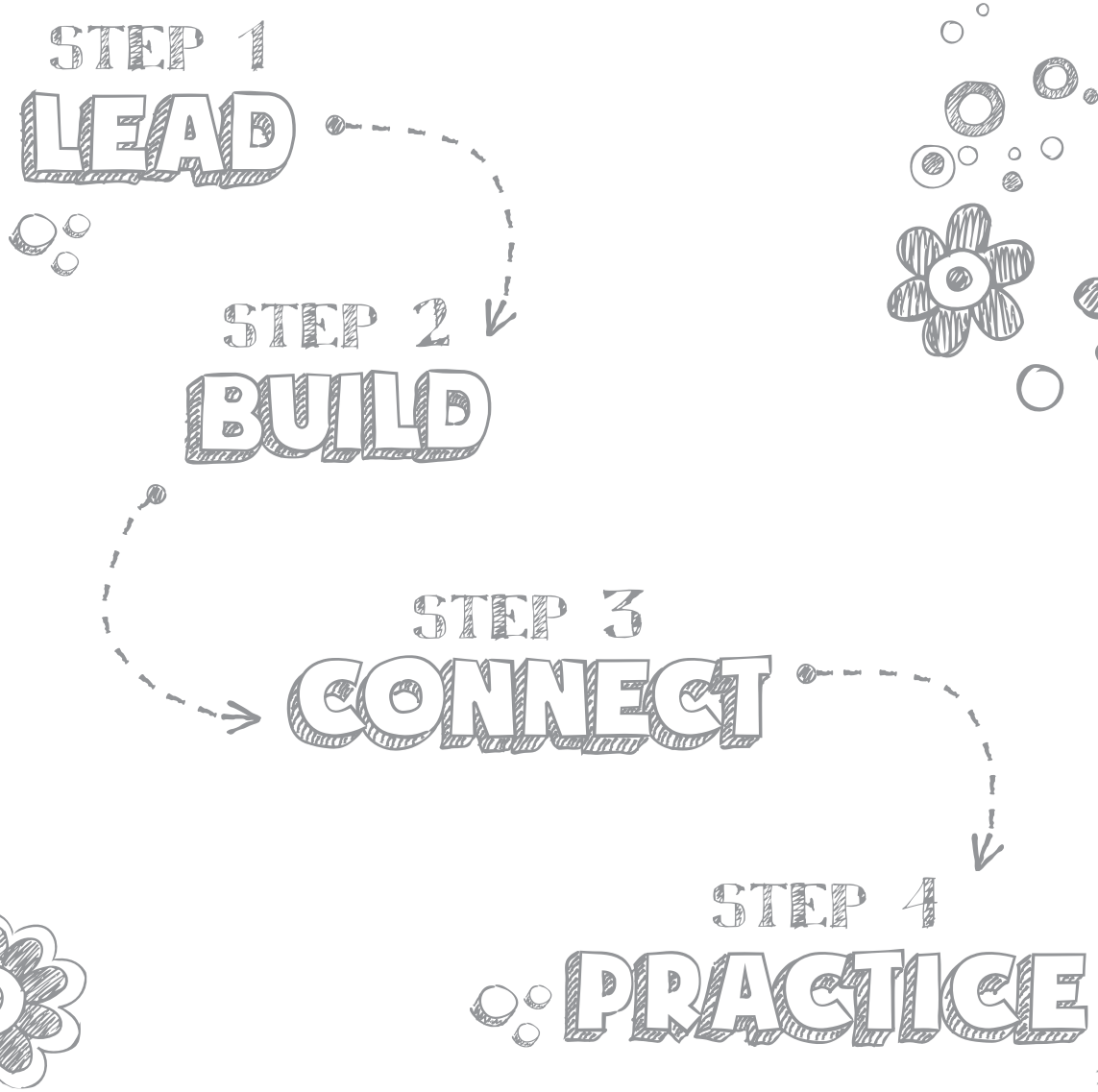
The concepts and dispositions for CT are at the core of many learning initiatives. It will take CT change makers/agents to bring CT into K–12 education. They will lead efforts to increase awareness of CT among both leaders and practitioners. To build traction for CT, they will need to work with decision makers to link CT to local goals, educational initiatives, or reform efforts. They will need to collaborate with teachers to help them explore grade-appropriate implementation, test-drive learning activities, and connect CT to current practice.

To begin to bring about the change necessary to bring CT to all students, remember these four steps.



A Model for Systemic Change

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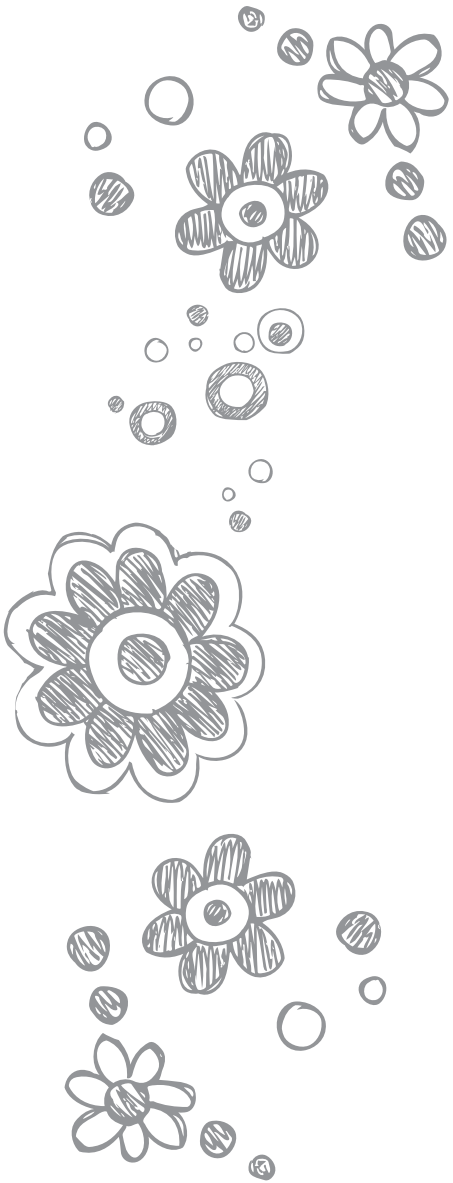

STEP 1
LEAD

CT change agents must take the lead and develop an effective conduit to decision makers.

- Education leaders and school improvement teams
- Teacher preparation and master's programs, including education leadership
- Individual teachers
- Informal education and after-school programs

STEP 2
BUILD

Once change agents have taken the lead, they must begin building awareness of CT among teachers and leaders. This will require positioning CT skills as part of the solution to current educational initiatives.

- Mapping and aligning to Common Core standards
- Integrate into technology, STEM content, NETS, and 21st century skills
- Extend critical thinking, improve test scores, address Adequate Yearly Progress

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STEP 3
CONNECT

Now is the time to begin connecting CT to innovative educational initiatives that will build value and understanding. Teachers and leaders should work to provide an age-appropriate continuum of resources to prepare for successful implementation of CT in the classroom.

- CT Vocabulary and developmental sequence
- Learning activities and experiences that are no tech, low tech, or active tech
- Curriculum development tool

STEP 4
PRACTICE

Begin the process of putting CT into practice in the classroom on a regular basis. Teachers and leaders will create, seek out, and disseminate PD materials that support CT awareness, experimentation, adoption, and integration.

- CT Teacher Resources
- Presentation and webinars for leaders
- Presentation and workshop materials for teachers
- Online units for teachers


Excite

4 Implementation Strategies Guide

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As a CT leader and change agent, you and your colleagues can participate in multiple ways to bring CT into K–12 education. This section of the toolkit provides a list of strategies, accompanied by short-, medium-, and long-term activities, outcomes, and indicators for each stakeholder group. Consider this resource as less of a roadmap or a linear path for individuals to follow, and more of a menu of opportunities for you to lead or to join others doing similar work.

This section, however, also provides you with the context for all of the actions that must be taken and resources that must be developed for successful implementation and systemic change.

Educational Policies that Include CT as a Part of Every Student's Education

- Make sure we are sharing a single message at the federal, state, and local levels.
- Make a convincing argument for CT as part of the 21st century skills requirements.
- Build a more extensive (informed) community that includes organizations that are already active on state standards.
- Leverage professional organizations to advocate at the federal and state levels.
- Look for ways to attach CT to existing policies (look for how to modify existing policies rather than focusing on creating new policies/legislations).
- Work to build CT concepts into the new Common Core Standards.
- Work to include CT outcomes as part of the state-level technology tests.
- Ensure that policies for CT engage students from the beginning of their school experience and provide outcomes that demonstrate incremental steps.
- Include a class on CT across disciplines (for all teachers) as part of all teacher preservice preparation programs.
- Allow for different models and infusion strategies (not just wide curricular change).
- Advocate to build a CT component into science fairs.

Shared Vision and Common Language

- Help computer science professionals demystify the terminology to make it more widely understandable/inclusive.
- Provide descriptions of CT terms and outcomes that administrators can understand.
- Help teachers find ways to integrate CT knowledge/skills with their current knowledge and practice.
- Present ideas and materials in terms/contexts that teachers will be comfortable with.
- Help all stakeholders understand/see that CT is a core competency in education.
- Create a strong business case to draw industry into the partnership.
- Communicate with educators using the language/terminology that is common in the educational environment.
- Leverage professional organizations to create and disseminate a shared vision.

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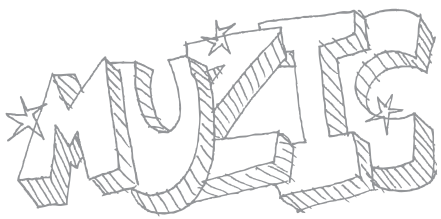
School- and District-Level Leadership Inspired to Change

- Create opportunities for K–12 and postsecondary professionals (faculty, administrators) to talk.
- Provide materials that will make CT understandable and relevant to school administrators.
- Provide ways for school-level leaders to understand how supporting CT will provide the outcomes that teachers believe are important to their students.
- Influence policies that determine who can teach so that content experts can become K–12 teachers.
- Provide professional development (PD) opportunities for school leaders/administrators that help them understand CT and the support teachers need to implement CT.
- Facilitate school/industry partnerships that will help district school leaders and administrators understand the need for CT skills in the workforce.
- Find ways to relate the need for CT in schools to what is happening/needed in individual communities.



Inspiring Teachers to Change

- Build an incentive or reward structure (extrinsic and intrinsic) into the change process for teachers (recognize the value of teachers' personal time).
- Find ways to help teachers understand why CT is important to/good for their students.
- Address issues of student engagement and achievement.
- Provide teachers with the PD they need, such as summer institutes.
- Build personal relationships with teachers.
- Identify the "right" teachers who will embrace and model effective change.
- Look for early adopters as examples to inspire change.
- Always model peer support and peer mentoring.
- Provide course materials.
- Involve teachers in the development of curriculum materials (both computer science faculty and K–12 teachers).
- Help teachers make a solid connection between CT and their own discipline/teaching level.

- Provide fun, simple examples for teachers that exemplify how to integrate CT effectively.
- Find ways to help teachers identify the relevance to CT within their own communities.
- Avoid what doesn't work.

Resources to Support Change

- Use multiple methods to deliver curricular materials, including in-person and web-based social and content-delivery mechanisms.
- Provide websites for independent student activities (self-guided, fun, non-teacher-directed).
- Identify the needed resources.
- Create PD materials.
- Test all resources to make sure they actually work.
- Provide a common language to describe CT that promotes a common understanding and ways to communicate about learning.
- Create videos that model effective teaching of CT concepts.
- Have teachers use free/available computer models and simulations in their teaching to help kids understand and appreciate modeling.

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- Provide model activities that incorporate best practices.
- Build an understanding of learning trajectories from learning sciences.
- Hold exhibitions where students can showcase their computational projects/artifacts and the skills they used to develop them.

Relevant Professional Development

- Facilitate the building and maintenance of professional learning communities.
- Provide continued and continuous support.
- Provide funding for substitute teachers so teachers can attend PD events.
- Provide summer institutes where teachers can engage with other teachers and provide incentives for teachers to attend.
- Model peer learning by having teachers who have CT experience offer PD.
- Provide teachers with time to learn.
- Model good pedagogy in PD events.
- Build into all PD the understanding that it is not necessary for teachers to know everything (intrepid teachers learn from students too).
- Provide opportunities for teachers to spend time in industry settings where CT skills are valued.
- Implementation strategies must include building partnerships that include all stakeholders.
- Provide teachers with the resources to support their learning.
- Provide resources that define CT and allow teachers to recognize where they already include it in their teaching.
- PD events must allow teachers from all disciplines to spend time with computer science specialists.
- Provide just-in-time videos.
- Help teachers make connections between CT outcomes and existing standards (don't create a whole new set of strategies).
- Trust teachers to use their professional knowledge and skills to do what is best for their students.

Access to a Learning Community for Ongoing Support

- Encourage current associations to show how CT fits into their current standards/work.
- Ask associations to include a focus on CT in their conferences/workshops/PD events.
- Make open-source tools (blogs, wikis, forums) and web-based social networks and content-delivery systems available to school districts so that they can use their networks to make them available to teachers and students (these should be vetted so that districts will not be compelled to block them).
- Use web-based social and content-delivery mechanisms.
- Pair students with expert practitioners in CT to solve problems that address their community's needs.
- Make CT a part of National Lab Day.
- Create a community of practice that serves as a resource center for sharing CT resources.
- Actively engage parents in the discussion/activities to support CT.

Implementation Strategies Guide

Models for changing practice and minds

Short-Term (Year 1)

Use this guide to target strategies or find synergies with others who are taking the lead. Every advocacy activity has four important elements: audience, timing, intended outcome, and evaluation (how you determine the intended outcome has been achieved).

Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
Map for change agent (depending on sphere of influence, some strategies and activities will apply, while others won't)

Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 1)	Activities (Year 1)
Teachers	Determine which teachers need to include CT in their curriculum and provide them with PD and resources appropriate for their discipline.	1. Identify pools of teachers in target subject areas who can be surveyed. 2. Conduct needs assessment. 3. Plan and share a workshop unit, including resources. 4. Explore existing curriculum resources for CT PD. 5. Develop partnerships for PD delivery with other institutions
Principals	Provide descriptions of CT terms and outcomes that administrators can understand. Provide materials that will make CT understandable and relevant to school administrators. Help each principal develop a local implementation plan to increase CT across the curriculum.	1. Organize a workshop with a small number of principals in key areas within the state to introduce CT descriptions and value and to show how CT is similar and different to other problem-solving methodologies by providing examples for various disciplines. 2. Create an implementation plan from Activity 1. 3. Execute implementation plan (for example, a series of statewide or regional workshops on critical thinking and other problem-solving strategies (including CT). 4. Give a session on same topic at the National Principals Association meeting.
School District Staff	Provide PD opportunities for school leaders and administrators that help them understand CT and what support teachers need to implement.	1. Build awareness at national level with articles in professional journals and other publications that school and district staff read regularly. 2. Offer free webinars on the impact of CT in schools highlighting several model classrooms demonstrating CT in action. Provide specific resources and support systems available to assist teachers in implementing CT. NOTE: These activities are priorities and need to be completed before most other activities.

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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
1. Design and test a needs assessment tool. 2. Distribute needs assessment and gather and analyze data. 3. Create workshop unit and upload to website for sharing and downloading. 4. Identify existing curriculum resources for CT PD that can serve as exemplars 5. Identify potential partners.	1. Create needs assessment tool. 2. Distribute assessment tool and collect datad from a minimum of 300 teachers. 3. Complete needs assessment from a specified diversity of teachers (subject area, location, race/ethnicity, computer expertise, etc.). 4. Verify that collected data are valid and useful (how this looks depends on whether your survey is quantitative or qualitative and the questions you asked). 5. Five entities agree to help disseminate workshop unit. 6. Select three to five exemplary curriculum resources. 7. Identitfy five potential partners.	CSTA, ISTE, State Educational Technology Directors Association (SETDA), National Association for Secondary School Principals (NASSP), National Association for Elementary School Principals (NAESP), American Association of School Administrators (AASA)	Teachers
1. Target number and diversity of principals attending the workshop. 2. Principals attend workshop. Principals create their own implementation plans. 3. Principals in at least three districts start to carry out their plans, including a system for monitoring their progress.	Evaluate their implementation plans in terms of effectiveness, commitment, cost, and organizational ability to adopt and sustain. Look for which implementations are models that could be replicated.	NASSP, NAESP, AASA	Principals
1. District leaders and PD providers begin to discuss CT and the implications for their schools. An interest is stimulated in further knowledge building and information gathering about CT. 2. Leaders visualize how they can implement CT in their schools.	1. Survey district leadership on knowledge of CT and on potential for district implementation of a CT plan. 2. Collect number of participants who participated in webinars or viewed archives. Collect the number of participants who requested further information and resources.	Association Supervision and Curriculum and Development (ASCD)	School district staff

Implementation Strategies Guide

Models for changing practice and minds

Short-Term (Year 1)

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Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
Map for change agent (depending on sphere of influence, some strategies and activities will apply, while others won't)

Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 1)	Activities (Year 1)
State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD	Make/develop a convincing argument for CT as a part of the 21st century skills requirement.	1. Create clear definition without computational thinking terms. 2. Correlate 21st century 4Cs to the areas of CT that connect. 3. Review and inform on national standards for various disciplines and technology and show where CT aligns. 4. Show connections to Common Core Math and ELA Standards. 5. Find areas in National Ed Tech Plan (NETP) that align with CT. 6. Find areas in reauthorized ESEA that align. NOTE: These activities are priorities and need to be completed before most other activities.
Federal-Level Policy Makers (Department of Education)	Look for ways to attach CT to existing policies (look for how to modify existing policies rather than focusing on creating new policies/legislations).	1. Work with Partnership to Assess Readiness for College and Career (PARCC), Smarter Balance Data Assessment Consortium and other state level organization to include CT in next-generation assessment being created for the Common Core, to be administered in 2014. 2. Include CT in the reauthorization of ESEA. 3. Solicit feedback from state departments of education on modification and creation of policy/legislation.
Students	Actively engage students in the discussion/activities to support CT.	1. Develop parent-focused resources, in easily understood language, that explain CT as a critical skill. 2. Pull together students with expert practitioners in CT to solve problems that address their community needs. 3. Ensure that policies for CT engage students from the very beginning of their school experience, and provide outcomes that demonstrate incremental steps 4. Advocate to build CT component into science fairs.
Parents	Actively engage parents in the discussion/activities to support CT	1. Develop parent-focused resources, in easily understood language, that explain CT as a critical skill. 2. Identify test groups (PTAs and other school support groups) to which we will distribute the resources. 3. Identify test groups among informal education groups (such as school clubs and student activity groups) through which we will disseminate resources.

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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
1. Devolop easy-to-understand statement with examples to make the case for including CT. 2. Develop visual alignment charts for 21st century 4C. 3. Develop visual alignment charts for NETS•S (T, A), ACM Model Curriculum for K–12 Computer Science, ALA Library Standards, and other standards that affect learning. 4. Develop visual alignment to Common Core Standards. 5. Develop visual to show alignment to NETP. 6. Reauthorize ESEA (when complete).	At least four groups will include CT in their messages and discussion of possible policies to integrate CT into instructional practice will increase.	SETDA, P21, ISTE, Intel Teach, DARPA CS-STEM initiative	State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD
1. CT strategies are part of the Common Core assessment program. 2. CT strategies are embedded within the reauthorized ESEA. 3. States are discussing the inclusion of CT strategies.	Reception for including CT in existing policies is positive. Parties provide feedback regarding inclusion of CT in policies for learning and teaching. CT is considered for inclusion in math and ELA assessments.	CSTA, ISTE, SETDA, CoSN, DARPA CS-STEM initiative	Federal-Level Policy Makers (Department of Education)
			Students
1. Develop resources that address the concerns of parents. 2. Make information on CT widely accessible to parents through school dissemination channels. 3. Make information on CT widely accessible through informal education programs (such as school clubs and student activity groups).	Survey parents in test groups to determine effectiveness of message delivery as well as depth of dissemination.		Parents

Implementation Strategies Guide

Models for changing practice and minds

Short-Term (Year 1)

Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
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Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 1)	Activities (Year 1)
School Boards	Provide ways for school board leaders to understand how supporting CT will address the outcomes they believe are important to their students.	1. Develop school board–focused resources, in easily understood language, that explain CT as a critical skill. 2. Identify individuals and groups to which we will distribute the resources.
General Public	Build a more extensive (informed) community that includes organizations that are already active on state standards.	1. Engage national and local Chamber of Commerce groups in dialogue about CT and its potential for workforce development. 2. Build a knowledge base and collaborative relationships with regional workforce development groups. Create public service announcements (PSAs) that focus on a consistent CT message, and begin airing at the same time across the United States.
Media/Publications	Increase media knowledge of CT and its importance.	Write articles about this workshop and its outcomes. Identify online, printed, and other media opportunities from organizations in non-CS disciplines and build relationships with those organizations. Build relationships with national media organizations. NOTE: These activities are priorities and need to be completed before most other activities.
Schools of Education	Make deans and faculties of education colleges aware of the importance of K–12 students being able to think in CT terms.	1. Bring together the deans of top teacher education schools to make them aware of CT and its role in producing well-educated students. 2. Have sessions at national conferences for coed faculty on CT ideas (e.g., AERA).
Industry	Create and disseminate a strong business case to draw industry into partnerships in support of the efforts to embed CT in K–12.	1. Develop and disseminate industry-focused resources that link CT concepts and capabilities to workplace needs and global competitiveness. 2. Target industry representatives who are likely to be early supporters of K–12 CT efforts. 3. Capitalize on key reports that focus on national competitiveness and CT concepts and capabilities (Rising Above Gathering Storm, PCAST report, Running on Empty Report, etc.) to make the business case.

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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
1. Provide resources that address the concerns of school board members. 2. Make information on CT widely accessible to school boards through school dissemination channels.	Survey school board members in test group to determine effectiveness of message delivery as well as depth of dissemination, with the goal of 10% awareness level of CT as a critical skill.		School Boards
1. Chamber groups will engage the business community in promoting CT as a viable strategy to develop a 21st century workforce and a component of economic development. 2. The general public will become aware of CT and via PSAs will inquire at their local districts if it is being taught.	1. Survey business groups about their knowledge and support of CT in schools as a critical 21st century skill. 2. Poll general public to find out their awareness of CT, with a goal of 30% of public aware of CT.		General Public
Articles will be directed toward different audiences and practitioners (e.g., *L&L* article for educational technology teachers, *Inroads* for college CS faculty, *CSTA Voice* for K–12 CS teachers, other outlets for non-CS and non-ed-tech populations).	At least 10 articles and other forms of media expression on CT will be published.		Media/Publications
1. Land grant deans organization will choose seven or eight deans to develop implementation plans for including CT in teacher education. 2. School of education faculty will become aware of existence and issues in CT and its relation to learning theory.	1. Review plans for proposed changes in teacher education program and the change processes they will use. 2. Observe increase in CT proposals for future conferences.	Association of Colleges of Teacher Education (ACTE)	Schools of Education
Industry will have increased understanding and support of CT concepts and capabilities and their importance in K–12 as well as college and worker preparation.	A small core group of industries will begin to participate in and sponsor CT initiatives.		Industry

Implementation Strategies Guide

Models for changing practice and minds

Mid-Term (Years 2–5)

Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
Map for change agent (depending on sphere of influence, some strategies and activities will apply, while others won't)

Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 2–5)	Activities (Year 2–5)
Teachers	Provide teachers with the PD they need (changing practice).	1. Deliver PD workshops. 2. Explore multiple models for delivering CT PD. 3. Expand and diversify partnerships for PD delivery.
Principals	Provide descriptions of CT terms and outcomes that administrators can understand. Provide materials that will make CT understandable and relevant to school administrators.	1. Principals support CT interdisciplinary working groups in their schools. 2. Do case studies of schools with successful working groups. 3. Facilitate principals sharing successful models across states and nationally. 4. Begin to create ways to support, observe, and evaluate CT in the classroom.
School District Staff	Provide PD opportunities for school leaders and administrators that help them understand CT and what support teachers need to implement CT	1. Provide seminars for school leaders and administrators that focus on the implementation of and potential strategies for CT in the classroom. 2. Secure funding for additional PD in the school district. 3. Build online, face-to-face, and blended PD classes for leaders and teachers to assure the tools, strategies, and resources to successfully implement CT (this should be an OER online course that could be "given away" to districts so that they can use in their LMS to provide an in-depth view of CT and using it within the existing curriculum, to help teachers make the CT connections and deepen understanding).
State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD	Develop a convincing argument for CT as a part of the 21st century skills requirement.	1. Create a variety of written and oral communications and online workshops (e.g., You Tube video(s), email blasts, Twitter messages, webcasts, talking points for bloggers). 2. Disseminate the messages to *Ed Week*, *Teacher Week*, AASA, NSBA, NEA, SETDA, ISTE, CSTA, SIGCSE. 3. Provide sample policies.

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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
1. Make workshops widely accessible for teachers across the United States. 2. Deliver CT PD using multiple delivery models/mechanisms. 3. Increase access to and diversity of PD for practitioners.	1. Twenty-five CT workshops will be offered each year across the United States. 2. Three to five models will be available to deliver CT PD (e.g., face-to-face, online, hybrid, independent study). 3. Sixty CT PD opportunities will be offered nationally across the United States.	CSTA, ISTE, other subject associations	Teachers
1. School-level CT working groups will be in several schools in the state. 2. Several case studies to describe successful models will be developed. 3. Principals will give presentations of successful CT implementation. 4. Principals will know what to look for in classrooms (students using CT to solve problems).	1. School-level CT working groups will be implemented in 30% of schools in the state. 2. Case studies will lead to at least six successful models. 3. Principals will give numerous (20+) presentations, publications, or webinars of successful CT implementations. 4. Principals will include CT in observations in 25% of schools in United States.		Principals
1. There will be active participation in seminars and planning for CT implementation. 2. Sustained funding will provide CT implementation with fidelity. 3. Staff will participate in various PD opportunities for CT implementation. 4. OER course will lead to onsistency of knowledge and adoption throughout the United States.	1. At least 30% of schools will participate in CT PD opportunities. 2. Adequate funding will allow at least 30% of schools to participate in CT implementation. 3. Fifty percent will participate in CT PD opportunities. 4. Twenty-five percent of U.S. districts will use OER CT online course to help teachers understand CT and find ways to naturally add to their teaching.		School District Staff
1. Multiple groups will use CT messages. 2. Preliminary work on CT policy begins.	Initial policies will be in place or proposed policies will be waiting for approval in 50% of schools.		State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD

Implementation Strategies Guide

Models for changing practice and minds

Mid-Term (Years 2–5)

Stakeholder Groups:
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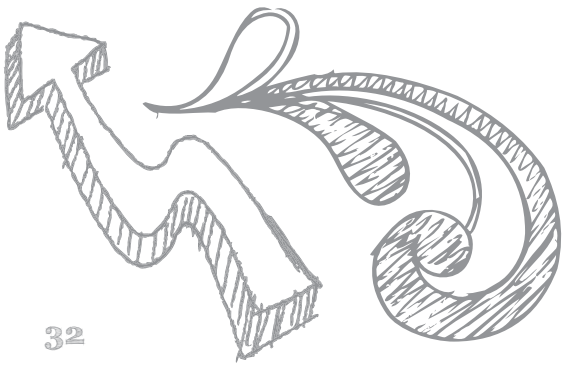
Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 2–5)	Activities (Year 2–5)
Federal-Level Policy Makers (Department of Education)	Look for ways to attach CT to existing policies (look for how to modify existing policies rather than than focusing on creating new policies/ legislations).	1. Continue to work through the U.S. Department of Education (DOE), state departments of education, and other organizations to further define and develop strategies to include CT in state standards and common assessment.
Students	Actively engage students in the discussion/activities to support CT.	Provide websites for independent student activities (self-guided, fun, non-teacher-directed).
Parents	Encourage parents to become advocates for inclusion of CT content in schools.	1. Broadly disseminate the resource(s) to PTAs and other school support groups. 2. Broadly disseminate resource(s) to informal education groups (such as school clubs and student activity groups).
School Boards	Provide ways for school board leaders to understand how supporting CT will address the outcomes that they believe are important to their students.	1. Broadly disseminate school board–focused resources. 2. Build relationships with individuals and groups to which we will distribute the resources.
General Public	Build a more extensive (informed) community that includes organizations that are already active on state standards.	Leverage local and state business groups and networks to advocate at the local, state, and national levels for the inclusion of CT as an integral strategy for preparing students for a 21st century workforce.
Media/Publications	Develop a concise media message about the importance of CT in education. Increase media knowledge of CT and its importance.	Leverage relationships with national educational media and general media at the regional and national level to generate articles about exemplary efforts to embed CT concepts and skills across the curriculum. This includes online and print media.



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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
State departments of education will establish committees to further develop strategies to include CT in state standards and assessments	1. Disseminate policies that reflect CT and instructional strategies needed in 50% of states. 2. U.S. DOE will include CT strategies in federal grant programs. 3. At least two CT concepts will be in the math and ELA common assessment.		Federal-Level Policy Makers (Department of Education)
			Students
1. School support groups begin to support CT-related curricular efforts in their schools 2. In locales where both school support and student activity groups have been reached, the activity groups reinforce the message with regard to the importance of CT concepts and skills	1. Survey results will show that 30% of contacted school support groups are taking some positive steps in their schools to support CT. 2. Seventy percent of contacted activity groups will report successful dissemination of CT resources to parents.	PIA	Parents
1. School boards in several states begin to support CT-related curricular efforts in their schools 2. In districts both school support and student activity groups have been reached; the activity groups reinforce the message with regard to the importance of CT concepts and skills	Survey results will show that 30% of contacted school board members are taking some positive steps in their districts or states to support CT.		School Boards
Local, state, and national entities begin to integrate CT into K–12 curriculum and standards	A scan of state standards and curriclum frameworks will indicate that 30% of states have embedded CT strategies into the state curriculum.		General Public
Articles will be directed toward the general public and the business community to build understanding of CT and its relationship to issues of careers preparation and national competitiveness	At least 75–100 articles and other forms of media expression will be “published” in educational and general media. These will vary in length, and some will be published in multiple venues, increasing the reach and impact.		Media/Publications

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Models for changing practice and minds

Mid-Term (Years 2–5)

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Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Short-Term Strategies (Year 2–5)	Activities (Year 2–5)
Schools of Education	Implement CT experiences into teacher education and disseminate to other schools of education.	1. Incorporate CT experiences into teacher ed classes. 2. Schools of education develop and field test assessments for CT. 3. Schools of education influence adoption of CT standards in national accreditation formats and state program approval formats.
Industry	Facilitate school/industry partnerships that will help district school leaders and administrators understand that CT concepts and capabilities are an essential element of strong workplace preparation.	1. Industry sponsors exhibitions or events (e.g., National Lab Day) where students showcase computational project/artifacts and the skills they use to develop their artifacts/solutions. 2. Industry partners with schools and districts to establish authentic CT projects and internships. 3. Industry begins to provide funding for the development and dissemination of CT resources for teachers and students.

Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
1. Teachers understand and know how to apply CT learning in K–12 schools. 2. Influence states and government to adopt key CT assessments in standards. 3. Standards become part of national and state accreditation.	1. School of education faculties and K–12 teachers evaluate their students on CT knowledge and applications. 2. States and federal government will have 100% adoption of CT assessments. 3. All states have CT accreditation standards.		Schools of Education
1. Industry develops a greater understanding of students' capabilities and the application of CT concepts and capabilities to industry concerns. 2. Other stakeholders develop a greater understanding of the importance of CT to industry, and therefore their children's future. 3. Industry financially supports national, state, and local CT initiatives in schools and PD for teachers.	1. Two high-level spokespeople from industry make public statements supporting CT in schools. A small group of champions comes forward from industry and begins to organize support for embedding CT in K–12. 2. Industry begins to fund CT initiatives in schools and incentive programs to support students and teachers learning.		Industry

Implementation Strategies Guide

Models for changing practice and minds

Long-Term (Years 6–10)

Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
Map for change agent (depending on sphere of influence, some strategies and activities will apply, while others won't)

Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Long-Term Strategies (Years 6–10)	Long-Term Activities (Years 6–10)
Teachers	Provide teachers with the PD they need (changing practice).	1. Acquire adequate funding to sustain ongoing PD for teachers to include CT into teaching/learning. 2. Update existing CT PD workshops and courses to reflect new ideas and innovations.
Principals	Look for ways to attach CT to existing or new state (and federal) policies.	Lobby through principal associations and interest groups to effect policy change.
School District Staff	Provide PD opportunities for school leaders and administrators that help them understand CT and what support teachers need to implement CT.	Ongoing and consistent best practice sharing and outreach of successful CT practices and implementation plans.
State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD	Develop a convincing argument for CT as a part of the 21st century skills requirement.	1. Provide ongoing refreshed CT examples and alignment for standards. 2. Review and update CT policies annually.
Federal-Level Policy Makers (Deptartment of Education)	Look for ways to attach CT to existing policies (look for how to modify existing policies rather than than focusing on creating new policies/ legislations).	Develop the policies necessary to move CT into core curriculum and assessment.
Students	Actively engage students in the discussion/activities to support CT.	

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Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
Teachers knowledge base relative to CT inclusion and instruction will be enhanced and increased.	Students will use CT strategies to be successful in the the workplace and in all disciplines in college.	CSTA, ISTE, other subject associations	Teachers
CT will be incorporated in state and federal policies.	Fifty states will incorporate CT into state policy.		Principals
Knowledge and practice of CT strategies in classrooms will be ongoing and consistent.	Data between schools that have widely implemented CT and student performance using multiple measures of assessment over time will correlate.	PIA	School District Staff
CT will be a regular part of the curriculum through policy at all ed levels.	One hundred percent of U.S. states will include CT teaching and learning approaches as a method for solving real-world problems and preparing students to meet or exceed the expectations of business and industry and college readiness (a.k.a. 21st century skills).		State-Level Ed Policy Makers Legislators and School Board Members, Educational Associations: Admin, Teachers, Ed Tech, Curriculum, PD
CT will be a part of all curriculum standards and assessments and is in regular use across the U.S.	Fifty percent of students will affect the world by solving unique problems applying CT strategies.		Federal-Level Policy Makers (Department of Education)
			Students

Implementation Strategies Guide

Models for changing practice and minds

Long-Term (Years 6–10)

Stakeholder Groups:
Intended audience for change-agent strategies

Strategies & Activities:
Map for change agent (depending on sphere of influence, some strategies and activities will apply, while others won't)

Outcomes/Impact & Evaluation:
Goals for strategies that help build momentum for systemic change

Suggested Partner Organizations:
National groups that have a mission, membership, or focus that would help achieve the goals

Stakeholder Groups	Long-Term Strategies (Years 6–10)	Long-Term Activities (Years 6–10)
Parents	Make parents change agents in districts and states where there has not yet been sufficient adoption of CT concepts and capabilities.	Provide two kinds of resources to parents: (a) the already existing resources (developed during prior years) about CT concepts and capabilities and (b) information about the process for bringing about change at the local, regional, state, and federal levels (with particular focus on local change).
School Boards	Provide ways for school board leaders to understand how supporting CT will address the outcomes that they believe are important to their students.	Provide two kinds of resources to school board members (a) already existing resources (developed during prior years) about CT concepts and capabilities and (b) information about the process for bringing about change at the local, regional, state, and federal levels (with particular focus on local change).
General Public	Build a more extensive (informed) community that includes organizations that are already active on state standards.	Continue to build capacity by leveraging national, local, and state business groups and networks to advocate at all levels for the inclusion of CT as an integral strategy for preparing students for a 21st century workforce.
Media/Publications	Increase media knowledge of CT and its importance.	Leverage relationships with national educational media and general media at the regional and national level to highlight the impact on student learning and student performance.
Schools of Education	K–12 schools will have cadres of CT-trained teachers who are the teacher leaders.	CT-aware/trained student teachers and teachers will form CT learning communities and collaborations.
Industry	Industry will be deeply committed to and supportive of CT in schools.	1. Industry will provide increased support for national projects and competitions focused on interdisciplinary applications of CT. 2. Industry will partner with schools and districts to establish real-world CT projects and internships. 3. Industry will increase funding for PD events for teachers.

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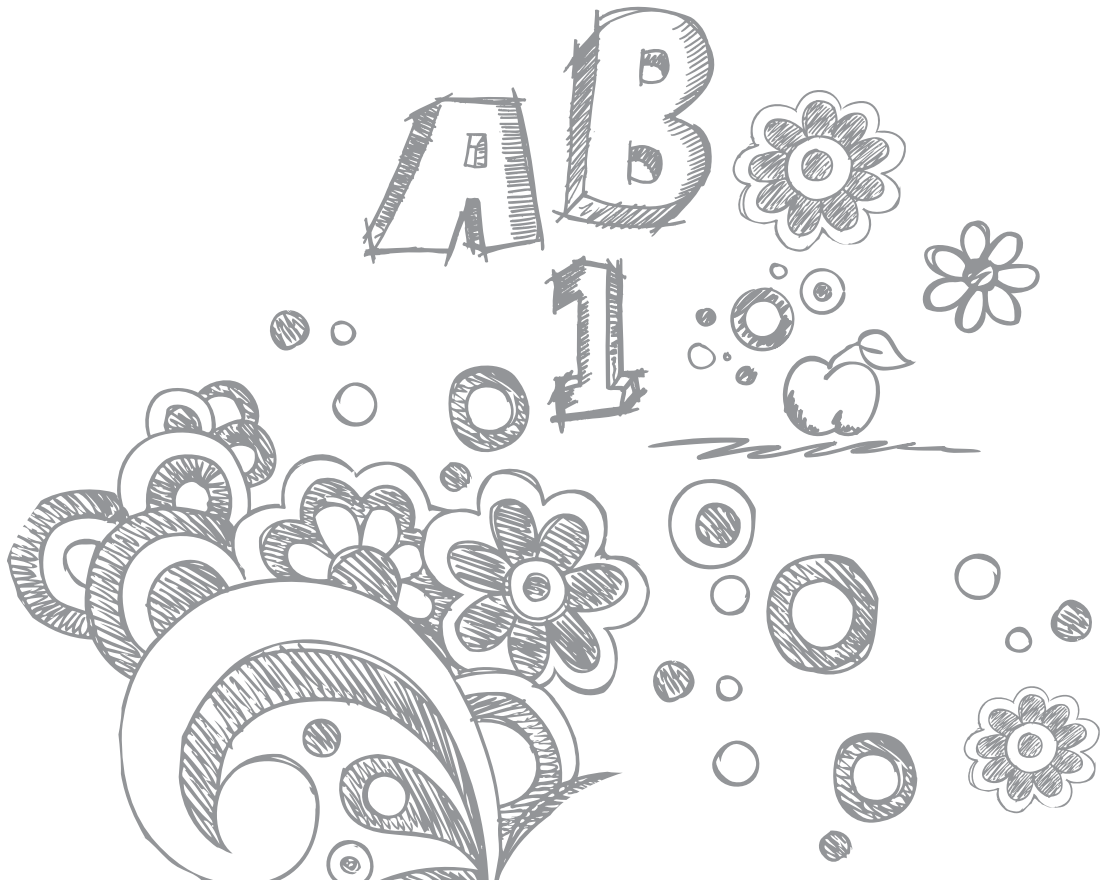
Outcomes/Impact	Evaluation	Suggested Partner Organizations	Stakeholder Groups
In school systems that are late adopters, a second wave of engaged parents and school support groups will begin to advocate for local inclusion of CT concepts.	Survey results will show that 60% of contacted school support groups are taking some positive steps in their schools to support CT.		Parents
In school districts/states that are late adopters, a second wave of engaged school board members will begin to advocate for local inclusion of CT concepts.	Survey results will show that 60% of contacted school board members are taking some positive steps in their districts or states to support CT.		School Boards
Local, state, and national entities include CT in all K–12 curriculum and standards.	A scan of state standards and curriclum frameworks will indicate that 80% of states have embedded CT strategies into the state curriculum.		General Public
Articles and other forms of delivery will be directed toward the general public to increase awareness of the impact of CT on education and its relationship to issues of career preparation and national competitiveness.	Material will be broadly distributed across a range of media (recognizing that we cannot predict in 2011 exactly what "media" will look like in 2016).		Media/Publications
Teachers influence persistence of CT inclusion in K–12 education.	At least 100% more graduating HS students will choose "tech" (computing-related, etc.) college majors than in 2011.		Schools of Education
1. Industry will develop a greater understanding of students' capabilities and the application of CT skills to industry concerns. Other stakeholders develop a greater understanding of the importance of CT skills to industry and their childrens' future. 2. Industry financially supports national, state, and local CT initiatives in schools.	1. Five high-level spokespeople from industry will make public statements support CT in schools. A large group of champions will come forward from industry and begin to organize support for embedding CT in K–12. 2. Industry will provide CT initiatives in schools and incentive programs to support student learning on a large scale.		Industry


Teach

5 Talking Points for Stakeholder Groups

Each stakeholder group will consider the value of CT from a unique perspective. It is important, as a change agent, to articulate CT within different perspectives.

A group of practitioners and CT leaders developed the following talking points to provide a foundation for making the case for CT to various stakeholder groups.



Why Should These Stakeholder Groups Care About CT

Teachers

- The reason we are here is to help students realize that computers are available to solve your problems and extend your thinking, and that every student has the capabilities to build tools on computers for that purpose.
- When students understand terms and concepts from computer science, they are better prepared for an increasingly technological world and workforce.
- CT is asking, "How can we use technology to extend what we're doing to big (but similar) data sets?"
- Ten years from now, much of what we've taught our students will be obsolete, but the thought processes will still be relevant. The thought processes that parallel a computer's processing enables students to be lifelong learners and incorporate computing tools regardless of how the tools change.

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Talking Points for Stakeholder Groups

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District Leaders and Principals

- CT prepares students for global competitiveness (Wagner).
- Raise the level of achievement for all students, especially those who are traditionally marginalized (Marzano).
- CT is a critical enabling skill.
- CT blends academic life with the real world.
- CT prepares students for their future, not our past.
- CT prepares students for college and career.
- Implementation may not require a huge infusion of money.
- PD can cross all content areas.

Statements:

1. CT is a key interdisciplinary component in preparing students to be successful in a globally competitive workforce. If students are going to be successful in postsecondary education and compete for and win jobs, they must have the critical thinking and problem-solving skills that CT provides (Wagner).
2. CT is a critical enabling skill that will raise the level of achievement for all students, especially those who are traditionally marginalized. Successful students must be able to connect and apply academic content to real-world situations, and CT provides a framework for that learning connection (Marzano).
3. CT is already a learning strategy in many classrooms and lessons today. However, we need to more closely examine the uses of CT and identify and expand student and teacher awareness about its impact and power. This means we probably do not have to expend large sums of money. We just need to recognize and align CT strategies to current practices.

State-Level Leaders

- CT creates college- and career-ready students.
  - Students will be prepared to be successful in a highly skilled 21st century workforce.
  - Students will be prepared for further study in STEM fields.
  - Students will master critical-thinking and problem-solving skills.
- CT will increase the state's competitive advantage.
  - A well-prepared workforce pipeline will increase economic development and make it sustainable.
  - CT fosters innovation.
- CT increases student success and achievement.
  - Innovative learning engages students which reduces the dropout rate and closes the achievement gap.
  - CT skills are learner-focused, authentic, real-world skills.
  - CT engages minority students which will help close the achievement gap.
- We need systematic application of CT practice throughout the PK–12 curriculum.

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Federal-Level Leaders

- CT enables students to use computers to solve real-world problems.
- CT aligns with and connects to existing national standards.
- CT meets the needs of U.S. industries.
- CT enables the United States to be competitive on a global scale, educationally and economically.
- CT is critical for securing the nation's cyberinfrastructure and communications.

Parents

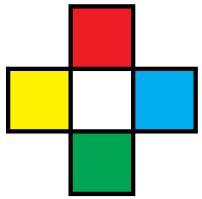
- CT expands children's creative process and their abilities to innovate.
- CT prepares students for success in college.
- CT prepares students to be competitive in a global workforce
- CT prepares students for jobs of the future and access to well-paying jobs today.
- CT reinforces and extends higher-order thinking skills.
- CT helps students develops good habits of mind and teaches them to think logically and creatively.

General Community

- CT increases U.S. competitiveness in STEM.
- CT increases the skills of the workforce.
- CT improves the community because students can apply CT skills to solve community issues.
- CT leads to a better-prepared local workforce (business community).
- CT raises the competitive bar for the whole community.
- Several government and private organizations believe that CT is a critical skill for youth.
- CT prepares students to be better-informed citizens.

Industry Stakeholders

- CT creates a well-prepared workforce. Workers who have higher-level CT skills are flexible, adaptable to change, and more easily trainable.
- CT develops thinkers who are tool users and tool builders, who can use the power of technology and cybertechnology to create new products/services, and who solve problems for organizations.
- CT improves the ability of workers to solve problems in realtime, creating efficiencies in the workforce and processes.
- CT cultivates a disposition of persistence (sticking to the problem and resolving it) among workers.
- CT empowers innovation and creativity.
- CT is critical to maintaining or attaining a competitive edge in the workforce.
- CT encourages risk-taking and risk assessment/entrepreneurial skills.
- CT skills are timeless and enable workers to function competently and efficiently even though the tools they use will change.



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This material is based on work supported by the National Science Foundation under Grant No. CNS-1030054.