Critical thinking

In critical thinking, students apply what they know to novel situations, formulate ideas, or create solutions to open-ended problems. They don't need to create knowledge or insights that are new to the world, but they should create knowledge or insights that are new to them. To challenge students this way, tasks should require conceptual understanding and creative exploration, and avoid known formulas or procedures. For critical thinking to be present, students must do one or more of the five higher order thinking activities below. The activities don't need an order or a hierarchy; any one is sufficient to demonstrate the use of critical thinking.

	Definition	Example
Analysis	Breaking material or concepts into parts to determine how they relate to each other or to examine an overall structure	Investigating an era in history to identify the features that were most influential on the economy at that time
Interpretation	Bringing out the deeper meaning of a text, observation, or artifact through reasoning	Studying the behaviors of animals seen near the school to formulate hypotheses about why they act in different ways
Synthesis	Combining multiple ideas to create a new, more comprehensive understanding	Consulting multiple sources and using the ideas they contain to generate themes for a position paper or classroom presentation
Evaluation	Making judgments based on criteria and standards to determine the value of ideas, data, or claims	Reading journalistic descriptions related to a scientific controversy to judge their accuracy and select resources to use
Solution generation	Using sound reasoning to create ideas that solve a problem or address a set of requirements or constraints	Using geometry to design milk carton shapes to make the transportation of milk most efficient

Critical thinking

In critical thinking, students apply what they know to novel situations, formulate ideas, or create solutions to open-ended problems. They don't need to create knowledge or insights that are new to the world, but they should create knowledge or insights that are new to them. To challenge students this way, tasks should require conceptual understanding and creative exploration, and avoid known formulas or procedures. For critical thinking to be present, students must do one or more of the five higher order thinking activities below. The activities don't need an order or a hierarchy; any one is sufficient to demonstrate the use of critical thinking.

Before	After	
During a physics field trip to an amusement park, students use the Camera app to record their activities.	During a physics field trip to an amusement park, students use the Camera app to **capture repeating patterns with time-lapse videos and rapid transitions with slo-mo. They then analyze the patterns of motion they find in their videos.**	Students are analyzing the motion they see in their data, using time-lapse and slow-motion videos to capture phenomena in ways that are conducive to analysis.
In small groups, students use iPad and the News app to review a news article about the challenges of providing medical translation services to patients who speak English as a second language. Students write a summary that describes an approach they read about.	In small groups, students use iPad and the News app to review multiple news articles about the challenges of providing medical translation services to patients who speak English as a second language. **Students compare and contrast different strategies and policies around medical translation, and come up with a proposal for new services.**	This task requires synthesis and analysis, instead of simply repeating information.
Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. Afterward, students use the given equation to plug in various sets of coordinate pairs and record the value for m in each of the resulting equations.	Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. **Based on their observations, students generate hypotheses for what the *m* and the *b* mean in the equation.**	This task requires students to analyze what they're observing and to interpret the meaning of various components of the equation for a line.

Main activity

The main activity is the most significant focus of a student's time and effort during a lesson. It's typically an important aspect of how students are assessed. The opportunity for critical thinking is stronger if students are spending the majority of their time on these activities rather than, for example, following a series of steps the teacher has given and then spending the last few minutes of class analyzing the results.

Before	After	
In small groups, students use iPad and the News app to review multiple news articles about the challenges of providing medical translation services to patients who speak English as a second language. Students create a website with a list of the resources they consulted. Students spend a short time writing an introductory paragraph for the website, explaining the key issues in the field of medical translation.	In small groups, students use iPad and the News app to review multiple news articles about the challenges of providing medical translation services to patients who speak English as a second language. **Students compare and contrast different strategies and policies around medical translation and come up with a proposal for new services.**	The main focus of students' time is synthesis and analysis.
Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. Based on their observations, students spend a few minutes generating hypotheses for what the *m* and the *b* mean in the equation. Students then spend the rest of the class period completing a digital worksheet that asks them to enter coordinates into the equation for the slope of a line to determine the slope.	Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. Based on their observations, students **generate hypotheses for what the *m* and the *b* mean in the equation. Students then work together in small groups to share their hypotheses, test each other's predictions, revise and refine their thinking, and present their understanding of linear equations to the class, using evidence to back up their thinking.**	Each component of this task requires students to analyze, synthesize, and interpret information.

Intellectual independence

Intellectual independence varies depending on the degree of scaffolding provided in a lesson. At lower levels, the teacher or the app might guide the student through an analysis process that breaks the challenge down step by step. Even though each step might require some degree of critical thinking, executing the series of steps invariably leads the student to an answer for the overall problem. At greater levels of intellectual independence, students are given less scaffolding and asked to independently work through challenges, and even confusion, to generate conclusions, new understandings, or solutions.

Before	After	
Students are taught a set of coding commands and solve a puzzle in the Swift Playgrounds app.	Students are taught a set of coding commands and are asked to **find multiple combinations of the commands** that solve a puzzle in the Swift Playgrounds app.	Students are generating solutions and must solve the puzzle with limited scaffolding.
In small groups, students use their iPad and the News app to review multiple news articles about the challenges of providing medical translation services to patients who speak English as a second language. The teacher gives students a worksheet with a table that prompts them to list beneficial practices and their value, and suboptimal practices and their challenges. From there, students compile a set of best practices.	In small groups, students use their iPad and the News app to review multiple news articles about the challenges of providing medical translation services to patients who speak English as a second language. **Students compare and contrast different strategies and policies around medical translation and come up with a best practice approach. Students do this work without substantial scaffolding from the teacher.**	The main focus of students' time is synthesis and analysis, and students are addressing the challenge independent of the teacher.
Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. The presentation asks students a series of questions that lead them to generate a hypothesis for what the *m* and the *b* mean in the equation. Students then work together in small groups, following a series of defined steps to share and test their hypotheses and decide which one to adopt.	Students who haven't yet learned line equations review a Keynote presentation that uses a Magic Move animation to show a series of lines and their equations *(y = mx + b)*, chosen specifically to draw attention to important math concepts. **Based on their observations**, students are asked to generate hypotheses for what the *m* and the *b* mean in the equations. Students then work together in small groups **to see if they can prove their hypotheses.**	Each component of this task requires students to analyze, synthesize, and interpret information; students don't have substantial scaffolding from the teacher.