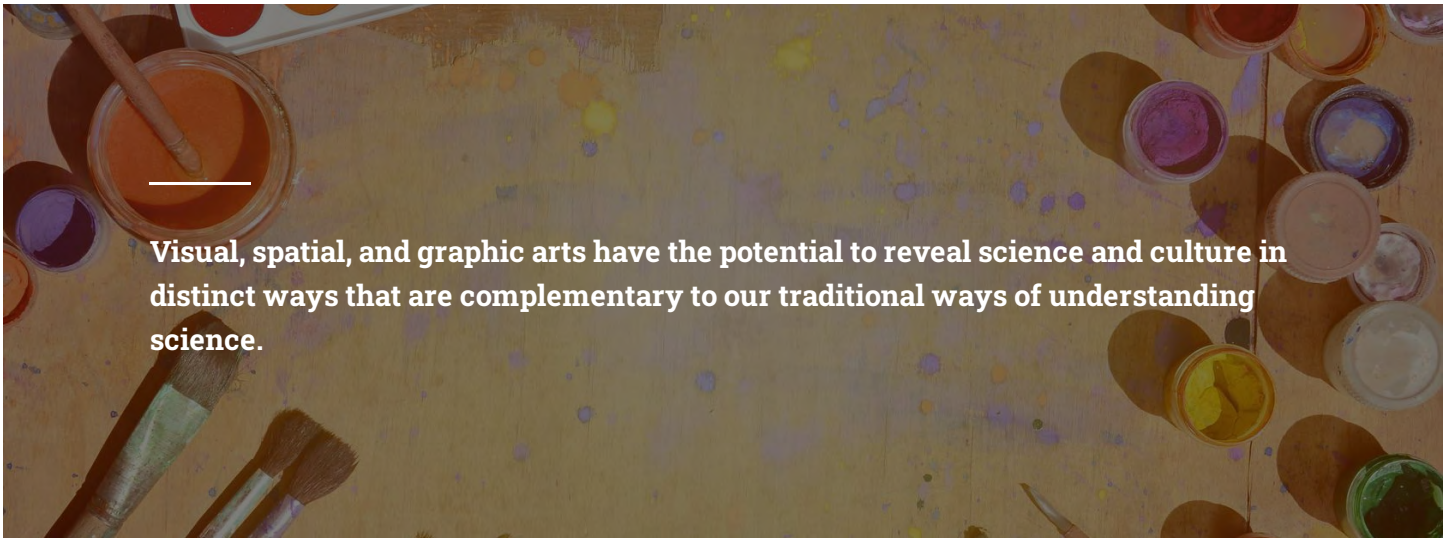
Art, Music, and Theater

Integration of the Arts

For students who are involved in either curricular or extra-curricular offerings, there are many activities that can integrate previously learned skills involving computational science. This section focuses on visual art, theater, and music.

Visual Art

When we show up to the present moment with all of our senses, we invite the world to fill us with joy. The pains of the past are behind us. The future has yet to unfold. But the now is full of beauty simply waiting for our attention.



Computational Thinking in the Arts Video

Art is such a broad field that requires imagination and originality. When looking at art, most people notice patterns, colors, and textures. Even looking at art and analyzing it promotes computational thinking. Computational thinking integrates perfectly into visual art because of 4 main components: algorithmic design, decomposition, pattern recognition, and abstraction.

By turning existing artwork into an abstract piece, students get to practice pattern recognition and abstraction by pulling out details and noticing patterns in the existing art piece. They also practice decomposition by breaking down the original art into components to create a theme or sense of cohesiveness in their abstract art work

Computational Thinking in the Arts-external link-YouTube

CodeNC - Computational Thinking in the Arts

Art is such a broad field that requires imagination and originality. When looking at art, most people notice patterns, colors, and textures. Even looking at ...

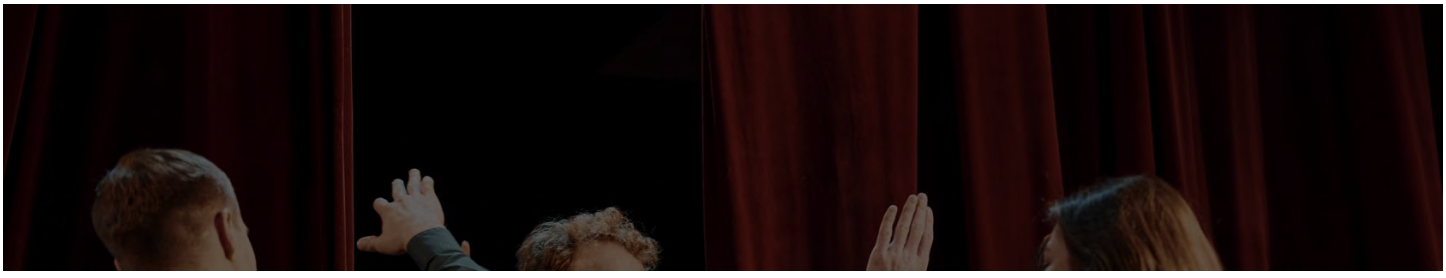
VIEW ON YOUTUBE >

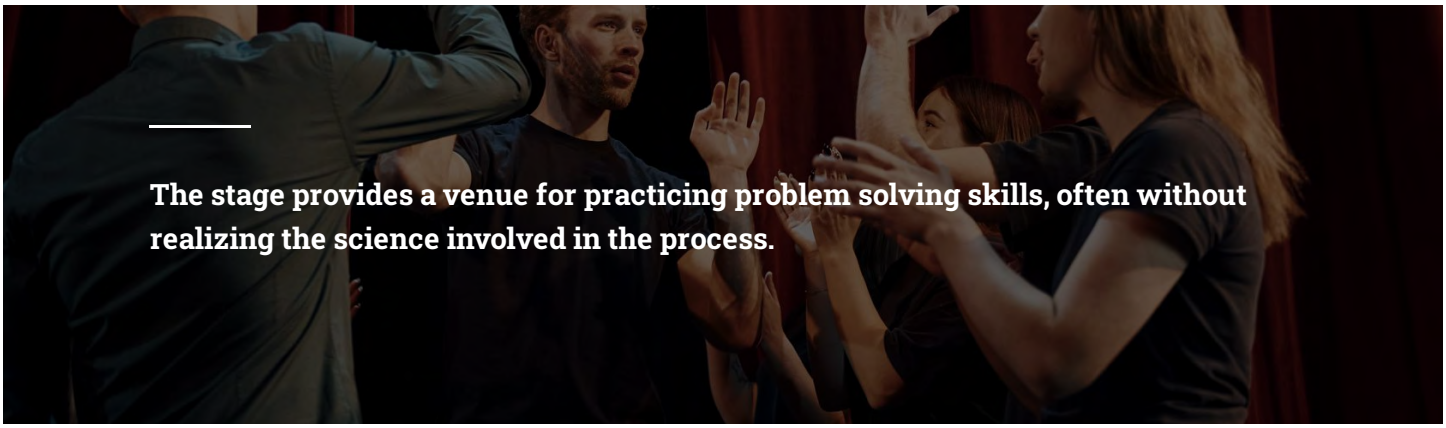
Manipulative visual arts such as sketching, photography, and origami have been proposed as effective cross-training for spatial intelligence, which is a crucial attribute of successful STEM professionals.

Theater

The stage offers many opportunities for integrating the four core principles of Computational Science, often in very unexpected ways!

- Have students suggest a hypothesis for one problem/struggle presented in the plot.
- Research the problem and see if they can prove their hypothesis.
- This requires a diagram showing connections, and models showing collected data.
- Have students create an infographic on the play/musical they are studying, finding connections to real-world data. (Learning Outcomes: DA.DCS.9-12.F.a)





Theater Lesson Plan

Explaining a complex story like Shakespeare's Romeo and Juliet in under 3 minutes can be tough. This video uses the power of visual explanations to tell and show the story, the plot, and the relationship between the characters. (Learning Outcomes: DA.IM.7.a)

Romeo & Juliet-explained visually in under 3 minutes-external link-YouTube

Romeo and Juliet - explained visually in under 3 minutes

Explaining a complex story like Shakespeare's Romeo and Juliet in under 3 minutes can be tough. I'm using the power of visual explanations to not only tell b...

VIEW ON YOUTUBE >

Music

The opportunities for combining music and computational thinking are endless, from the Fibonacci sequence to graphing pitch, to actual personal performances, there are many ways for students to combine this topical integration.

Music Lesson Planning

1

Data Scraping with Python: Today artists use data to plan tours where they can meet the widest audience of fans. They use it to determine what songs are streaming and to find common patterns between the songs. An example of scraping data from the web with Python for a high school programming class can be found here. (Learning Outcomes: DA.DCS.9-12.A.a and DA.DCS.9-12.F.a)

Analyzing the most popular artists using data science

2

Have students analyze patterns in various styles or genres of music by analyzing the notes and tempo. (Learning Outcomes: DA.DCS.9-12.F.a)

Patterns in Music and Math

3

Use jazz music to discover the mathematical formula to discover the formula to number of possible rhythmic calculations. (Learning Outcomes: DA.DCS.9-12.F.a)

Jazz and Math: Improvisation Permutations

4

This music lesson plan incorporates math that can then be graphed or modeled. (Learning Outcomes: ATP.VDR.8.a)

Mozart: Mathematics in Music

For every 16 bars of music in this piece, Mozart offers two choices for the eighth and sixteenth bars and eleven choices for every other bar. Any combination of choices results in a lovely minuet conforming to harmonic and compositional requirements for the Viennese minuets of his time. Mozart suggests the use of a pair of dice to make the choices: throw the dice and take the sum of the resulting numbers as the choice. More melodies can be made from this piece than there are people on Earth today!

5

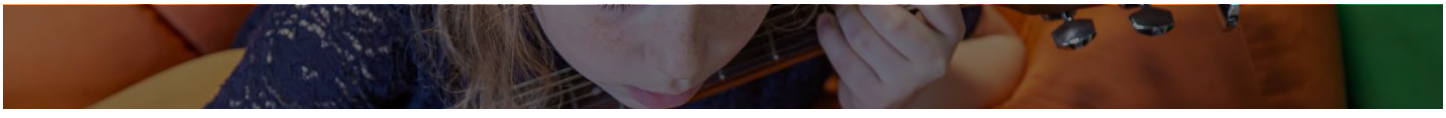
This lesson plan is to have students graph the pitch of various instruments. They could also graph the highest and lowest pitches students can sing, to see patterns in the classroom, in order to organize for a choir. (Learning Outcomes: DA.VC.7.a and DA.VC.8.a)

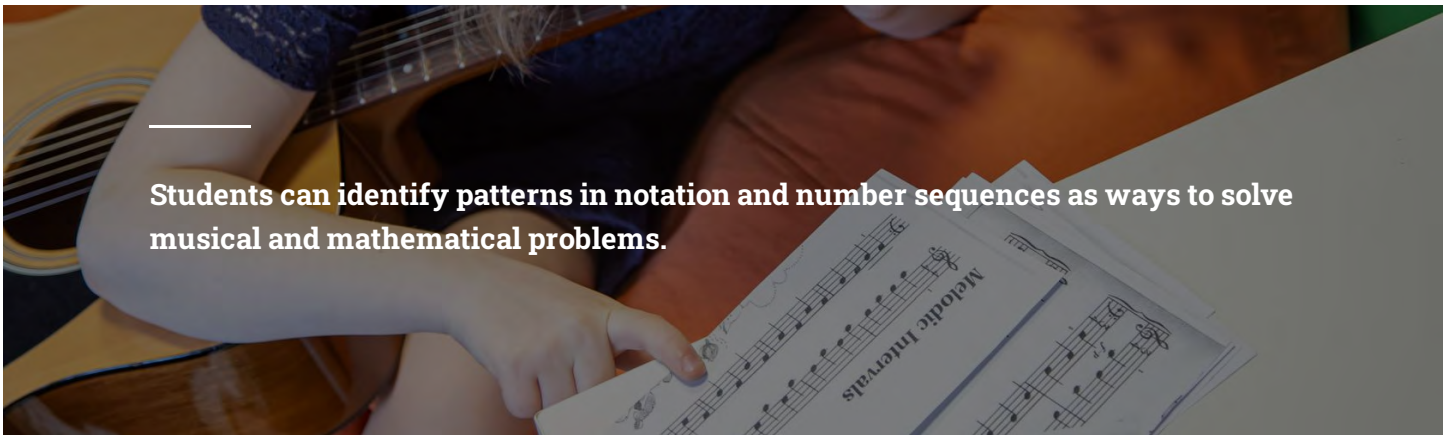
Graphing Pitch

6

Music with the Fibonacci sequence: Locating patterns and Fibonacci numbers with music. (Learning Outcomes: DA.VC.6.a)

Math and Music: Fibonacci Sequence





Students can identify patterns in notation and number sequences as ways to solve musical and mathematical problems.

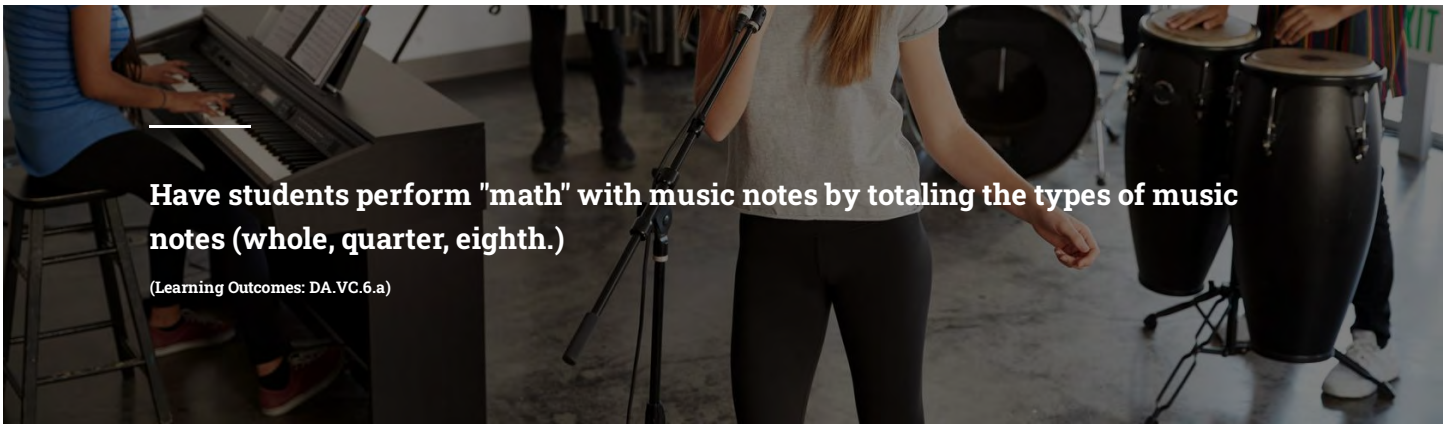
Using "The Golden Ratio" in Music Education

The Golden Ration and Fibonacci in Music-external link-YouTube

The Golden Ratio and Fibonacci in Music (feat. It's Okay To Be Smart)

PBS Member Stations rely on viewers like you. To support your local station, go to: http://to.pbs.org/DonateSoundField↓ More info below ↓The golden ratio is ...

VIEW ON YOUTUBE >



Visual Art, Theater, and Music Resources

Video Links

- 5 Ways to Add Dance and Theater to the Classroom
- Arts Integration with Oil Pastels
- Making Thinking Visible by Creating a Soundtrack
- The Value of the Arts

Journal Articles

- Bequette JW, Bequette MB. A place for ART and DESIGN education in the STEM conversation. Art Educ. 2012;March:40–47.
- Robelen E. STEAM: experts make the case for adding arts to STEM. Educ Week. 2011;31(13):8.
- Newcombe NS. Picture this: increasing math and science learning by improving spatial thinking. Am Educ. 2010;13(Summer):29–43.

Downloadable Learning Outcome and Standards Table

PDF **Art_Music_Theater (AYA_Multi-age).pdf**
73.8 KB

Sports

Physical Activity and Computational Thinking

Given the large numbers of students who participate in sports, whether through their school or independently, for competition or just for fun, integrating sports in the curriculum provides a meaningful link to the student, who can relate to what is being explained by thinking about their own activities.

Sport-themed Lesson Plans

1. Hypotheses a new team maneuver. Research playbook moves by your favorite teams. Create one or more new maneuvers and provide data supporting why this would work for your team.(Learning Outcomes: DA.IM.7.a)

2. Create a recipe that meets NASA's macronutrient requirements (NASA in-flight macronutrient guidelines have remained at 55% carbohydrate, 30% fat, and 15% protein), (bonus challenge: and can be freeze-dried, or rehydrated). Not a fan of NASA? Many athletes post about their own diets and nutrition plans, investigate the metrics in the same way, and perhaps even see how they could tweak their diet for more success. (Learning Outcomes: ATP.A.9-12.F.a & b)

3. Ask students to determine the fasted evacuation route for a given floor plan. To do this, students will break down the problem by measuring every other student's stride when walking, and then when running, as well as the distance to various exits, and the number of students who can use the exits. Have them determine the average stride for the classroom, then use that to model an efficient evacuation plan for two or more different rooms on the floor plan. (Learning Outcomes: ATP.A.9-12.F.a & b)

Learn Math through Sport

Learn Math through Sport-external link YouTube

Learn Math through sport: 'Shuttle runs' › Division & multiplication PE game

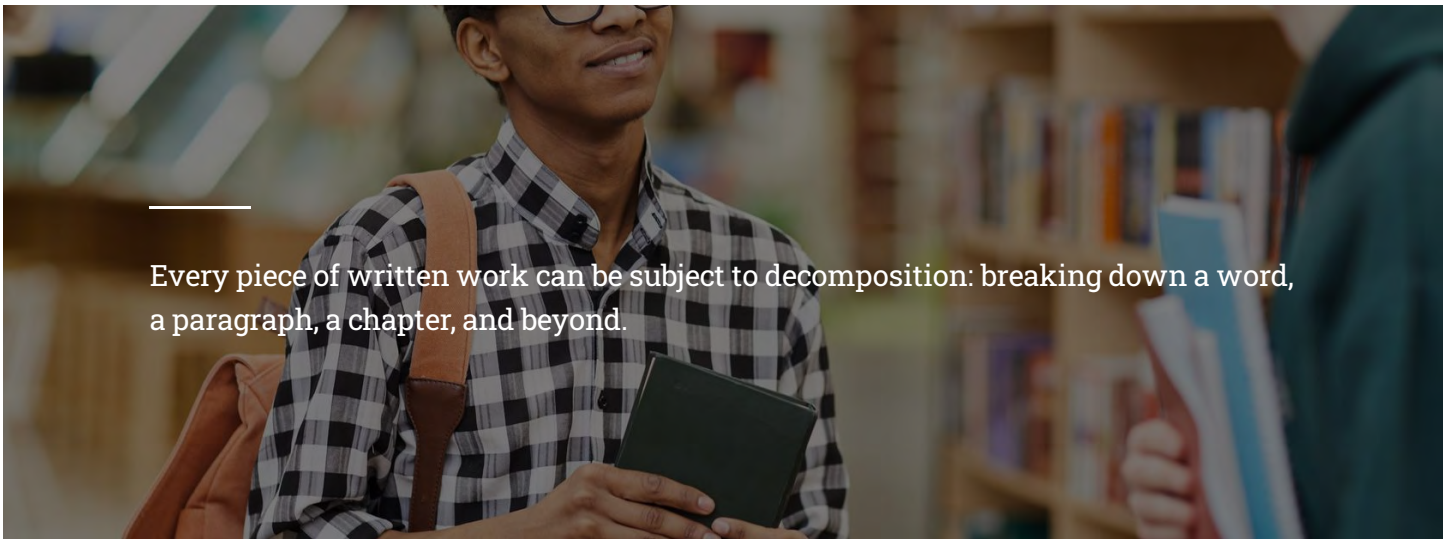
5 unique math-based PE games for grade 3: https://www.teacherspayteachers.com/Product/Learn-Math-through-sport-Grade-3-PE-games-worksheets-for-active-learnin...

VIEW ON YOUTUBE ›

English/British Literature

ELA offers a myriad of ways to apply computational thinking

Literature of any type can be used in the application of the four core principles of computational thinking, the type of reading can be adapted for a specific classroom while the activities and lesson plans work across literary genres and styles.



Using Scratch to Analyze a Textbook

(Learning Outcomes: ATP.M.8.a and ATP.PD.8.a)

Computational Thinking in English-external link-Prezi

Example ELA Activities

1. **Identify helpful and harmful behavioral patterns of a character** in the book being studied. (Learning Outcomes: DA.VC.7.a and ATP.VDR.8.b)
2. **Create an infographic** that tells the story of the book in < 3 minutes. (Learning Outcomes: ATP.M.9-12.F.b)
3. **Study a current event on social media** - what patterns of behavior occur? (Learning Outcomes: DA.VC.7.a and ATP.VDR.8.b)
4. **Decomposition: break it down into smaller parts:** (Learning Outcome: ATP.M.9-12.F.a)
    - analysis of writing extracts
    - breaking words down into syllables
    - analyze and break down sentence structure
5. **Pattern recognition:** looking for similarities and trends within a problem, linguistic analysis, identifying and or representing patterns of a sentence, writing directions, instructions, or stories with branches, developing an outline, using simile and metaphor. (Learning Outcome: ATP.M.9-12.F.a)
6. **Identify patterns** in various types of writing: past, present future tense, persuasion, narration, description, exemplification. (Learning Outcome: DA.VC.8.a)
7. **Abstraction: filter out unnecessary stuff and only pull out the important stuff.** (Learning Outcome: ATP.A.9-12.F.b)
    - Create a timeline of events in a book.
    - Create a flowchart of decisions the protagonist made, and what could have happened if a different choice was made.
    - Dylan-Dylan contest (From Dangerous Minds) have students select a favorite song, then research a book or poem published at least 30 years before the song, that has the same meaning.

8

Implement modeling for storytelling, text analysis:

(Learning Outcomes: ATP.M.9-12.F.b)

- Unified Modeling Language diagram to describe a character, protagonist, or antagonist and their behavior, or hierarchies of characters (people with a subclass of workers, supervisors, parents/children et. al).
- Process flow diagram to identify events in the book or what "could" have happened instead.
- Entity Relationship Diagram (ERD) to describe relationships between objects (people or events).
- Flowchart of activities, questions/decisions, starts and stops in the story.
- Case Study-informatics evaluation of information/events in the text.

Downloadable Learning Outcome and Standards Table

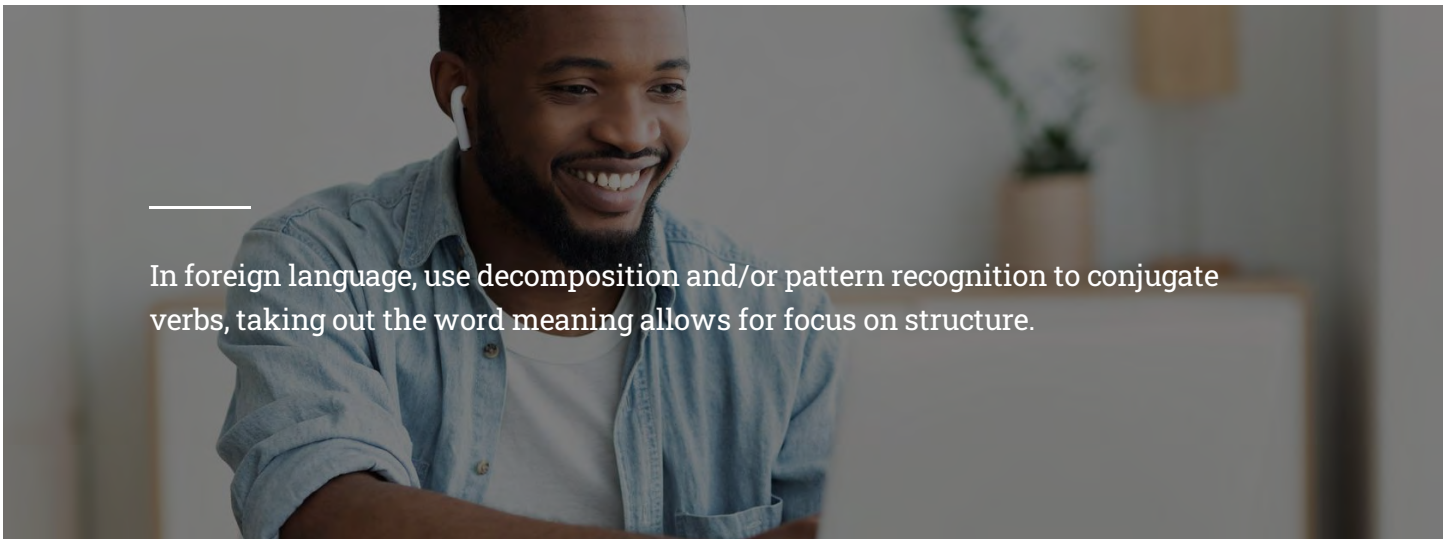
PDF

English_British Lit (AYA_Multi-age).pdf
79.9 KB

Foreign Languages

Foreign Language Acquisition

Learning a foreign language allows the learner to take the context of the words out of the equation and apply all the parts of computational thinking in a new way, relying on visual cues and loops.



Lesson Plan Ideas

1

In foreign language, use decomposition and/or pattern recognition to conjugate verbs for I, you, he/she, we, they, you all/everyone: (ATP.M.8.a)

- Present simple tense
- past perfect (specific events), past imperfect (general events)
- future inflection (will happen) or conditional future/present/past (could/would, will, may)
- conditional future/past (could/would(subjunctive uncertainty/feeling of past, present future (don't think, hoped)
- perfect aspect (has/had, or will have been done)
- progressive action (currently happening) or compound past/present/future
- irregular (doesn't fit the pattern)

2

Pattern recognition for similarity/differences in languages or conjugation. (ATP.M.8.a)

3 **Algorithm development** (ATP.PD.8.a)

- Flowchart to conjugate a regular or irregular verb
- Having students use or develop an algorithm for accomplishing a task (ordering at a restaurant, getting directions, a hearing-impaired person speaking with a hearing person

4 **Abstraction: filter out unnecessary stuff and only pull out the important stuff.** (ATP.M.8.a)

- Create a timeline of events in a book
- Create a flowchart of decisions the protagonist made, and what could have happened if a different choice was made
- Dylan-Dylan contest (From Dangerous Minds) (have students select a favorite song, then research a book or poem published at least 30 years before the song, that has the same meaning. (Learning Outcome: ATP.A.9-12.F.b)

5 **Implement modeling for conversations or foreign text analysis:**

(Learning Outcomes: ATP.M.9-12.F.b)

- Unified Modeling Language diagram to describe a character, protagonist, or antagonist and their behavior, or hierarchies of characters (people with a subclass of workers, supervisors, parents/children et. al)
- Process flow diagram to identify events or what "could" happened instead
- Entity Relationship Diagram (ERD) to describe relationships between objects (people or events)
- Flowchart of activities, questions/decisions, starts and stops in a conversation
- Case Study (informatics evaluation of information/events in a foreign language newspaper)

6 **Code.org examples in a Spanish class**

Students practiced the global competency skills “Investigate the World” and “Recognize Perspectives” by comparing how children in Spain don’t leave out stockings for Santa on Christmas Eve, but instead put out their shoes every Jan. 5 for the three kings to put gifts in. They learned coding by writing algorithms – using direction words like “go forward” and “go left” in Spanish – to solve problems about how to get the three kings to deliver their gifts to Bethlehem and to the different shoes left out for them. (Learning Outcomes: ATP.CS.9-12.F.a)

Source Link: Spanish meets STEAM

Downloadable Learning Outcome and Standards Table

PDF **Foreign Languages (AYA_Multi-age).pdf**
46.8 KB

History/Social Studies/Government

Social Studies

There are four disciplines within the social studies strand: History, Geography, Government, and Economics -- all of which lend themselves to the application of computational thinking.

Lesson Planning

The following is a list of sample lesson plans incorporating social studies standards with computational thinking -- it is often practical to combine ELA standards in order to make the lessons interdisciplinary.

Civil War

- Create a Venn diagram showing the beliefs that the North had, the South had, and what beliefs they shared together: (shared beliefs included basic rights and liberties in the debate over expansion, expansions caused irreconcilable differences, and all states had slavery initially. North used slave labor for industries (eventually abolished), the South used slave labor for, and both believed in indentured servants.(Learning Outcomes: DA.VC.7.a)
- Decompose the factors affecting the availability of resources to the states of the North, and of the South. Conclude what possible mitigations the states could have implemented to prevent adverse effects, and increase positive effects. (Learning Outcomes: DA.IM.7.a, ATP.M.7.a)

Revolution/Founding of United States

- Create a flowchart showing the major decisions/actions of the British Monarchy that caused the states to rebel. The flowchart should showcase what alternatively might have happened if that decision was not made. (Learning Outcomes: ATP.A.7.a)

World War I, II, and Vietnam War

- Collect data on the resources needed to support the war efforts. Compare the price and availability before, during, and after the war using a graph. Draw conclusions on how the war helps or hinders economy. (Learning Outcomes: DA.VC.7.b, DA.VC.8.b)

Miscellaneous

- Research and identify which sorting algorithm (bubble sort or selection sort) would be the fastest for sorting 300 freed prisoners of war by height to different tables for clothing in their size. Is there a better sort? [Edit: both bubble sort and selection sort are terrible sorts, though either would sort 300 values in a very short period of time on modern computers. Insertion sort is likely to be faster, but is a sorting algorithm the right approach for learning in this module?](Learning Outcomes: ATP.CS.7.a, ATP.A.8.a, or DA.DCS.9-12.F.a depending on the level of difficulty of a similar challenge)

- Part two: rewriting the above prompt in a different way, come up with an efficient, systemic way of sorting 300 freed prisoners of war by height to different tables for clothing in their size. Flowchart this method.

Downloadable Learning Outcome and Standards Table

Middle Childhood Resources and Lesson Planning

Middle Childhood Learners

In between PK-3 and AYA (7-12), the middle childhood learner can begin computation using the mathematical and reading skills they have acquired and begin using critical thinking to extrapolate and imagine alternative solutions.

Online Resources

Various Youtube and website links geared toward the middle childhood student.

- JULES Computational Thinking
- BBC Learning: Computers and Algorithms
- HopScotch (ages 10-16)
- Scratch (ages 8-16)
- TinkerCAD (grades 3-8)
- Code.org
- Computer Science Unplugged (ages 5-14, no computer needed)
- CS First

Articles

The following articles provide additional readings focusing on middle childhood, as well as concepts applicable across grade levels.

- Teaching kids Algorithmic Thinking through games
- Computational Thinking through unplugged activities
- Algorithmic Thinking: how can you help your kids perform better
- Computational Thinking for Teacher Education
- What is computational thinking?

- Algorithms for Kids

Lesson Planning Ideas

This section contains links to lesson planning ideas and adaptable plans to present in the middle childhood classroom.

1. Rock Climber, Cliff, and Shadows
2. Ciphering a Sentence
3. Water, Water, Everywhere!
4. Language Arts: Characterization
5. Language Arts: Analyzing Dialogue
6. Language Arts: Setting up a story
7. Science: Cause and Effect
8. Social Studies: Friends
9. Math: Graph theory for Kids