



Newtown Public Schools

BOE C&I Sub Committee Meeting
June 3, 2025

Reed Intermediate School Main Office
Conference Room
3 Trades Lane
Newtown, CT 06470
5:00 PM

As citizens of our community, we will conduct ourselves in accordance with Newtown's Core Character Attributes as displayed in our character tree. We will be responsible for our actions and show respect for each other. We will interact peacefully, productively, and politely. We will be trustworthy and honest and show compassion toward others. Newtown's continued success is contingent upon our ability to persevere, to follow through with our commitments, and to stay focused on the greater good.

AGENDA

1. **CALL TO ORDER**
2. **APPROVAL OF MINUTES**
3. **OLD BUSINESS**
4. **NEW BUSINESS**
 - A. Presentation of the RIS 5th and 6th Grade Computer Integrations Curriculum
 - B. Presentation of the NHS Differential Equations Curriculum
 - C. Presentation and possible action on the adoption of a Spanish 1 resource for NMS and NHS
5. **PUBLIC PARTICIPATION**
6. **ADJOURNMENT**

**Board of Education
Newtown, Connecticut**

Minutes of the Curriculum and Instruction Subcommittee meeting held on May 6, 2025 at 5:30 p.m. in the Board of Education conference room, 3 Primrose Street, Newtown, CT.

C. Gilson, Chair
J. Vouros

F. Purcaro

Item 1 – Call to Order

Dr. Gilson called the meeting to order at 5:31 p.m.

Item 2 – Public Participation

Item 3 – Approval of Minutes

MOTION: Mr. Vouros moved to approve the minutes of April 22, 2025 Dr. Gilson seconded. Motion passes unanimously.

Item 4 – New Business

Discussion on NMS Academic Calendar:

Jim Ross spoke about the current academic calendar and proposed changes from the current quarterly marking periods. He proposes to simplify this and move to trimester marking periods except for Kitchen Science and Project Adventure which are half year courses and will remain on semester marking periods. This would make it simpler for students and families and there will be more instructional time for courses that don't meet daily. There will also be less pressure for teachers and students to rush through the curriculum. A staff survey was taken and 70% were in favor of this change. If approved, he will begin his communication with parents and students.

Mr. Vouros commended Mr. Ross for bringing this recommendation forward, which he's done without being asked. This will be a big change for staff and students.

Mr. Ross feels it a change in the right direction and will be beneficial. 40 certified staff members out of 60 responded and he would like to tell the parents and get their feedback.

Dr. Gilson suggested telling parents that this would be like the semesters in the high school.

Mr. Ross would also like to present this to his PTA.

Mr. Purcaro wanted the C & I Committee to be aware of this change which does not require approval.

Mr. Vouros wants the high school to know what is going on in the middle school compared to what is going on in the high school, which is very different. The transition from 8th into 9th grades is difficult for students and that needs to be addressed.

Mr. Purcaro asked the impact on special education with this change and also why Kitchen Science and Project Adventure were not going to a trimester format.

Mr. Ross said Maureen Hall also supports this change and he feels having more days in class for these students will be a positive. Kitchen Science and Project Adventure are not going into a trimester format because there are scheduling logistics. Students are in one or the other of these classes at the same time of year so we would need to have another program for them to be able to go to trimester.

Grade 7 and 8 Social Studies Textbook:

Will Ryan and Kara DiBartolo provided information on the proposed Grade 7 and 8 social studies textbook adoption.

Mrs. DiBartolo said the reasons to move to these textbooks is because of current outdated materials, ours does not align with the new Connecticut social studies standards, and we are shifting from teacher led instruction to inquiry-based learning. She reviewed the selection process and evaluation criteria. We went with "TCI History Alive" which has superior standards alignment, inclusive content, and comprehensive support.

Mr. Ryan spoke about our stakeholder feedback. TCI was far easier to use and the content was organized. It helps us incorporate the system of inquiry-based learning. An advantage for students is they can highlight important information and it's easy to print

Mrs. DiBartolo noted that the next steps are Board approval and final budget allocation in May or June, materials procurement in July, teacher training and curriculum integration planning, and the full implementation in all middle school classrooms in September. The TCI cost is approximately \$80,000. There will be checkpoints during the year to answer our questions and a 2-hour professional development.

7th and 8th Grade Art Curriculum:

Leigh Anne Hildebrandt and Kristen Ladue presented the 7th and the 8th grade art curriculum and gave an overview of what will be taught. Michelle Hiscavich joined them.

Mr. Vouros asked how much art are high school students expected to take.

Ms. Hiscavich said they can take as much art as they want each semester. There are so many students who want to take art but we can't accommodate everyone. We only have two art teachers and felt they could use another one.

MOTION: Dr. Gilson moved to send the textbook "TCI History Alive" for grades 7 and 8 to the full Board for approval. Mr. Vouros seconded. Motion passes unanimously.

MOTION: Dr. Gilson moved to send the 7th and 8th grade art curriculum to the full Board for approval. Mr. Vouros seconded. Motion passes unanimously.

Item 5 – Public Participation

Item 6 – Adjournment

Dr. Gilson adjourned the meeting adjourned at 7:02 p.m.

Respectfully submitted,
Kathy June



Unit Plan

Intro Computing/Basic Skills/Digital Citizenship

Reed Intermediate School / Grade 5 / F&AA: Technology

Week 1 - Week 6 | 2 Curriculum Developers | Last Updated: May 14, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit on digital citizenship for 5th graders is to introduce students to the essential principles of safe, responsible, and respectful behavior in the digital world. As many of these students are just beginning to engage with technology and the internet, this unit aims to equip them with the knowledge and skills they need to navigate online environments confidently. Through age-appropriate discussions and activities, students will learn about topics such as online privacy, digital footprints, and the importance of respectful communication. This foundation will help them make informed decisions and develop positive habits as they begin to explore and interact in the digital world. This unit is placed at the beginning of the year so the 5th graders can be assessed on their prior knowledge with computers and computer science.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Responsibility

Concepts: Perspective, Self-Awareness, Balance, Consequences, Interaction, Security, Privacy

Computer Microconcepts: Computer Literacy, Digital Footprint, Online Actions, Digital Etiquette

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Following digital etiquette guidelines increases the likelihood of positive online interaction.
2. Awareness and actions by the user protect privacy and strengthen security.
3. Actions online have real world consequences.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What are some rules of digital etiquette? (F)
- 1b. What are some ways to interact positively with others online? (F)
- 1c. What is a digital footprint? (F)
- 1d. What are real world results of positive or negative etiquette online? (C)
- 1e. How does a digital footprint and online etiquette influence how a user is perceived? (C)
- 1e. Is there a downside or cost for practicing online etiquette? (P)
- 2a. Why are passwords necessary? (F)
- 2b. What are some effects of having poor passwords? (F)
- 2c. What are some characteristics of a strong password? (F)
- 2d. What are some strategies for remembering multiple passwords? (C)
- 2e. What could happen if proper password management is not implemented? (C)
- 3a. How long can an online action follow a user? (F)
- 3b. What are some consequences for not following online etiquette? (C)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

Students must be able to:

- Understand the importance of keeping personal information private, such as full names, addresses, and passwords, and knowing how to create strong passwords.
- Recognize that their online actions leave a digital footprint that can be permanent and affect their reputation.
- Identify what cyberbullying is, understanding its impact, and knowing how to respond appropriately if they or someone they know experiences it.
- Understand the importance of communicating respectfully online, including understanding that tone and words can be misinterpreted and hurtful.
- Know the importance of not sharing personal information with strangers online and understanding what to do if they encounter inappropriate content or uncomfortable situations.
- Understand that they should always ask for permission before sharing photos, videos, or other personal content of others online.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.d. Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively and are adept at thoughtfully exploring emerging technologies.

1.2 Digital Citizen

Students recognize the responsibilities and opportunities for contributing to their digital communities. Students:

- 1.2.a. Manage their digital identity and understand the lasting impact of their online behaviors on themselves and others and make safe, legal and ethical decisions in the digital world.
- 1.2.b. Demonstrate empathetic, inclusive interactions online and use technology to responsibly contribute to their communities.
- 1.2.c. Safeguard their well-being by being intentional about what they do online and how much time they spend online.
- 1.2.d. Take action to protect their digital privacy on devices and manage their personal data and security while online.

1.6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

- 1.6.a. choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Introduction of Typing Practice Curriculum/Standards/Expectations
- TypeTastic
5th Grade Digital Citizenship Pretest - Google Form
Be Internet Awesome Activity 1 - Pear Deck Google Classroom
Interactive Discussion
Be Internet Awesome Activity 2 - Pear Deck Google Classroom
Interactive Discussion
Quick Basic Computer Skill Review - Class Discussion and Activity
Email Etiquette Video and Examples - Class Discussion
Creating a Powerful Password - Class Discussion and Pear Deck
Interactive Activity
Safe Internet Scenarios - Discussion and Online Worksheet

Portrait of the Newtown Graduate

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

Resources

Teacher and student resources used to support the learning.

- Digital Footprint
- Privacy
- Cyberbullying
- Online Safety
- Password
- Personal Information
- Respectful Communication
- Consent for use
- Social Media
- Netiquette
- Phishing

TypeTastic (login through Clever)
CodeMonkey (subscription based)
Online Digital Citizenship Tutorials

- 5th Grade Digital Citizenship Pretest 2024
- Be Internet Awesome: It's Cool to be Kind, Activity 1
- Be Internet Awesome: It's Cool to be Kind, Activity 2
- Safe Internet Scenarios - Follow the Rules
- Interland Digital Citizenship Game
- Email Etiquette
- Quick Review Model
- Creating a Powerful Password

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Safe Internet Scenarios | Formative | Technology Project

Technology Project

[4 Standards Assessed](#)

Safe Internet Scenarios - Follow the Rules

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Google Apps (Google Docs & Google Slides)

Reed Intermediate School / Grade 5 / F&AA: Technology

Week 7 - Week 20 | 2 Curriculum Developers | Last Updated: Apr 25, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit is for students to become fluent in most aspects of the most commonly used programs in the Google Suite: Google Docs and Google Slides (and by extension other multimedia presentation software). Students will recognize effective and poor techniques of creating multimedia presentations for an audience. Students will explore different methods for finding and manipulating fair use images for presentations.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Communication

Concepts: Process, Understanding, Creation, Multimedia Presentations, Audience, Digital Literacy

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. A well formatted document/presentation requires cultivating an intended message.
2. Specific messaging techniques allow effective message delivery to an audience.
3. Multimedia presentations require diverse forms of media to engage and keep an audience.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What is a message? (F)
- 1b. What are some ways to format a document/presentation? (F)
- 1c. How is a message evident in a document/presentation? (C)
- 1d. What is the purpose of a multimedia presentation? (C)
- 1e. How does the format of a presentation affect the message? (C)
- 1f. How is a message for a presentation determined? (C)
- 1g. What is the best way to reach an audience? (P)

- 2a. What are some techniques to easily relay information? (F)
- 2b. How is an audience defined? (C)
- 2b. How can a presentation (or presenter) grab the attention of an audience? (C)
- 2c. What makes for an effective or ineffective presentation? (P)

- 3a. What are components of a multimedia presentation? (F)
- 3b. Which components of a multimedia presentation appeal to all audiences? (C)
- 3c. What are the best ways to relay a message to an audience? (C)
- 3d. Is it always the presenter's job to entertain an audience when attempting to deliver information? (P)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

Students must be able to:

- Create and efficiently use the formatting tool bar in Google Docs and Google Slides
- Insert images, text boxes, video, and links into a Slides presentation
- Master basic computer shortcuts for word processing/presentations
- Manipulate backgrounds and animations in a presentation
- Find and distinguish free use appropriate images to avoid copyright conflicts in their work
- Understand different methods to save media from the internet for use in their presentations
- Understand effective and ineffective presentation techniques
- Plan and design a cohesive presentation in Google Slides on a topic of their choosing

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- 1.1.d. Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively and are adept at thoughtfully exploring emerging technologies.

1.3 Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

- 1.3.a. Use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Students review formatting skills in Google Docs

Portrait of the Newtown Graduate

Students create a short Google Slides presentation on topic of their own choosing

Students create a "Stop Motion Animation" using Google Slides

See attachments for descriptions of activities






















Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Tool bar
- Format
- Text box
- Image
- Copy and paste
- Slide
- Duplicate
- Background
- Animation
- Transition
- Font
- Style

Resources

Teacher and student resources used to support the learning.

-  Links to Stop Motion Student Examples 2024  
-  Directions/Examples for Stop Motion with Google Slides Project 2024  
-  Google Slides Presentation - Assignment Description 2024  
-  Google Slides Presentation Self Check 2024  
-  Worst Slideshow Ever 2024    Google Docs Basics  
-  Formatting Practice 2024  

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Google Docs Formatting Practice | Formative | Technology Project

[1 Standard Assessed](#)




Google Slides Presentation | Formative | Technology Project

[2 Standards Assessed](#)

Stop Motion Animation with Google Slides | Summative | Technology Project

Students create a brief Stop Motion Animation movie using Google Slides using knowledge learned during the beginning of this unit.

[3 Standards Assessed](#)

 Stop Motion Animation Project Rubric (5th Grade)  

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

When developing their Google Slides presentation or their Stop Motion Animation, students have the ability to go build in additional slides and go beyond the basic parameters of the assignment. For the stop motion assignment, students are taught an additional optional technique to "autoplay" their file which requires additional learning, planning, and execution.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Intro to Spreadsheets (Google Sheets)

Reed Intermediate School / Grade 5 / F&AA: Technology

Week 21 - Week 26 | 2 Curriculum Developers | Last Updated: Apr 25, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit is to introduce students to spreadsheets in the form of Google Sheets (and by extension other spreadsheets).

Students will learn the basic structure of a spreadsheet, uses for a spreadsheet, how to navigate and format the cells of a spreadsheet, how formulas work in a spreadsheet, and how to create a basic graph using a spreadsheet. During an extension activity, students will learn more advanced features involving navigating/formatting in a spreadsheet and conditional formatting.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Organization

Concepts: Data Collection, Organization, Analysis, Data

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Spreadsheets simplify the organization of data.
2. Spreadsheets facilitate a variety of ways to organize and analyze data.
3. Spreadsheets provide multiple tools for data analysis that facilitate organization and understanding.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What are spreadsheets? (F)
- 1b. How are spreadsheets set up in a way to help organize data/information? (F)
- 1c. How can spreadsheets help organize information efficiently and effectively? (C)
- 2a. How are spreadsheets used? (F)
- 2b. How does the basic functionality of a spreadsheet work (cells, formatting, formulas, graphing)? (F)
- 2c. How can using spreadsheets be helpful in life and work? (C)
- 2d. Does technology always improve organization? (P)
- 3a. What tools do spreadsheets utilize to analyze data? (F)
- 3b. What makes spreadsheets unique in the way they help users understand information? (C)
- 3c. What is the best digital tool for understanding data? (P)

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Critical Skills

*Critical skills that students are expected to be able to **DO** at the end of the unit.*

Students will know and be able to:

- Understand the unique structure of a spreadsheet
- Navigate and format cells, rows, and columns
- Make a basic list
- Have a basic understanding of how formulas work in a spreadsheet
- Understand how to input information/data into a spreadsheet and turn that data into different types of graphs
- Understand the different uses of spreadsheets and how they might apply and be useful in their lives

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.

Standards

The content standards that are taught and/or assessed in this unit.

CSTA: Computer Science Standards (2017)

CSTA: 3-5

Algorithms & Programming

Algorithms

- 1B-AP-08 Compare and refine multiple algorithms for the same task and determine which is the most appropriate. (P6.3, P3.3)

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- 1.1.d. Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively and are adept at thoughtfully exploring emerging technologies.

1.5 Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

- 1.5.a. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- 1.5.b. collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
- 1.5.d. understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

- With teacher guidance, students will be introduced to basic workings of a spreadsheet including navigating cells, row, columns, manipulating data in lists, formulas, and graphs and relate how

Portrait of the Newtown Graduate

spreadsheets could be applicable digital tools in their own lives (see resources for the teacher guided Sheet students will complete).
-Students will complete a Pixel Art activity where they will create a piece of digital artwork using a spreadsheet and the tools they have learned. Extended learning during this activity will consist of the concept of conditional formatting (see Google Applied Digital Skills website for reference)

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Cells
- Rows
- Columns
- Highlighting and Selecting
- Data collection
- Formulas
- Graph/Graphing
- Conditional formatting
- Insert
- Table
- Alignment
- Border

Resources

Teacher and student resources used to support the learning.

- Google Applied Digital Skills - Pixel Art
- Spreadsheet Examples
- PIXEL ART!!!
- Sheets Template 2024
- How to Automate your Stop Motion Animation - 2025

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Pixel Art | Summative | Technology Project

Students will create at least two examples of pixel art utilizing what they have learned about formatting and navigation within a Google Sheet.

6 Standards Assessed

- PIXEL ART!!!

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Students will have the opportunity to extend their learning of formatting cells of a spreadsheet through the more advanced features of conditional formatting rather than use the formatting tool bar. This will be completed during the Pixel Art assessment activity.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Website Creation (Google Sites)

Reed Intermediate School / Grade 5 / F&AA: Technology

Week 27 - Week 38 | 2 Curriculum Developers | Last Updated: Apr 28, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit is to introduce students to the concept of building a website to display/deliver information. Students will understand what makes for a cleanly designed website that portrays information effectively. Students will recognize websites as an alternative multimedia presentation resource to Google Slides. Students will utilize secondary software like Google Drawings and Google Forms to appropriately supplement the builds of their website projects.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Communication/Expression

Concepts: Design, Multimedia, Resources, Form, Function

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Different mediums allow for unique methods to deliver information
2. Function determines the form/design of a project (website)
3. Websites creation facilitates maximum interactivity with users

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What is a website? (F)
- 1b. What is the purpose of a website? (F)
- 1c. How can websites be an effective alternative to other multimedia presentation software? (C)
- 1d. Does the structure of a website offer a unique method of delivering information? (P)

- 2a. What is form as it relates to web design? (F)
- 2b. What is function as it relates to web design? (F)
- 2c. Why does form follow the function (requirements of a website)? (C)
- 2d. Should form always follow function in web design? (P)

- 3a. How are websites structured? (F)
- 3b. How are websites different from other multimedia software applications? (F)
- 3c. How are websites interactive? (F)
- 3d. What criteria should be used to decide on a multimedia presentation tool? (P)
- 3e. Which is the better multimedia presenting tool - Slides or a website? (P)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

Students must be able to:

- Effectively plan and research a topic for a website using a graphic organizer
- Create a Google Site
- Create multiple pages in their site
- Insert text boxes for research and fair use images from the internet to deliver information about a topic
- Utilize themes and templates in Google Sites
- Manipulate an image in Google Drawings and insert into website
- Create a short Google Form to survey the end user about the topic of the website
- Understand how to adjust font, size, background colors, and other visuals inside Google Sites
- Use Google Site tools for finding appropriate videos for website

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.a. Set learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process to improve learning outcomes.
- 1.1.c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- 1.1.d. Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively and are adept at thoughtfully exploring emerging technologies.

1.3 Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

- 1.3.a. Use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.
- 1.3.b. Evaluate the accuracy, validity, bias, origin, and relevance of digital content.
- 1.3.c. Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.

1.4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

- 1.4.b. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

1.6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

- 1.6.a. choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.
- 1.6.b. create original works or responsibly repurpose or remix digital resources into new creations.
- 1.6.c. Use digital tools to visually communicate complex ideas to others.
- 1.6.d. Publish or present content that customizes the message and medium for their intended audiences

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

- Using graphic organizer, plan and research a website based on a topic of their choosing
- Create and publish a four-page website (Google Sites) based on a topic of their choosing
- Use Google Forms and Google Drawings to supplement the website

See attachments for project description

Portrait of the Newtown Graduate

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Website
- Pages
- Format
- Theme
- Embed
- Text box
- Image
- Video
- Insert
- Design
- Form
- Function
- Fair use vs copyright images
- Preview vs Editing
- Download
- Save Image As...

Resources

Teacher and student resources used to support the learning.

- Storyboards for Website - 2024
- Creating A Website - Directions and Requirements 2024
- Cupcake Recipe Google Drawing Example
- Pokemon Model
- Pizza Oven Diagram - Google Drawing Example 2024
- Applied Digital Skills - Google Forms reference videos
- Applied Digital Skills - Google Sites reference videos




Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Website | Summative | Technology Project

Students create a website using Google Sites, publish it, view peers' work, provide feedback, and self-assess using a Google Form.

[11 Standards Assessed](#)

 Creating A Website - Directions and Requirements 2024  

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Computer Integration Gr. 6

Reed Intermediate School / Grade 6 / F&AA: Technology

2 Curriculum Developers | Last Updated: Tuesday, Apr 29, 2025 by Corvello, Michael

Unit Calendar by Year

Unit	Au		Sep				Oct				Nov				Dec				Jan				Feb				Mar				Apr				May				Ju																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38																																					
<input type="checkbox"/> Draft Digital Citizenship and Google Strategies	█																																																																										
<input type="checkbox"/> Draft Basic Photo Editing								█																																																																			
<input type="checkbox"/> Draft Basics of Coding																									█																																																		
<input type="checkbox"/> Draft Introduction to Computer Aided Design																																							█																																				

4 Units found



Unit Plan

Digital Citizenship and Google Strategies

Reed Intermediate School / Grade 6 / F&AA: Technology

Week 1 - Week 7 | 2 Curriculum Developers | Last Updated: Apr 28, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this digital citizenship unit for 6th graders is to deepen their understanding of safe, ethical, and responsible online behavior, building on the foundation they established in 5th grade. With more advanced concepts and real-world applications, this unit will help students navigate the increasingly complex digital landscape they encounter as they grow older. Students will explore topics such as screen time and the ethical use of digital resources. By the end of the unit, they will be exposed to skills needed to protect their digital identities, make informed decisions online, and contribute positively to the digital world.

This unit will also serve as an opportunity to hone some basic computer skills, particularly those needed to efficiently search the internet.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Responsibility

Concepts: Perspective, Self-Awareness, Security, Balance, Consequences, Interaction, Privacy

Computer Microconcepts: Computer Literacy, Digital Literacy, Digital Footprint, Online Actions, Digital Etiquette

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Adhering to digital etiquette supports positive and constructive communication with different parties in digital spaces.
2. Using technology involves self-awareness and digital literacy, enabling students to navigate online environments safely and effectively.
3. Problem-solving online requires understanding security risks and the potential consequences of online actions.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What are the key principles of digital etiquette? (F)
- 1b. How should digital etiquette influence your interactions online? (C)
- 1c. How can you ensure that your communication in digital spaces is respectful and constructive, even when you disagree with others? (C)
- 1d. Why is it important to consider the tone and language in digital communication, and how can this impact relationships with others? (P)
- 2a. What does digital literacy mean? (F)
- 2b. How does being digitally literate help make safe and informed decisions online? (C)
- 2c. What strategies can be used to assess the credibility of online information and protect personal information? (C)
- 3a. What are some common online security risks? (F)
- 3b. How can you protect yourself against common security risks? (C)
- 3c. How can understanding the consequences of online actions help users make better decisions when using technology? (C)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

Students will be able to:

- Understand the importance of respectful communication and appropriate behavior in digital spaces.
- Recognize how their online actions contribute to their digital identity and the impact this can have on their reputation.
- Identify common online security threats, such as phishing, hacking, and social engineering, and know strategies to protect against them.
- Safeguard personal information on online platforms
- Understand that their online actions leave a digital footprint that can be permanent and influential.
- Realize that online actions have real-world consequences, both positive and negative, and the importance of responsible behavior.
- Be aware of how their behavior and presence online reflect on them and affect others.
- Understand what cyberbullying is, its impact, and how to respond appropriately if they or others experience it.
- Knowing how to create and maintain strong, secure passwords and the importance of using two-factor authentication.
- Understand the importance of not sharing personal information with strangers online and knowing what to do if they encounter inappropriate content.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.a. Set learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process to improve learning outcomes.
- 1.1.c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

1.2 Digital Citizen

Students recognize the responsibilities and opportunities for contributing to their digital communities. Students:

- 1.2.a. Manage their digital identity and understand the lasting impact of their online behaviors on themselves and others and make safe, legal and ethical decisions in the digital world.
- 1.2.b. Demonstrate empathetic, inclusive interactions online and use technology to responsibly contribute to their communities.
- 1.2.c. Safeguard their well-being by being intentional about what they do online and how much time they spend online.
- 1.2.d. Take action to protect their digital privacy on devices and manage their personal data and security while online.

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Digital Citizenship Pretest - Google Form
 Cyberbullying Presentation - Class Discussion
 Cyberbullying: Be Upstanding - Worksheet Questions
 Digital Life Activity - Google Forms and Discussion
 Digital Life Vocabulary - Google Drawing Activity
 Email Etiquette and Spam Review - Class Discussion
 Full Value Digital Badge - Google Drawing Activity Assessment
 Become an Internet Search Master - Class Discussion
 Google Search Challenge - Google Slides Activity/Assessment

*refer to Resource section for directions, models, and digital handouts

Portrait of the Newtown Graduate

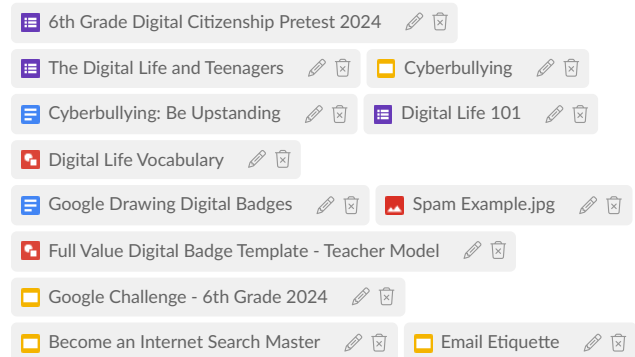
Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Digital Identity
- Two-Factor Authentication
- Digital Etiquette
- Cyberbullying
- Digital Literacy
- Digital Footprint
- Privacy Settings
- Phishing
- Online Reputation
- Intellectual Property
- Plagiarism
- Trolling
- Digital Divide

Resources

Teacher and student resources used to support the learning.



Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Full Value Digital Badge | Summative | Technology Project

Technology Project

Refer to Resource section for handout and template/model

[3 Standards Assessed](#)

Google Search Challenge | Formative | Technology Project

Refer to Resource section for directions, digital handout

No Standards Assessed

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Basic Photo Editing

Reed Intermediate School / Grade 6 / F&AA: Technology

Week 8 - Week 18 | 2 Curriculum Developers | Last Updated: Apr 28, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit is to introduce students to the fundamental skills and tools of digital photo editing, providing them with a foundation for creative expression through images while continuing to build on their computer literacy. As this is their first experience with photo editing, the unit will focus on teaching basic techniques such as cropping, resizing, adjusting color, and applying simple filters while also touching on more advanced features such as combining multiple images into one composition. Students will also learn how to use layers and text tools to enhance their images. Through hands-on projects, they will gain confidence in navigating photo editing software, understanding the importance of composition, and exploring their creativity. The unit will culminate in an activity that assesses all the skills they have learned through the course of the unit.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Creativity, Practicality

Concepts: Process, Understanding, Creation, Design, Skill, Image Editing, Expression, Interpretation, Message, Ethical Considerations

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Editing images proficiently cultivates a message.
2. Effective image editing requires specialized process.
3. Learning multiple photo editing tools permits one to be effective at creating a cohesive product/message.
4. Photo editing and manipulation provokes ethical considerations.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What is photo editing and how does it work? (F)
- 1b. Why is photo editing an effective way to cultivate a message? (C)
- 1c. Can editing an image change the tone in a meaningful way? (P)
- 1d. Can editing an image present ethical dilemmas? (P)
- 2a. What editing tools exist for digital photo editing? (F)
- 2b. What are essential photo editing techniques? (F)
- 2c. What photo editing methods cause the most dramatic change/impact? (P)
- 2d. Which tools are the most effective at changing a photo or video? (C)
- 3a. How can photo editing be used to present a message? (F)
- 3b. How can photo editing be incorporated into other programs or presentations? (F)
- 3c. What are some different digital programs that use photo editing? (F)
- 3d. Which photo editing techniques are best for cultivating a message? (P)
- 3e. Is learning a single editing program sufficient? (P)

- 4a. What are potential problems with using copyrighted imagery? (F)
- 4b. What is propaganda? (F)
- 4c. What is the difference between propaganda and cultivating a message? (C)
- 4d. In what ways can copyrighted imagery be used? (P)

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know and be able to:

- Understand how to find, save, and import copyright free images into different photo editing software
- Utilize basic photo editing techniques to deliver a specific message, such as:
 - Use the cropping tool on images
 - Overlay text on an image
 - Use multiple techniques, both manually and computer aided, for removing unwanted backgrounds from images
 - Adjust the color of specific parts of an image
 - Merge multiple pictures into one image
- Create an original image using multiple pictures
- Understand the ethical dilemmas of using other people's work/images to cultivate a message

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.d. Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively and are adept at thoughtfully exploring emerging technologies.

1.2 Digital Citizen

Students recognize the responsibilities and opportunities for contributing to their digital communities. Students:

- 1.2.b. Demonstrate empathetic, inclusive interactions online and use technology to responsibly contribute to their communities.
- 1.2.c. Safeguard their well-being by being intentional about what they do online and how much time they spend online.

1.3 Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

- 1.3.c. Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.

1.4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

- 1.4.a. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 1.4.b. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

1.6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

- 1.6.a. choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.
- 1.6.b. create original works or responsibly repurpose or remix digital resources into new creations.
- 1.6.c. Use digital tools to visually communicate complex ideas to others.
- 1.6.d. Publish or present content that customizes the message and medium for their intended audiences

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

- Basics of Photo Editing Software - Cropping/Text/Filters: Class Activity
- Multiple Methods for Removing Backgrounds on Images - Class Discussion and Practice
- Layering Images - Class Discussion and Practice
- Multiple Methods for Adjusting Color to Parts of An Image - Class Discussion and Practice

Summative Assessment: Creating a Photo Advertisement for a Real Life Product

Portrait of the Newtown Graduate

Vocabulary

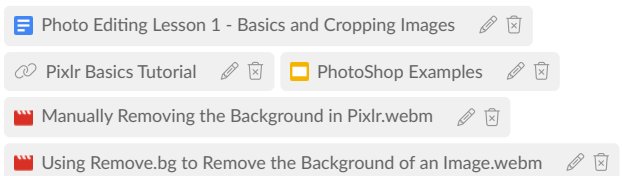
Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Propaganda
- Copy and paste
- Import/Export
- Select (Lasso, Marquee, Wand)
- Polygon Select
- Mask
- Blend
- Layer
- Filter
- Hue/Saturation
- Clone (Clone Stamp)
- Color balance
- Gradient
- Portfolio






















Resources

Teacher and student resources used to support the learning.

- www.pixlr.com/e
- www.photopea.com/
- www.canva.com/
- docs.google.com/drawings/
- www.adobe.com/education/express/
- Adobe PhotoShop and peripheral software (when available)
- www.remove.bg and similar image background removing websites



Unit Plan

-  Finding a Image in Google Images with a Transparent Background.webm  
-  Homer in Monica's Apt.webm  
-  Cutting Out A Shape Using the Polygonal Lasso Select Tool.webm  
-  Photo Editing Lesson 3 - Merging Pictures  
-  Photo Editing Lesson 4 - Colorizing!  
-  Ansel Adams Black and White Images  
-  Lesson #4 - Colorizing Images in Pixlr.webm  










Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Advertising with Photo Editing | Summative | Technology Project

See attachment for detailed description of the final assessment

[10 Standards Assessed](#)

-  Photo Editing Final Lesson - Advertising with Photo Editing Techniques  
-  PhotoShop in Advertising  
-  Photo Editing Final Project Rubric: Advertisement Design  

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

An alternative or extended activity to the summative advertising project, students are given the option to create a poster for the current school play.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Basics of Coding

Reed Intermediate School / Grade 6 / F&AA: Technology

Week 19 - Week 27 | 2 Curriculum Developers | Last Updated: Apr 28, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

This introductory coding unit is designed to expose students to the backbone of computer science with one of the first steps into coding, developing programs with block-based code - primarily using the Scratch program. This unit will guide students through the fundamentals of programming, such as sequencing, loops, and conditionals. By focusing on creative projects, students will not only learn essential coding concepts, but also develop problem-solving skills and logical thinking,

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Problem Solving/Logical Thinking

Concepts: Coding, Efficiency, Logic, Patterns, Process, Structures

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. Coding requires an understanding of key concepts, involving planning, problem solving, and the idea that multiple approaches could achieve the same result.
2. Coding requires flexibility from the user to see different solutions and approaches.
3. Coding structures like loops and conditionals help organize and simplify a program, making it efficient and easier to understand.
4. Coding is made efficient by removing unnecessary steps, utilizing distinct code structure, and simplifying when possible.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What is coding (block-based)? (F)
- 1b. How does coding work? (F)
- 1c. What are the steps to creating a basic code? (F)
- 1d. What are some structures that coders rely on to make coding easier to implement? (C)
- 2a. What are the necessary items to know before starting to code a program? (F)
- 2b. How can different approaches result in the same program? (C)
- 2c. How does a coder decide which path to take when there are multiple solutions? (P)
- 3a. What coding structures (loops, conditionals, etc.) can organize your programming? (F)
- 3b. What role do different coding blocks play in building your project? (C)
- 4a. What coding structures allow for simplicity and efficiency while coding? (F)
- 4b. How can removing unnecessary steps make your code more efficient? (C)
- 4c. What are some ways to simplify your program while maintaining its functionality? (C)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

-With teacher guidance, students will be introduced to the basic tools of Scratch and block based coding

Students will be able to:

Know how coding is used to achieve real world results.

Know how to start coding effectively using block-based code.

Know the basics of coding block loops.

Understand the purpose of variables.

Use coding to solve basic abstract problems.

Follow step by step directions to building a program with basic block coding.

Demonstrate effective coding by producing their own code.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- 1.1.c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

1.4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

- 1.4.a. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

1.5 Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

- 1.5.a. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- 1.5.c. break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- 1.5.d. understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Formative:

- Introduction to Scratch - Tutorial and Exploration of Resource
- Scratch Exit Ticket
- Coding/Creation of Project Using Scratch Step by Step Directions from Workbooks

Summative:

- Partner Project - Creation of Simple Program, Self Choice

Vocabulary









Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

1. Algorithm
2. Sequence
3. Loop
4. Conditional
5. Variable
6. Sprite
7. Backdrop
8. Event
9. Broadcast
10. Block
11. Script
12. Debugging
13. Iteration
14. Input
15. Output
16. Cloning

Resources

Teacher and student resources used to support the learning.

- www.codemonkey.com
 - Coding Adventures Part 1 & 2 module
- Scratch (currently using the offline version)
- Scratch DK Workbooks
 - [Coding in Scratch: Games Workbook](#)
 - [Coding in Scratch: Projects Workbook](#)
 - [Coding in Scratch: Challenge Workbook](#)
 - [Star Wars Coding Projects: A Step-by-Step Visual Guide to Coding. Your Own Animations, Games, Simulations](#)

- Introduction to Scratch Exit Ticket  
- Making your First Program in Scratch  
- Rocket Landing Program   Pac Man Program  

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Create A Scratch Project | Formative | Technology Project

Technology Project

See attachment for description/directions







[4 Standards Assessed](#)

Design Your Own Scratch Project | Summative | Technology Project

Technology Project

See attachment for description/directions

[4 Standards Assessed](#)

- Introduction to Scratch Exit Ticket  
- Create A Project in Scratch!  
- Design Your Own Scratch  

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Using the CodeMonkey program, students will work at their own pace (outside of the normal coding unit) to build on their coding knowledge.

The CodingAdventure modules in the program introduce students to text-based coding and allow for higher level learning of the different structures and concepts of coding.

Also, the opportunity for differentiation within both the "Create a Project" formative assessment and the "Design Your Own Scratch" summative assessment exists both in their choice of projects and the depth of the coding they choose to implement in their own final project.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Unit Plan

Introduction to Computer Aided Design

Reed Intermediate School / Grade 6 / F&AA: Technology

Week 28 - Week 38 | 2 Curriculum Developers | Last Updated: Apr 29, 2025 by Corvello, Michael

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

The purpose of this unit is to introduce students to the concept of computer aided design (CAD). Students will understand the basic tools of CAD and how basic shapes can be manipulated to creating larger and more complex designs. Using Tinkercad as their primary resource, students will be introduced to the beginning stages of the design process and how to model different designs based on different prompts and real world problems that might require specific criteria for their designs. After an introduction to different skills/tools of CAD design, students will build more a complex design as their culminating assessment.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Lens: Design, Creativity

Concepts: Visual Communication, Computer Aided Design, Precision, Accuracy, 2D and 3D Design, Computational/Digital Design, Design Process, Brainstorming, Geometrical Design, Spatial Reasoning, Collaboration, Critical Thinking, Efficiency

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

1. The design process organizes and refines an idea from concept to final product.
2. Computer Aided Design (CAD) facilitates complex design allowing high levels of precision and accuracy in creating models.
3. Learning multiple specific computer aided design tools/skills allows efficiency in creating a cohesive design/product.

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

- 1a. What is the design process (F)
- 1b. Why is the design process important? (C)
- 1b. What are the main stages of the design process? (F)
- 1c. How can the design process help organize and refine our ideas? (C)
- 1d. When does a design needs to be refined or improved? (C)
- 2a. What is CAD? (F)
- 2b. How is CAD useful? (C)
- 2b. How is computer aided design different from other types of design? (C)
- 2c. What does CAD allow a user to do when compared to analog tools? (C)
- 2d. Why is precision important in CAD design? (C)
- 3a. What are the basic features and tools of a typical CAD software? (F)
- 3b. What are the basic operations for modifying 3D models (scaling, rotating, mirroring)? (F)
- 3c. How do you combine different 3D shapes to create a complex model? (F)

3d. What are constraints, and how do they help in creating accurate designs? (F)

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

-With teacher guidance, students will be introduced to the basic tools of CAD through the use of the TinkerCAD program (a basic introductory CAD software program).

Students will be able to:

- Manipulate digital shapes
- Create shapes both by assembling digital shapes and carving away at shapes using the "hole" tool
- Assemble shapes into a cohesive and final product with accurate measurements using multiple CAD software tools (hole tool, grouping, alignment, rotation, duplication)
- Understand and manipulate shapes along the different axis of a three dimensional workspace
- Learn the process to convert basic 2 dimensional shapes from the internet into 3 dimensional shapes in the TinkerCAD program
- Create and edit original digital 3D designs
- Demonstrate proficiency in editing and designing within the introductory CAD software (TinkerCAD)

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.

Standards

The content standards that are taught and/or assessed in this unit.

ISTE: ISTE for Students (2024)

ISTE: All Grades

1.4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

- 1.4.a. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 1.4.b. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
- 1.4.c. Develop, test and refine prototypes as part of a cyclical design process.
- 1.4.d. Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

1.5 Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

- 1.5.a. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

1.6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

- 1.6.a. choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.
- 1.6.b. create original works or responsibly repurpose or remix digital resources into new creations.
- 1.6.c. Use digital tools to visually communicate complex ideas to others.
- 1.6.d. Publish or present content that customizes the message and medium for their intended audiences

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Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Following an introductory class on the basics of the software, students will be asked to assemble a portfolio of designs. The avatar and house design are considered mandatory and students are given choice in other designs to contribute to their portfolio.

Each class following the introduction, students will be shown more advanced tools and skills to add to the designs in their portfolio.

Refer to resource section for materials for different assignments.

Formative:

Introduction of basics through interactive TinkerCAD tutorials - Classroom Demo and Activity

Avatar Creation - Classroom Demo and Activity

House Design and Creation - Formative Assessment

Free Choice Design

Summative:

Portfolio Compilation - Summative Assessment

Portrait of the Newtown Graduate




























Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- CAD (Computer-Aided Design)
- Tinkercad
- 3D Model
- Workspace
- Shape
- Solid
- Hole
- Group
- Ungroup
- Align
- Rotate
- Scale
- Duplicate
- Mirror
- Grid
- Snap
- Object
- Layer

Resources

Teacher and student resources used to support the learning.

-  Tinkercad Portfolio Final Submission  
-  Dream House and Dream Room Examples  
-  Tinkercad Avatar Minilesson.webm  
-  3D CAD Design Examples  
-  Tinkercad Design Portfolio Directions  
-  TinkerCAD Formative Assessment  
-  Redesigning a Living Room Video  
-  Creating Custom Characters Video    TinkerCad  

- Prototype
- Simulation
- Rendering
- Export
- STL File
- Vertex
- Edge
- Face
- Polygon
- Cylinder
- Sphere
- Cube
- Plane
- Transform
- Zoom
- Pan
- Orbit
- Tool
- Toolbar
- Menu
- Palette
- Library
- Axis
- Coordinate
- Grid Snap
- Chamfer
- Dimension
- Perspective
- Orthographic View
- Solid View
- Material
- Texture

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

CAD Formative Assessment | Formative | Technology Project

See TinkerCAD Formative Assessment attachment for description of activity










[8 Standards Assessed](#)

CAD Portfolio | Summative | Student Portfolio

Technology Project

See attachment for portfolio description

[8 Standards Assessed](#)

 Tinkercad Portfolio Final Submission    Tinkercad Design Portfolio Directions    TinkerCAD Formative Assessment  

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

Students are asked to complete a portfolio of designs for this unit. Because of this structure, students are able to differentiate their final product with the number and complexity of their designs. See rubric for the House activity formative assessment for how they will be

assessed on these different concepts.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.



Differential Equations

Newtown High School / High School / Mathematics

5 Curriculum Developers | Last Updated: Tuesday, May 6, 2025 by Bremer, Kathleen

Unit Calendar by Year

Unit	Au		Sep				Oct				Nov				Dec				Jan				Feb				Mar				Apr				May		Ju		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
Introduction to Differential Equations	█																																						
First Order Equations							█																																
Numerical Methods													█																										
Applications of First Order Equations																				█																			
Linear Second Order Equations																									█														
Laplace Transformations																																					█		

◀ 6 Units found ▶



Unit Plan

Introduction to Differential Equations

Newtown High School / High School / Mathematics

Week 1 - Week 6 | 5 Curriculum Developers | Last Updated: May 6, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

Equations **simplify** real-world problems into solvable mathematical forms.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concepts:

- Model
- Differential equation
- Logistic model
- Order
- General solution
- Solution curve
- Direction field

Lens: Abstraction

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Applications Leading to Differential Equations

Concepts:

- Mathematical model
- Differential equation
- Logistic growth model

1. A **mathematical model** simplifies problem solving with **differential equations** while accurately predicting real world outcomes.
2. **Differential equations** such as the **logistic growth model** can be used to solve problems relating to Population Growth and Decay, laws of physics, and human biology.

Strand 2: Basic Concepts

Concepts:

- Order
- Derivative
- Function
- General solution
- Solution curve

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is the definition of the **derivative** of a **function**? (F)
- What is a **differential equation**? (F)
- What is the **logistic growth model**? (F)
- What is meant by the term '**mathematical model**'? (F)
- What are some real-life phenomena that can be modeled using **differential equations**? (F)
- What distinguishes a **mathematical model** that uses a **differential equation** from one that does not? (F)
- How are **differential equations** used to create **mathematical models**? (C)
- What is a **mathematical model** and why is it useful in solving real-world problems? (C)
- How can the solution to a **differential equation** predict long-term behavior of a system? (C)
- What are the limitations of using **differential equations** to model real-world situations? (P)

Generalization 2:

- How is the appropriate type of **differential equation** selected to best serve the model? (C)

3. A **differential equation** is an equation with order that contains one or more derivatives of an unknown function.

4. The **general solution** to a differential equation is a family of **solution curves** that differ only by a constant.

Strand 3: Direction Fields for First Order Equations

Concepts:

- Direction field

5. A **direction field** displays the general solution to a **differential equation**.

Unit Plan

- Why is the **logistic model** used for population growth and Decay? (C)
- How do **differential equations**, like the **logistic growth model**, bridge the gap between theoretical understanding and practical applications? (C)
- Why does the **logistic model** approximate the exponential model under certain circumstances? (C)
- To what extent can mathematical models like the **logistic model** truly predict complex real-world systems, or are they just educated guesses? (P)
- Can relying on mathematical models like the **logistic model** lead to biased or misleading decisions in real-world policy or science? (P)

Generalization 3:

- How is the **order** of a Differential equation determined? (F)
- What is an ordinary **differential equation**? (F)
- How does the order of a **differential equation** impact the complexity and behavior of its solutions? (C)

Generalization 4:

- What is the **general solution** to a Differential equation? (F)
- How is each **solution curve** related to the general solution? (C)
- How do the multiple **solution curves** for each **differential equation** aid in describing dynamic processes in nature and physics? (C)
- Does the number of **solution curves** limit or enhance the usefulness of a **differential equation** in modeling real-world systems? (P)

Generalization 5:

- How is a **direction field** constructed? (F)
- What is the connection between a **direction field** and a **solution curve**? (C)

Provocative: Does the complexity of real-world situations challenge the capacity of mathematical models, like differential equations, to accurately predict outcomes?

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know:

- how to utilize mathematical models to simplify complex problem-solving tasks while accurately predicting real-world outcomes.
- how to apply differential equations, such as the logistic growth model, to analyze and solve problems in population dynamics, physics laws, and biological systems.
- how to define a differential equation as an equation containing one or more derivatives of an unknown function, classified by its order based on the highest derivative present.
- how to explain that the general solution to a differential equation represents a family of solution curves, distinguished only by a constant parameter.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
2. Work independently and collaboratively to solve problems and accomplish goals.
3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

- how to interpret and visualize the general solution of a differential equation by graphing it as a direction field, illustrating the behavior of solutions over a range of values.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

In this unit, students will be given the opportunity to work collaboratively and independently.

Utilize mathematical models to simplify complex problem-solving tasks while accurately predicting real-world outcomes.

- Formulate mathematical models that represent real-world phenomena, such as population growth, economic trends, or physical processes.
- Perform parameter estimation techniques to determine unknown parameters in mathematical models using available data.
- Apply numerical methods, such as finite difference, finite element, to solve complex mathematical models.
- Discuss the advantages and limitations of numerical methods in solving real-world problems compared to analytical solutions.

Apply differential equations, such as the logistic growth model, to analyze and solve problems in population dynamics, physics laws, and biological systems.

- Analyze case studies of population growth and decline in different species, discussing how differential equations are used to model these dynamics.
- Explore factors such as birth rates, death rates, and carrying capacity, and their impact on population stability and growth patterns.
- Apply fundamental physics principles, such as Newton's second law of motion, to analyze the motion of objects under varying forces.

Define a differential equation as an equation containing one or more derivatives of an unknown function, classified by its order based on the highest derivative present.

- Define terms such as dependent variable, independent variable, order of a differential equation, and initial/boundary conditions.
- Discuss the distinction between ordinary differential equations (ODEs) and partial differential equations (PDEs) based on the number of independent variables.
- Illustrate examples of first-order, second-order, and higher-order differential equations in various contexts, such as physics, biology, and engineering.
- Apply differential equations to model real-world phenomena, such as exponential growth, harmonic motion, or heat conduction.

Portrait of the Newtown Graduate

Explain that the general solution to a differential equation represents a family of solution curves, distinguished only by a constant parameter.

- Provide examples of differential equations where the general solution includes constant parameters, such as in first-order linear equations or separable equations.
- Plot solution curves for differential equations with varying constant parameters using software or graphing tools.
- Discuss how different values of the constant parameter result in distinct solution curves within the same family.
- Analyze the geometric interpretation of solution curves and their relationship to the differential equation's general solution.
- Solve differential equations using initial conditions to find particular solutions.

Interpret and visualize the general solution of a differential equation by graphing it as a direction field, illustrating the behavior of solutions over a range of values.

- Explain the concept of a direction field as a graphical representation of the slopes of solution curves at various points.
- Demonstrate how direction fields are constructed for first-order differential equations using a grid of points and arrows indicating the direction of the derivative.
- Overlay solution curves onto direction fields to illustrate how they intersect and follow the direction indicated by arrows.
- Analyze the relationship between the slope field and the solution curves, emphasizing how the field predicts the behavior of solutions over different intervals.

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Model
- Differential Equation
- Logistic Model
- Order
- General Solution
- Solution Curve
- Initial Condition
- Direction Field

Resources

Teacher and student resources used to support the learning.

[https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_\(Trench\)/03%3A_Numerical_Methods](https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_(Trench)/03%3A_Numerical_Methods)

- Basic Integration Rules.pdf
- Integration by Parts Homework.pdf
- Integration by Parts Notes.pdf
- Parts Quiz Review Solutions.pdf
- Parts Quiz Review.pdf
- Rational Integration Notes.pdf
- Rational Integration Quiz.docx
- Basic Functions Answers V_1.pdf
- Basic Functions notes.pdf
- Basic Functions Version 1.pdf
- Basic Functions Version 2.pdf
- basic functions.docx
- Interlude_3__Slope_Fields.pdf
- Slope Fields Flamingo.pdf
- Slope Fields Quiz.pdf
- Slope Fields.docx
- Slope-Fields_Slides.pdf

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

- Create tiered problem sets where each tier varies in complexity and depth of conceptual understanding required.
 - Provide students with options to choose problems aligned with their current understanding, allowing for differentiated learning experiences.
 - Provide structured supports such as guiding questions, hints, or partial solutions to scaffold students' problem-solving skills while deepening their understanding of concepts.
 - Design choice boards offering a variety of activities related to differential equations concepts.
 - Implement think-pair-share activities where students individually reflect on a differential equations concept or problem, discuss their thoughts with a partner, and then share their insights with the class.
 - Encourage students to explain their reasoning and engage in peer-to-peer learning, promoting collaborative understanding.
 - Flip classroom instruction by providing pre-recorded lectures or readings on differential equations concepts for students to review outside of class.
 - Organize peer teaching sessions where students research and prepare mini-lessons on specific differential equations topics.
 - Facilitate problem-based learning workshops where students work collaboratively to solve authentic differential equations problems.
 - Encourage students to make connections between theoretical concepts and real-world applications, fostering metacognitive awareness and deeper conceptual understanding.
-

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.

Does not apply.



Unit Plan

First Order Equations

Newtown High School / High School / Mathematics

Week 7 - Week 12 | 5 Curriculum Developers | Last Updated: May 5, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

Study first-order differential equations for which there are general methods of solution.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concepts:

- Linear
- Homogeneous
- Nonhomogeneous
- Trivial solutions
- Nontrivial
- First-order differential equation
- Separable differential equation
- Arbitrary constant
- Family of solutions
- Boundary values
- Open rectangle
- Existence
- Uniqueness
- Bernoulli equation
- Transformations

Lens: Linearization

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Linear First Order Equations

Concepts:

- Linear
- Homogeneous
- Nonhomogeneous
- Trivial solutions
- Nontrivial

1. **Linear** first-order differential equations are **homogeneous** and **nonhomogeneous** with **trivial solutions** for the homogeneous case, with any other solution being **nontrivial**.

Strand 2: Separable Equations

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is a **trivial solution**? (F)
- What is a **nontrivial** solution? (F)
- What distinguishes a **linear** differential equation from a nonlinear one, and how does this classification impact the methods used for finding solutions? (C)
- How does the linearity of a first-order differential equation influence the classification of its solutions as **homogeneous** or **nonhomogeneous**? (C)
- Why is the concept of **trivial solutions** important when discussing **homogeneous** linear differential equations? (C)
- Are **nontrivial solutions** of **nonhomogeneous** linear differential equations essential for truly understanding the

Concepts:

- First-order differential equation
- Separable differential equation
- Arbitrary constant
- Family of solutions
- Boundary values

2. A **first-order differential equation** is a **separable differential equation**, allowing for the method of separation of variables where x and y are isolated on opposite sides.

3. Integrating a **separable differential equation** introduces an **arbitrary constant**, which represents the **family of solutions** and accommodates specific initial conditions or **boundary values**.

Strand 3: Existence and Uniqueness of Solutions of Nonlinear Equations

Concepts:

- Open rectangle
- Existence
- Uniqueness

4. An **open rectangle**, excluding its boundary, serves as a domain for **existence** and **uniqueness**.

Strand 4: Transformation of Nonlinear Equations into Separable Equations

Concepts:

- Bernoulli Equation
- Transformations

5. The **transformation** of **Bernoulli equations** into separable differential equations requires the variation of parameters.

dynamics of physical systems, or do **trivial** solutions provide sufficient insight? (P)

Generalization 2:

- How does the method of **separation of variables** apply to first-order differential equations?
- What advantages does **separation of values** offer in terms of solving first-order differential equations? (C)
- How does the concept of **separability** in differential equations contribute to understanding the interplay between independent and dependent variables in the context of modeling dynamic systems? (C)

Generalization 3:

- What is an **arbitrary constant**? (F)
- What are **boundary values**? (F)
- What is **existence**? (F)
- What is **uniqueness**? (F)
- What role does the **arbitrary constant** play in the solution of separable differential equations? (C)
- How does the **arbitrary constant** facilitate the determination of specific solutions given initial conditions or **boundary values**? (C)

Generalization 4:

- What is an **open rectangle**? (F)
- What role does an **open rectangle** play in the context of establishing the **existence** and **uniqueness** of solutions to initial value problems for nonlinear differential equations? (C)
- Do the theoretical conditions for the **existence** and **uniqueness** of solutions in nonlinear differential equations align with the practical challenges of applying these concepts to real-world phenomena? (P)

Generalization 5:

- What is the **Bernoulli equation**? (F)
- How does the variation of parameters method **transform** a **Bernoulli equation** into a separable differential equation? (C)
- How does the process of **transforming** a nonlinear **Bernoulli equation** into a separable form through variation of parameters enhance the understanding of the relationship between different solution methods in differential equations? (C)
- Is the **transformation** of a nonlinear **Bernoulli equation** into a separable form through variation of parameters merely a mathematical convenience, or does it fundamentally alter our interpretation of the underlying dynamics described by the equation? (P)

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know:

- how to apply linear first order differential equations.
- how to integrate separable differential equations.
- how to identify and apply the existence and uniqueness of solutions of nonlinear equations.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.

- how to transform nonlinear equations into separable equations.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

In this unit, students will be given the opportunity to work collaboratively and independently.

Apply linear first order differential equations.

- Analyze and understand the components of a linear differential equation.
- Solving linear first-order differential equations using integrating factors, separation of variables, and exact equations.
- Interpret and analyze the solutions in the context of domain and initial conditions.
- Explore the conditions for the existence and uniqueness of solutions to initial value problems posed by linear differential equations.

Integrate separable differential equations.

- Identify differential equations that can be separated into functions of x and y .
- Formulate separable differential equations from given physical or mathematical scenarios.
- Apply integration techniques such as integration by parts, substitution, or partial fractions to solve the separated differential equations.
- Interpret the solutions in terms of the initial conditions provided and the behavior of the system over time.

Identify and apply the existence and uniqueness of solutions of nonlinear equations.

- Study the theoretical conditions under which solutions to nonlinear equations exist and are unique.
- Analyze specific nonlinear differential equations and determine whether they satisfy the conditions for existence and uniqueness of solutions.
- Explore how boundary conditions and initial values affect the existence and uniqueness of solutions in nonlinear equations.
- Set up and solve initial value problems for nonlinear differential equations.
- Compare and contrast the concepts of existence and uniqueness for linear versus nonlinear equations.

Transform nonlinear equations into separable equations.

- Identify nonlinear equations, such as Bernoulli equations, that can be transformed into separable form.

Portrait of the Newtown Graduate

- Understand the characteristics of nonlinear equations and the challenges they present for direct solution methods.
- Apply the variation of parameters technique to transform specific types of nonlinear equations into separable form.
- Explore substitution methods for transforming nonlinear equations into forms amenable to separation of variables.
- Apply the transformation techniques to model and solve practical problems from physics, biology, economics, etc., where nonlinear equations arise.

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Linear
- Homogeneous
- Nonhomogeneous
- One-parameter family
- Trivial solutions
- Complementary equation
- Nontrivial
- Principle of superposition
- First-order differential equation
- Separable differential equation
- Implicit function theorem
- Arbitrary constant
- Family of solutions
- Boundary values
- Open rectangle
- Existence
- Uniqueness
- Bernoulli Equation
- Transformations

Resources

Teacher and student resources used to support the learning.

[https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_\(Trench\)/03%3ANumerical_Methods](https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_(Trench)/03%3ANumerical_Methods)

- [Checking for Solutions to Differential Equations.pdf](#)
- [Separable Notes.pdf](#)
- [Separable Practice.pdf](#)
- [Separable Quiz.pdf](#)
- [Bernouli homework.docx](#)
- [Bernouli notes.docx](#)
- [Bernoulli Quiz.pdf](#)
- [Bernoulli supplemental.docx](#)
- [Homogeneous Homework.pdf](#)
- [Homogeneous notes.pdf](#)
- [Homogeneous online resource for homework.pdf](#)
- [uniqueness.docx](#)

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

- Create tiered problem sets where each tier varies in complexity and depth of conceptual understanding required.
- Provide students with options to choose problems aligned with their current understanding, allowing for differentiated learning experiences.
- Provide structured supports such as guiding questions, hints, or partial solutions to scaffold students' problem-solving skills while deepening their understanding of concepts.
- Design choice boards offering a variety of activities related to differential equations concepts.
- Implement think-pair-share activities where students individually reflect on a differential equations concept or problem, discuss their thoughts with a partner, and then share their insights with the class.
- Encourage students to explain their reasoning and engage in peer-to-peer learning, promoting collaborative understanding.
- Flip classroom instruction by providing pre-recorded lectures or readings on differential equations concepts for students to review outside of class.

- Organize peer teaching sessions where students research and prepare mini-lessons on specific differential equations topics.
- Facilitate problem-based learning workshops where students work collaboratively to solve authentic differential equations problems.
- Encourage students to make connections between theoretical concepts and real-world applications, fostering metacognitive awareness and deeper conceptual understanding.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.

Does not apply.



Unit Plan

Numerical Methods

Newtown High School / High School / Mathematics

Week 13 - Week 18 | 5 Curriculum Developers | Last Updated: May 6, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

Students will study three methods for solving first order differential equations.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concept:

- Euler's method
- Differential equations
- Tangent line
- Integral curve
- The Improved Euler method
- The Runge-Kutta method

Lens: Approximation

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Euler's method

Concepts:

- Euler's method
- Tangent line
- Integral curve
- Differential equations

1. **Euler's method** solves a **differential equation** by approximating the tangent line to the integral curve on a set interval.

Strand 2: The Improved Euler method and related methods

Concepts:

- Improved Euler method

2. The **Improved Euler method** solves differential equations using two evaluations.

Strand 3: The Runge-Kutta method

Concepts:

- Runge-Kutta method

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is **Euler's method**? (F)
- Why is **Euler's method** used? (C)
- What is a **tangent line**? (F)
- What is an **integral curve**? (F)
- How does **Euler's method** approximate the **tangent line**? (C)

Generalization 2:

- What is the process for the **Improved Euler's method**? (F)
- How is the **Improved Euler method** different than Euler's Method? (C)

Generalization 3:

- What is the **Runge-Kutta method**? (F)
- How does the **Runge-Kutta method** differ from the Euler Method and the Improved Euler Method? (C)

Provocative: Under what circumstances might one method, the **Improved Euler** or **Runge-Kutta**, provide a more accurate approximation than the other.

3. The **Runge-Kutta method** computes approximate values of a solution to a differential equation.

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know:

- how to apply the Euler's method
- how to apply the Improved Euler method
- how to apply the Runge-Kutta method

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

Students will work independently and collaboratively

Apply the Euler's method

- Discuss the accuracy and limitations of Euler's method as the step size varies.
- Present a differential equation with a known exact solution.
- Calculate the numerical errors (difference between the approximate and exact solutions) for each step size.
- Plot the errors against the step size to analyze the convergence behavior of Euler's method.
- Formulate the corresponding differential equation and initial conditions.
- Discuss how the method can be generalized to higher-order differential equations by extending this approach.

Apply the Improved Euler method

- Calculate the approximations of the solution iteratively and compare them with the exact solution (if available).
- Discuss the advantages of the Improved Euler method over the basic Euler's method, emphasizing its improved accuracy.
- Compare the accuracy of the numerical solutions obtained from both Euler's method and the Improved Euler method.
- Improved Euler Method to numerically approximate the solution over a specified time interval.

Apply the Runge-Kutta method

Portrait of the Newtown Graduate

- Compute the approximations of the solution iteratively and compare them with the exact solution (if available).
- Discuss how to optimize the step size for Runge-Kutta to achieve accurate results while balancing computational efficiency.
- Interpret the results in the context of the problem and discuss any insights gained from using Runge-Kutta
- Visualize how the solution evolves over time and compare it with the exact solution or other numerical methods..

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Euler's Method
- Taylor's Theorem
- Semi-linear method
- Improve Euler Method
- Runge-Kutta Method

Resources

Teacher and student resources used to support the learning.

[https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_\(Trench\)/03%3ANumerical_Methods](https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_(Trench)/03%3ANumerical_Methods)

- AP Calculus BC - Live Review Session 2 - Differential Equations on the AP Calculus BC Exam Final.pdf
- AP Classroom BC Unit 7.1-7.5 video Guided Notes .docx
- AP Classroom BC Unit 7.1-7.5 video Guided Notes.pdf
- Day 16 - Eulers Method - FRQ Review.pdf
- Euler's Method Notes and Homework.docx
- Euler's Method Notes.pdf
- Euler's Method Quiz.docx
- Euler's Quiz.pdf
- Improved Euler's Method.docx
- Programming Assignment.docx
- Programming Assignment.pdf

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

- Create tiered problem sets where each tier varies in complexity and depth of conceptual understanding required.
- Provide students with options to choose problems aligned with their current understanding, allowing for differentiated learning experiences.
- Provide structured supports such as guiding questions, hints, or partial solutions to scaffold students' problem-solving skills while deepening their understanding of concepts.
- Design choice boards offering a variety of activities related to differential equations concepts.
- Implement think-pair-share activities where students individually reflect on a differential equations concept or problem, discuss their thoughts with a partner, and then share their insights with the class.
- Encourage students to explain their reasoning and engage in peer-to-peer learning, promoting collaborative understanding.
- Flip classroom instruction by providing pre-recorded lectures or readings on differential equations concepts for students to review outside of class.
- Organize peer teaching sessions where students research and prepare mini-lessons on specific differential equations topics.
- Facilitate problem-based learning workshops where students work collaboratively to solve authentic differential equations problems.

- Encourage students to make connections between theoretical concepts and real-world applications, fostering metacognitive awareness and deeper conceptual understanding.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.

Does not apply.



Unit Plan

Applications of First Order Equations

Newtown High School / High School / Mathematics

Week 19 - Week 24 | 5 Curriculum Developers | Last Updated: May 6, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

To consider applications of first order differential equations.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concepts:

- Rate of change model
- Growth and Decay
- Exponential Model
- Newton's Law of Cooling
- Mixing problem
- Newton's Second Law of Motion
- Terminal velocity
- Escape velocity

Lens: Dynamic Change

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Growth and Decay

Concepts:

- Rate of change model
- Growth and decay
- Exponential Model

1. **Rate-of-change models** are applicable to a wide range of scenarios, including radioactive **decay**, carbon dating, and compound interest.
2. The most common model for **growth and decay** is the **exponential model** which assumes that the rate of change of a quantity is proportional to the quantity itself.

Strand 2: Cooling and Mixing

Concepts:

- Newton's Law of Cooling
- mixing problem

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is the **rate-of-change model**? (F)
- What are some specific examples where **rate-of-change models**, such as exponential **growth and decay**, are widely applicable in real-world scenarios? (F)
- How does the **exponential model** represent **growth and decay** processes, and what does it assume about the relationship between the rate of change and the quantity itself? (F)
- How do **rate-of-change models**, particularly the **exponential model**, provide insights into the behavior of quantities over time in various contexts like population growth, radioactive decay, and financial investments? (C)

Generalization 2:

- What is the **Exponential Model**? (F)
- How does the **exponential growth model** describe the relationship between the rate of change of a quantity and the quantity itself, and what are its key characteristics? (F)

3. **Newton's Law of Cooling** is used to model the temperature **growth or decay** of a surrounding medium when an heated object is introduced.
4. Differential equations can be used to measure the **rate of change** of a quantity in a **mixing problem** when two solutions are combined.

Strand 3: Elementary Mechanics

Concepts:

- Newton's Second Law of Motion
- Terminal velocity
- Escape velocity

5. **Newton's Second Law of Motion** governs the acceleration of an object under gravitational force, defining both **terminal velocity** and **escape velocity**.

Unit Plan

- In what contexts is the **exponential decay model** commonly applied? (F)
- How does the **exponential decay model** differ from the **exponential growth model** in terms of its mathematical formulation and implications? (C)
- How does the assumption of proportionality between the rate of change and the quantity itself in the **exponential growth and decay model** provide insight into natural processes involving growth, decay, and dynamic equilibrium? (C)

Generalization 3:

- What is **Newton's Law of Cooling**? (F)
- What factors influence the rate of temperature change predicted by **Newton's Law of Cooling** when an object of different initial temperature is introduced into a medium at a different temperature? (F)
- How does **Newton's Law of Cooling** mathematically describe the rate at which the temperature of a heated object changes as it interacts with a surrounding medium? (C)
- How does **Newton's Law of Cooling** illustrate the principles of heat transfer between an object and its surroundings? (C)

Generalization 4:

- What are **mixing problems**? (F)
- How does the initial concentration of each solution and their respective volumes influence the formulation of the differential equation used in a **mixing problem**? (F)
- How does the application of differential equations in **mixing problems** reflect the underlying principles of conservation of mass and the dynamics of concentration changes over time? (C)

Generalization 5:

- What is **Newton's Second Law of Motion**? (F)
- What is **terminal velocity**? (F)
- What is **escape velocity**? (F)
- How does **Newton's Second Law of Motion** mathematically relate the acceleration of an object to the forces acting upon it, including gravitational force? (F)
- What factors determine the **terminal velocity** of an object falling through Earth's atmosphere? (F)
- How does **terminal velocity** relate to the forces of gravity and air resistance as described by **Newton's laws**? (C)
- How does understanding the relationship between **Newton's Second Law of Motion**, **terminal velocity**, and **escape velocity** contribute to our ability to analyze and predict the behavior of objects in gravitational fields? (C)
- If an object were launched from Earth at precisely **escape velocity**, would it be forever free from the influence of Earth's gravitational pull, or are there other factors that could affect its trajectory over time? (P)
- To what extent does **Newton's Second Law** remain valid under extreme gravitational conditions, and when might its limitations become significant? (P)
- To what extent do additional forces—such as atmospheric drag or relativistic effects—expand our understanding of **terminal** and **escape velocity** beyond what **Newton's Second Law** provides? (P)

Content Knowledge

Critical facts and information that students are expected to **KNOW** at the end of the unit.

Students will know:

- how rate-of-change models are applied in real-world scenarios.
- how to explain the exponential model and its representation of growth and decay.
- how to describe Newton's Law of Cooling.
- how to apply differential equations to model concentration changes in mixing problems.
- how to analyze Newton's Second Law of Motion and related concepts like terminal velocity and escape velocity.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

In this unit, students will be given the opportunity to work collaboratively and independently.

Understand how rate-of-change models are applied in real-world scenarios.

- Analyze case studies and examples where rate-of-change models, such as first-order differential equations, are used to describe real-world phenomena like population growth, radioactive decay, chemical reactions, or economic trends.
- Practice formulating first-order differential equations that represent rate-of-change models based on given scenarios.
- Solve first-order differential equations using analytical and numerical methods to understand how solutions evolve over time.
- Verify the validity of rate-of-change models by comparing model predictions with empirical data or experimental results.

Explain the exponential model and its representation of growth and decay.

- Discuss the concept of exponential growth and decay in natural and social systems, emphasizing how the rate of change of a quantity is proportional to the quantity itself.
- Analyze how real-world applications of exponential growth and decay accurately describe the dynamics of these processes and discuss their practical implications.
- Compare the exponential model with other growth and decay models, such as linear growth or logistic growth.
- Investigate the sensitivity of the exponential model to changes in parameters such as growth rates or initial conditions.

Describe Newton's Law of Cooling.

Portrait of the Newtown Graduate

- Investigate real-world applications of Newton's Law of Cooling in various contexts, such as food preservation, climate control systems, or medical applications.

Apply differential equations to model concentration changes in mixing problems.

- Formulate differential equations that describe the rate of change of concentration in a mixing problem.
- Discuss how to incorporate factors such as flow rates, initial concentrations, and mixing efficiencies into the differential equation.
- Explore how different parameters and initial conditions affect the concentration profile and mixing efficiency.
- Apply differential equations to solve engineering problems involving mixing, such as designing chemical reactors, optimizing pollutant dispersion in environmental engineering, or calculating drug concentrations in pharmacokinetics.

Analyze Newton's Second Law of Motion and related concepts like terminal velocity and escape velocity.

- Formulate differential equations to describe the concentration changes of reactants and products in chemical reactions occurring within reactors.
- Solve differential equations to predict reaction rates, optimize reactor design, and determine the necessary conditions for desired product yields.
- Develop differential equations to model the dispersion of pollutants in air, water, or soil environments.
- Apply pharmacokinetic models to optimize drug dosage regimens, understand drug interactions, and design drug delivery systems for enhanced therapeutic efficacy.

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Rate of change model
- Growth and Decay
- Exponential Model
- Newton's Law of Cooling
- mixing problem
- Newton's Second Law of Motion
- Terminal velocity
- Escape velocity

Resources

Teacher and student resources used to support the learning.

[https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_\(Trench\)/03%3A_Numerical_Methods](https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_(Trench)/03%3A_Numerical_Methods)

[1_Growth and Decay Quiz.docx](#)

[1_Growth and Decay.docx](#)

[2_Cooling and Mixing.docx](#)

[3_Mechanics.docx](#)

[Cooling and Mixing Quiz.docx](#)

[Growth and Decay Quiz.pdf](#)

[Growth and Decay.pdf](#)

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

- Create tiered problem sets where each tier varies in complexity and depth of conceptual understanding required.

- Provide students with options to choose problems aligned with their current understanding, allowing for differentiated learning experiences.
- Provide structured supports such as guiding questions, hints, or partial solutions to scaffold students' problem-solving skills while deepening their understanding of concepts.
- Design choice boards offering a variety of activities related to differential equations concepts.
- Implement think-pair-share activities where students individually reflect on a differential equations concept or problem, discuss their thoughts with a partner, and then share their insights with the class.
- Encourage students to explain their reasoning and engage in peer-to-peer learning, promoting collaborative understanding.
- Flip classroom instruction by providing pre-recorded lectures or readings on differential equations concepts for students to review outside of class.
- Organize peer teaching sessions where students research and prepare mini-lessons on specific differential equations topics.
- Facilitate problem-based learning workshops where students work collaboratively to solve authentic differential equations problems.
- Encourage students to make connections between theoretical concepts and real-world applications, fostering metacognitive awareness and deeper conceptual understanding.

Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.

Does not apply.



Unit Plan

Linear Second Order Equations

Newtown High School / High School / Mathematics

Week 25 - Week 31 | 5 Curriculum Developers | Last Updated: May 6, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

Students will be able to solve homogenous and non-homogenous differential equations using the constant of coefficient, the principle of superposition, reduction of order, and variation of parameters.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concepts:

- Homogenous
- Non-homogenous
- Second order differential equations
- Linear
- Constant coefficient
- Principle of superposition
- Particular solution
- Reduction of order
- General solution
- Variation of parameters

Lens: Variation

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Homogenous Linear Equations

Concepts:

- Homogenous
- Non-homogenous
- Second order differential equations
- Linear

1. A **homogenous** or **non-homogenous second order differential equation** can be **linear**.

Strand 2: Constant Coefficient Homogenous Equations

Concepts:

- Constant coefficient

2. A **constant coefficient** determines a **homogenous** equation.

Strand 3: Non-Homogenous Linear Equations

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is a **homogenous equation**? (F)
- What is a **non-homogenous equation**? (F)
- How can a **second order differential equation** be linear? (C)
- What is the different between a **homogenous** and **non-homogenous equation**? (F)

Generalization 2:

- What is a **constant coefficient**? (F)
- What defines a **homogeneous equation**? (F)
- Why does the presence of **constant coefficients** influence the structure of a **homogeneous equation**? (C)
- How does the behavior of solutions change when **coefficients** are **constant** versus variable? (C)
- Does the reliance on **constant coefficients** limit our understanding of more realistic, time-dependent phenomena in nature and engineering? (P)

Concepts:

- Principle of Superposition
- Particular solution

3. The **Principle of Superposition** breaks down a **non-homogenous** equation into smaller parts.

4. The smaller parts of a **non-homogenous** equation yields a **particular solution** for each part.

Strand 4: Reductions of Order

Concepts:

- Reduction of order
- General solution

5. **Reduction of order** finds the **general solution** to a **homogenous second order linear equation**.

Strand 5: Variation of Parameters

Concepts:

- Variation of parameters

6. **Variation of parameters** solves **non-homogenous linear** equations.

Generalization 3:

- What is the **principle of superposition**? (F)
- In what ways does the principle of **superposition** deepen our understanding of solutions to **homogeneous equations**? (C)
- How does the **principle of superposition** apply to the solutions of **homogeneous equations**, and what makes this principle inapplicable to **nonhomogeneous** cases? (C)
- Why is the distinction between **homogeneous** and **nonhomogeneous equations** essential when modeling physical systems, especially when interpreting the combined effects of external forces and natural system behavior?

Generalization 4:

- What is a **particular solution** to a differential equation? (F)
- How is a **particular solution** found using the principle of superposition? (C)

Generalization 5:

- What is the method for using the **reduction of order**? (F)

Generalization 6:

- What is the **variation of parameters**? (F)
- How is the **variation of parameters** used? (C)

Provocative: Is there a best method for solving **non-homogenous** second order differential equations?

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know how to:

- Identify the difference between a homogenous and non-homogenous linear equation.
- Determine a constant coefficient in a homogenous equation.
- Apply the principle of superposition.
- Identify the particular solution to a non-homogenous differential equation.
- Apply the reduction of order to find the general solution to a homogenous second order linear equation.
- Apply the variation of parameters to solve non-homogenous linear equations.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

- 1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
- 2. Work independently and collaboratively to solve problems and accomplish goals.
- 3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
- 4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
- 5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
- 6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

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In this unit, students will be given the opportunity to work collaboratively and independently.

Identify the difference between a homogenous and non-homogenous linear equation.

- Differentiate between homogeneous linear equation and a non-homogeneous linear equations based on the presence or absence of the non-zero forcing term (right-hand side) in the non-homogeneous equation.
- Explore the key characteristics of solutions to homogeneous and non-homogeneous linear equations.
- Discuss how the solutions to homogeneous equations form a vector space (the solution space) and include the trivial solution.
- Explore techniques like variation of parameters or the method of annihilators for solving non-homogeneous linear equations.
- Apply different methods for solving homogeneous linear equations, such as finding eigenvalues and eigenvectors for systems or using the method of undetermined coefficients for scalar equations.

Determine a constant coefficient in a homogenous equation.

- Define what constitutes a constant coefficient in the context of a differential equation or a system of linear equations.
- Investigate how constant coefficients affect the nature of solutions and the methods used to find them.
- Differentiate between homogeneous and non-homogeneous equations and their implications for constant coefficients.
- Explore applications in physics, engineering, and other fields where constant coefficient equations arise (e.g., vibrational systems, circuit analysis, population dynamics).
- Identify and analyzing specific examples of homogeneous equations with constant coefficients, and solving them using appropriate methods.

Apply the principle of superposition.

- Differentiate between superposition as applied to linear differential equations, integral equations, and systems of linear equations.
- Solve practical problems in physics, engineering, and other fields by decomposing them into individual components and applying the principle to find the total solution.
- Explore the limitations and conditions under which the principle of superposition holds.

Identify the particular solution to a non-homogenous differential equation.

- Identify and calculate the particular solution using either the Method of Undetermined Coefficients or Variation of Parameters.
- Interpret the particular solution in the context of the problem and discuss its significance.
- Solve the differential equation using both the particular solution method and numerical methods.
- Discuss on the advantages and disadvantages of using analytical methods (such as finding particular solutions) versus numerical methods in solving differential equations with non-homogeneous terms.

Apply the reduction of order to find the general solution to a homogenous second order linear equation.

- Compare and contrast reduction of order with variation of parameters in terms of ease of application and conceptual understanding.
- Explore real-world applications where second-order homogeneous linear differential equations arise, such as mechanical vibrations, electrical circuits, or heat conduction.
- Apply reduction of order to find the general solution and interpret the solutions in the context of the physical or engineering problem.
- Discuss how the general solution encapsulates the behavior and characteristics of the system under study.

Apply the variation of parameters to solve non-homogenous linear equations.

- Contrast the variation of parameters method with the method of undetermined coefficients for solving non-homogeneous linear differential equations.
- Discuss when it is advantageous to use variation of parameters over the method of undetermined coefficients based on the structure of the non-homogeneous term.
- Explore practical applications where non-homogeneous linear differential equations arise, such as in physics (e.g., forced oscillations, electrical circuits) or engineering (e.g., control systems, fluid dynamics).
- Formulate differential equations based on these applications and provide initial conditions.

Vocabulary




Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

- Homogenous
- Non-homogenous
- Second order Differential Equations
- Linear
- Constant Coefficient
- Principle of Superposition
- Particular solution
- Reduction of order
- General Solution
- Variation of parameters
- Complementary equation
- Characteristic Equation
- Distinct Real Roots
- Repeated Real Root
- Complex Conjugate Root
- Forcing Function
- Cramer's Rule




Resources

Teacher and student resources used to support the learning.

[https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_\(Trench\)/05%3A_Linear_Second_Order_Equations](https://math.libretexts.org/Bookshelves/Differential_Equations/Elementary_Differential_Equations_with_Boundary_Value_Problems_(Trench)/05%3A_Linear_Second_Order_Equations)

 2nd order linear homogeneous.pdf  

 Homogeneous Constant Coefficient.docx  

 non-Homogeneous Constant Coefficient.docx  

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

Core learning activities, resources and assessments that meet the needs of all learners.

- Create tiered problem sets where each tier varies in complexity and depth of conceptual understanding required.
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Test Prep Connections

As appropriate, include activities that build skills for standardized testing, such as IABs.

Does not apply.



Unit Plan

Laplace Transformations

Newtown High School / High School / Mathematics

Week 32 - Week 38 | 5 Curriculum Developers | Last Updated: May 6, 2025 by Bremer, Kathleen

Concept-Based Curriculum Unit Template

Purpose of the Unit

The overarching goal(s) of the unit.

Students will solve differential equations using the Laplace transform.

Conceptual Lens/Concepts

Concepts are the "big ideas" of the unit. The conceptual lens is a particular concept that focuses the thinking of the unit.

Concepts:

- Laplace transforms
- Linearity
- Time shifting
- Frequency shifting
- Inverse Laplace transform tables
- Heaviside's method
- Partial fraction decomposition
- time domain
- Solution of Initial Value Problems
- The unit step functions
- Constant coefficient equations with piecewise continuous forcing functions
- Convolution
- Constant coefficient equations with impulses

Lens: Simplification of a Complex System

Generalizations

*Critical conceptual relationships that students are expected to **UNDERSTAND** at the end of the unit.*

Strand 1: Intro to Laplace Transforms

Concepts:

- Laplace transform
- Linearity
- Time shifting
- Frequency shifting

1. The **Laplace transform** uses **linearity**, **time shifting**, and **frequency shifting** properties to simplify the solution to complex engineering, physics, and control theory problems.

Strand 2: Inverse Laplace Transforms

Concepts:

- Inverse Laplace transform tables

Guiding Questions

A combination of Factual (F), Conceptual (C) and Provocative/Debatable (P) questions that lead to the generalizations. Label each question (F), (C) or (P).

Generalization 1:

- What is a **Laplace Transform**? (F)
- What is the **linearity** property? (F)
- What is **time shifting**? (F)
- What is **frequency shifting**? (F)
- How are integrals and exponentials used to find **Laplace transforms**? (C)
- How can the table of Laplace transforms be used to find the **Laplace transform**? (C)
- How can the **Linearity** property be applied to complex linear differential equations. (C)
- How are the **Laplace transforms** of piecewise functions found? (C)

- Heaviside's method
- Partial fraction decomposition
- time domain

2. The **inverse** transform converts solutions back to the **time domain** using **Heaviside's method**, **Laplace transforms tables**, **partial fraction decomposition** tables to providing meaningful physical interpretations.

Strand 3: Applications of Laplace Transforms

- Solution of Initial Value Problems
- The unit step functions
- Constant coefficient equations with piecewise continuous forcing functions
- Convolution
- Constant coefficient equations with impulses

3. **Initial value problems**, **unit step functions**, **constant coefficient equations with piecewise continuous forcing functions**, **convolution**, **constant coefficient equations with impulses** illustrate the broad applicability of differential equations and the Laplace transform in modeling real-world problems.

Laplace transforms are used to solve initial value problems for constant coefficient second order equations.

Generalization 2:

- What is **Heaviside's method**? (F)
- Why must Laplace transforms be converted back to the **time domain**? (F)
- How can the table of Laplace transforms be used to find the **inverse Laplace transform**? (C)
- How can the **inverse transform** of a rational function be found? (C)
- How is **Heaviside's method** used to find the **inverse Laplace transform**? (C)
- How can **partial fraction decomposition** be used to simplify complex rational expressions into forms that are easily inverted using transform tables? (C)
- What challenges or considerations arise when transforming and interpreting the solution in the **time domain**? (C)

Generalization 3:

- What is **Convolution**? (F)
- What are **Constant coefficient equations with impulses**? (F)
- What are some real world **applications of Laplace transforms**? (F)
- How does the Laplace transform aid in solving **initial value problems** in differential equations? (F)
- In what way does the Laplace transform facilitate the solution of **constant coefficient equations with piecewise continuous forcing functions**? (F)
- How do **unit step functions** enhance the modeling of systems in differential equations? (F)
- How does the Laplace transform methodically handle **initial value problems** in differential equations, and what advantages does it offer over traditional methods like separation of variables? (C)
- How does the role of **unit step functions** facilitate the modeling of systems, and what are the implications of their use in representing system behavior with sudden changes?
- In what way do Laplace transforms effectively solve **initial value problems** with discontinuous functions, such as unit step functions and piecewise continuous forcing functions? (P)

Content Knowledge

*Critical facts and information that students are expected to **KNOW** at the end of the unit.*

Students will know how to:

- Find Laplace transforms.
- Find inverse Laplace transforms.
- Apply Laplace transforms to differential equations.

Critical Skills

Critical skills that students are expected to be able to **DO** at the end of the unit.

1. Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks.
2. Work independently and collaboratively to solve problems and accomplish goals.
3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
5. Effectively apply the analysis, syntheses, and evaluative processes that enable productive problem solving.
6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

Standards

The content standards that are taught and/or assessed in this unit.

Core Learning Activities

The learning activities that support the acquisition of content knowledge, attainment of critical skills and lead to the generalizations of the unit. Activities should be clearly articulated, include teacher instructions and identify optional vs. assured experiences.

In this unit, students will be given the opportunity to work collaboratively and independently.

Find Laplace transforms.

- Understand the definition of the Laplace transform and its basic properties.
- Apply the step-by-step process of transforming a differential equation into an algebraic equation using the Laplace transform
- Apply linearity, time-shifting, scaling properties to find Laplace transforms of polynomial, exponential, and trigonometric functions.
- Transform different types of differential equations (ordinary and partial) with constant coefficients into algebraic equations using the Laplace transform.
- Use Laplace transform tables.

Find inverse Laplace transforms.

- Solve initial value problems using the transformed equations and then inverse Laplace transform to find the solution in the time domain.
- Apply inverse Laplace transforms to model and analyze practical scenarios, verifying solutions through both Laplace and time domain perspectives.
- Apply the inverse Laplace transform to solutions obtained in the Laplace domain to derive explicit solutions in the time domain.
- Use partial fraction decomposition to decompose the Laplace transform into simpler fractions to facilitate the inverse transform.

Apply Laplace transforms to differential equations.

- Solve initial value problems by combining the transformed differential equation with the transformed initial conditions, and then applying inverse Laplace transform to find the solution in the time domain.
- Apply advanced techniques such as partial fraction decomposition and convolution theorem in the context of Laplace transforms.
- Explore applications of Laplace transforms in engineering disciplines (electrical, mechanical, chemical) to solidify understanding and relevance.
- Investigate Laplace transforms to handle special functions like unit step functions, piecewise continuous functions, and impulses and understand their significance in practical applications (circuit analysis, control systems, etc.).
- Apply the convolution theorem to solve non-homogeneous differential equations with various types of forcing functions (polynomial, exponential, sinusoidal).

Portrait of the Newtown Graduate

- Explore applications in control theory, circuit analysis, and mechanical systems

Vocabulary

Academic and content-specific vocabulary needed to support knowledge, understanding and/or skills.

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- Time shifting
- Frequency shifting
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- Solution of Initial Value Problems
- The unit step functions
- Constant coefficient equations with piecewise continuous forcing functions
- Convolution
- Constant coefficient equations with impulses

Resources

Teacher and student resources used to support the learning.

Department developed materials on google drive.

[William F. Trench, Elementary Differential Equations with Boundary Value Problems](#)

Assessments

The means by which students will demonstrate what they know (content knowledge), what they can do (critical skills), and what they understand (generalizations) as a result of their learning from the unit.

Differentiation

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