4th grade
Game Design Unit
Time frame: 13 – 15 hours of instruction
Topic: Design thinking, Engineering design process,

Nutley Public Schools

Nutley TALENT
"Nutley Together Achieving Lasting Engagement
to Build National and Local Talent."

Stage 1 – Desired Results

Nutley TALENT programming design keeps the *Partnership for 21st Century Skills* Learning and Innovation Skills Framework and Michael Fullan's *New Pedagogy for Deeper Learning* at its core. The program, therefore, incorporates 6 C's:

Collaboration
Creativity
Critical Thinking
Communication
Citizenship
Character

The National Association for Gifted Children provides standards:

3.2. Talent Development. Students with gifts and talents become more competent in multiple talent areas and across dimensions of learning.
3.4. Instructional Strategies. Students with gifts and talents become independent investigators.
4.1. Personal Competence. Students with gifts and talents demonstrate growth in personal competence and dispositions for exceptional academic and creative productivity. These include self-awareness, self-advocacy, self-efficacy, confidence, motivation, resilience, independence, curiosity, and risk taking.

Understandings:	**Essential Questions:**
● Students will understand how other games work by evaluating games that they already play ● Students will learn to collaborate with peers ● Students will understand how to modify their idea to achieve consensus ● Students will create a plan to develop their own ideas	● What makes a game fun? ● What makes a game boring? ● What are essential components of a board game? ● How can we evaluate a "mentor game" so that we can bring in the best parts to our own game? ● How can our critique be useful to improve the game? ● Important: Student-generated questions through a Question Formulation Technique protocol (rightquestion.org) ignite thinking and a focus on areas of student interest.

- *Students will know how to use their gifts and talents to share ideas, collaborate, analyze and implement their vision.*
- *Students will be able to overcome challenges to collaboration, learn to use available resources, understand how to design for outcomes.*

Stage 2 – Assessment Evidence

Performance Tasks:

- Compiling a list of essential components of every game
- Brainstorming using mind mapping technique or graphic organizers
- Designing a prototype gane
- Use materials available in a novel or creative manner
- Build a game that can be played by peers, working in class, but also creating parts of the game outside of school, tapping into resources at home and in school if available.

Other Evidence:

- Teacher assesses students ongoing participation, collaboration and clarity of expression
- Students with talent are encouraged to use their areas of strength in the game-design process
- Students investigate the academic components of games and create challenge questions that cross academic disciplines.
- Teachers notice student self-awareness when collaborating, self-advocating and designing new versions of game.
- Collaboration during the culminating game playing event.
- Debriefing the game playing experience – What did we learn? What would we improve? What was successful? How can we incorporate what we learned into a second iteration of the culmination?
  What do we wish we knew when we started?

Stage 3 – Learning Plan

Learning Activities:

- Brainstorming: "What are the components of every game?
- Metacognition – What is it?
- Leonardo Da Vinci as a model for creative thinking
- Mind mapping our ideas
- Sharing ideas within a small group
- Sketch out an initial idea
- Assembling materials from school and home: paper, markers, glue sticks, paints, clay, toothpicks, large papers, scissors
- Creating a back story for the game
- Creating characters that fit into the backstory
- Matching the story and the physical design of the game
- Designing and perfecting simple directions to play the game.
- Designing and perfecting simple rules for players
- Deciding on roles of group members based on interests
- Creating game prototypes with simple materials
- Testing the prototype
- Discussing the pros and cons of each version of the game with peers
- Ongoing practice: students assign homework to peers
- Students use Google Classroom to collaborate in real time, ask for instructor comments and add game

back stories and project modifications
- Students will invite their classroom teachers to choose peers who want to participate in a culminating game playing activity by drawing popsicle sticks
- Students will discuss what went right and what needs improvement about their games
- Students will begin to understand the iterative nature of all human products

Annotated Resource List for Game Design

- Framework for 21st Century Learning. Retrieved from http://www.p21.org/about-us/p21-framework

These resources are crucial to keep in mind the 4cs, ways to assess competencies and cross-curricular connections.

- K-12 Lab Network at the Standford D-School. https://dschool.stanford.edu/resources/

A plethora of resources are available at the Standford University D-School. Materials about how to create a space for design thinking, ways to help students innovate, protocols that make this possible, and the opportunity to connect with K-12 educators that want to incorporate more design thinking into their classrooms.

Swan, M., Binns, B and John Gillespie. Design a board game.
http://www.mathshell.com/publications/numeracy/boardgame/boardgame_teacher.pdf

This 96-page pdf could be a full-year GT curriculum. The examples of games to test, ways to support student thinking and critique are outstanding resources for this unit. Furthermore, the gaming unit keeps our students' mathematical development firmly in mind as students understand how to use numbers and sequences in new ways with peers.

Juliani, A.J. "Let's be intentional about innovation." http://ajjuliani.com/

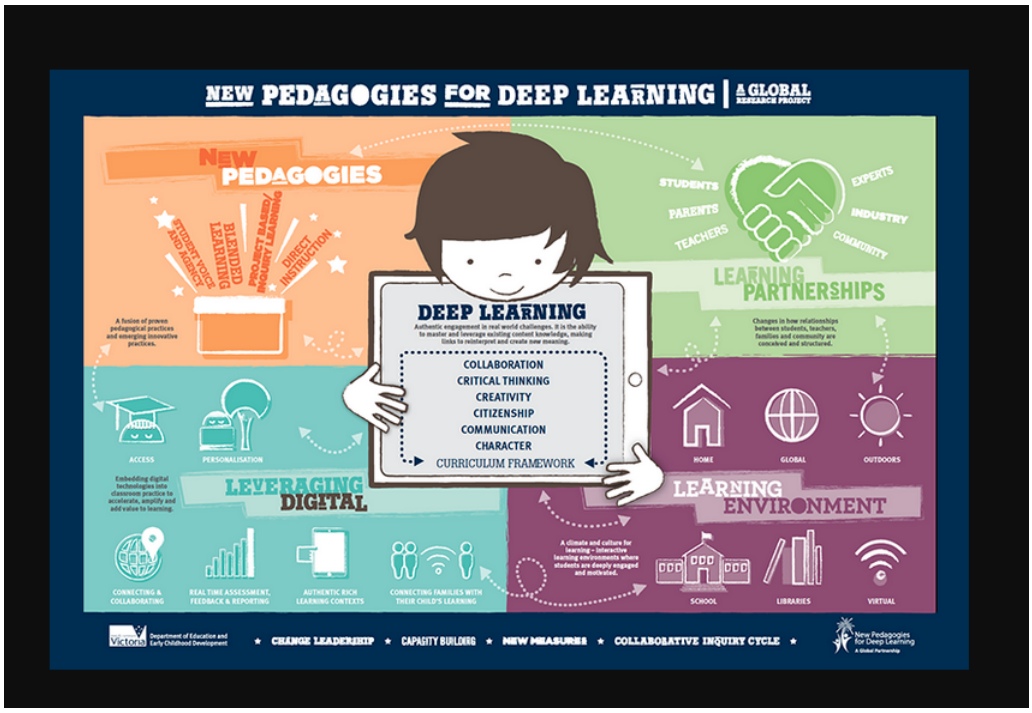
A.J. Juliani provides a constant stream of resources related to design thinking, innovation, inquiry and engagement. Newsletters, three recent books on project-based learning and design offer continual resources, chances to collaborate with peers across the world (faculty and students) as well as practical tips on how to create lessons that incorporate the 4cs and design thinking.

Wise, Susie. Design Thinking in Education: Empathy, Challenge, Discovery, and Sharing

Edutopia is a wonderful source for educators' experiences with design thinking. Susie Wise's article is but one example of many on the site.

Deeper Learning as a Frame

The 6 Cs of Deep Learning are incorporated by asking questions, focusing on competencies, using Question Formulation Technique (QFT, rightquestion.org), respectful group norms, mind mapping, intellectual risk taking, infusion of purpose/service


NEW PEDAGOGIES FOR DEEP LEARNING | A GLOBAL RESEARCH PROJECT
NEW PEDAGOGIES
STUDENT VOICE AND AGENCY
BLENDED LEARNING
PROJECT BASED/ INQUIRY LEARNING
DIRECT INSTRUCTION
A fusion of proven pedagogical practices and emerging innovative practices.
DEEP LEARNING
Authentic engagement in real world challenges. It is the ability to master and leverage existing content knowledge, making links to reinterpret and create new meaning.
COLLABORATION
CRITICAL THINKING
CREATIVITY
CITIZENSHIP
COMMUNICATION
CHARACTER
CURRICULUM FRAMEWORK
STUDENTS
PARENTS
TEACHERS
EXPERTS
INDUSTRY
COMMUNITY
LEARNING PARTNERSHIPS
Changes in how relationships between students, teachers, families and community are conceived and structured.
ACCESS
PERSONALISATION
Embedding digital technologies into classroom practice to accelerate, amplify and add value to learning.
LEVERAGING DIGITAL
CONNECTING & COLLABORATING
REAL TIME ASSESSMENT, FEEDBACK & REPORTING
AUTHENTIC RICH LEARNING CONTEXTS
CONNECTING FAMILIES WITH THEIR CHILD'S LEARNING
HOME
GLOBAL
OUTDOORS
LEARNING ENVIRONMENT
A climate and culture for learning – interactive learning environments where students are deeply engaged and motivated.
SCHOOL
LIBRARIES
VIRTUAL
Department of Education and Early Childhood Development
CHANGE LEADERSHIP
CAPACITY BUILDING
NEW MEASURES
COLLABORATIVE INQUIRY CYCLE
New Pedagogies for Deep Learning
A Global Partnership

5th Grade
Unit: Our Amazing Brain
Time: 13-15 hours of instruction
Topic: Neuroscience, Neurodiversity, Brain Rules

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Nutley TALENT

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Stage 1 – Desired Results

Nutley TALENT programming design keeps the Partnership for 21st Century Skills Learning and Innovation Skills Framework and Michael Fullan's New Pedagogy for Deeper Learning at its core. The program, therefore, incorporates 6 C's continually by using strategies, protocols and practices that enhance the following:

Collaboration
Creativity
Critical Thinking
Communication
Citizenship
Character

The National Association for Gifted Children standards:

3.4. Instructional Strategies. Students with gifts and talents become independent investigators.
4.3. Leadership. Students with gifts and talents demonstrate personal and social responsibility and leadership skills.
4.1. Personal Competence. Students with gifts and talents demonstrate growth in personal competence and dispositions for exceptional academic and creative productivity. These include self-awareness, self-advocacy, self-efficacy, confidence, motivation, resilience, independence, curiosity, and risk taking.

Understandings:	**Essential Questions:**
● Students will understand how their brains work to coordinate everything we do. ● Students will appreciate the complexity and coordination between different parts of their brains and bodies. ● Students will understand how human perception differs.	● How does our brain work? ● Do people see and think the same way? ● Are there research based practices that will help our brain function better? ● How do people know that what their brain tells them is true? (perception) ● How does nutrition affect the brain?

Students will know . . .

- The lobes of the brain and what they do
- The role of neurons and how they pass information through the brain
- What magnifications of neurons and their movements looks like

- How to describe what happens in their brains
- That the brain can improve and change and is not static
- That people's brains work differently (neurodiversity)

Students will be able to…

- Describe how their brains work, using **academic language**
- Imagine and visualize the flow of electrical energy through their neural network
- Learn how to help their brains work better
- Begin to appreciate the way different people's brains work in diverse ways
- Engage in conversation and dialog about how the brain works with their peers.

Stage 2 – Assessment Evidence

Performance Tasks: **(Choices)**	**Other Evidence:**
• At the end of this unit, students will create and perform a song that describes the way that their amazing brain works. • Students will participate in an academic trivia experience learning about their brain vocabulary and ways that the brain works. • Students write a story about a student who shrinks down so small that she can travel through the amazing brain on a journey.	• Through formative assessments, students will demonstrate their familiarity with brain vocabulary and an understanding of brain functions. • Students will create a hat that depicts their brain lobes and will be able to touch a lobe on their heads, name a lobe and function. • Students will design a dance called "The Neuron Dance" based on a student projects like https://www.youtube.com/watch?v=mcQ1H4K64kA

Stage 3 – Learning Plan

Learning Activities:

Introduction: The "Amazing Brain" unit involves more content development and focus than many others, asking that students learn the names of brain lobes, neuroscience terminology and functions of the brain. The names and functions of the different lobes of the brain are emphasized, but also the fact that ongoing research is uncovering information that is informing our understanding of our amazing brains. Students dig into the nature of perception, the movement of 100 billion neurons in their brains, the diversity of human brains. The unit asks that students learn and even memorize a great deal of information about the brain in order to be able to talk about the brain and its functions using proper academic vocabulary and discussing with understanding what the different parts of the brain do and how they work in concert. There are many resources indicated below, but they may be selected according to the group's interest/ability to grasp the material. Drawing, charting, thinking, wondering and the use of high quality videos helps students begin to understand the amazing brain in their heads. Furthermore, students understand that what they do - how they live - will affect the optimal functioning of their brains. John Medina's Brain Rules offer a deepening of the students' understanding that will allow them to design a culminating project which may be a brain song, dance, or presentation. What matters here is not that students retain all of the information we cover, but that they understand key ideas: The brain has a variety of functions, what we do affects its functioning and our amazing brains are all different.

- Introduction: Students draw their vision of their brain. "Draw what you think your brain looks like and name any parts you may know."
- Think, pair, share - Discuss their drawings (Think, Pair, Share)
- During weeks of class, present the slide deck a few slides at a time, stopping for explanation, movement, Q & A.
- https://docs.google.com/presentation/d/1V1RyLBXUi0tsc-lZc90GFxJP-vUr1AVsn0-SVKiMT-0/edit?usp=sharing
- Discuss with students the differences they see between what they drew and first imagined the brain would be and then compare this image to what is actually in their brains. Move to slide 21 to see a diagram of a neuron.
- The slide deck is the content for several classes. Stop and present activities at key slides. "Neurons" on slide three is a lesson composed of several parts:

  Neurons - Show, https://www.youtube.com/watch?v=GIGqp6_PG6k "Firing Neurons, Cell Dance" - Have students draw a neuron, talk about what surprises them, is interesting. Next, share the youtube song, "Neuron Dance" - a silly, catchy song students love. Play several times and sing along.

  Depending on interest, one may draw from the PBS lesson plan for high school and adapt for 5th graders - There are many adaptable activities - Prompts great discussions of opticle illusions
  https://www.pbs.org/newshour/extra/lessons-plans/nobel-prize-medicine-honors-discoveries-cells-move-cargo-neuroscience-lesson-plan/

  Students can create their own optical illusions

- Pass out "**Brain Vocabulary**" cards for students to fill out as they watch the slides

  https://drive.google.com/drive/u/0/search?ogsrc=32&q=brain%20vocabulary

https://docs.google.com/document/d/1dATLshZ9wx2MhB5_MdpOt7aY5CPn1OKaHeFfTDWjnFQ/edit?usp=sharing

- **Perception** - Students view the “Inverted Vision Experiment” and wonder about how their brains and not their eyes interpret visual data https://www.youtube.com/watch?v=MHMvEMy7B9k
- Many more perceptual experiments are interesting to students. BBC offeres a http://www.bbc.com/future/bespoke/story/20150130-how-your-eyes-trick-your-mind/

- Students create a “Brain Hat” - http://www.ellenjmchenry.com/homeschool-freedownloads/lifesciences-games/documents/BrainHatColor.pdf

- After they create the brain hats, they pair up and touch the lobes and say what the lobes can do.

- Introduce John Medina’s “Brain Rules” http://www.brainrules.net/the-rules - There are many videos on the site as students learn about ways we can help our brains function better.

- Culminating activity - choice to reflect and share our brain journey. Here is a link to a song made by the whole class. https://docs.google.com/document/d/1R5QtgG9q8AMpFwIl9aDltvKNVXqiCuijdXCl9u0mSA0/edit?usp=sharing

- Whatever is created must be shared with peers to build communication and presentational skills and to share with the larger community.

Our Amazing Brain Resources

Brain Rules Illustrated. Website with videos and illustrated “Brain Rules.”http://www.brainrules.net/the-rules

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Center for Neurotechnology: A national science foundation education resource center. http://www.csne-erc.org/education-resources-teachers/neuroscience-elementary-school-students

- This resource has great background information for educators, but also student facing pages like “Your brain and nervous system” (http://www.csne-erc.org/education-resources-teachers/neuroscience-elementary-school-students)

5-Minute Film Festival: Learning and the Brain. *Edutopia.*

https://www.edutopia.org/blog/film-festival-brain-learning

Inverted vision experiment. https://www.youtube.com/watch?v=MHMvEMy7B9k

Medina, John. (2008). Brain rules : 12 principles for surviving and thriving at work, home, and school. Pear Press: Seattle, WA.

Materials for students

Brain hats
http://www.ellenjmchenry.com/homeschool-freedownloads/lifesciences-games/documents/BrainHatColor.pdf

Neuron Dance https://www.youtube.com/watch?v=mcQ1H4K64kA

Amazing Brain Slide Deck.
https://docs.google.com/presentation/d/1V1RyLBXUi0tsc-lZc90GFxJP-vUr1AVsn0-SVKiMT-0/edit?usp=sharing

Brain vocabulary cards

https://drive.google.com/drive/u/0/search?ogsrc=32&q=brain%20vocabulary

https://docs.google.com/document/d/1dATLshZ9wx2MhB5_MdpOt7aY5CPn1OKaHeFfTDWjnFQ/edit?usp=sharing

4th Grade
Scratch - Coding
Time Frame: 13 - 15 hours of instruction
Topic: Coding, designing, digital arts, creativity

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STAGE 1: DESIRED RESULTS

Nutley TALENT programming design keeps the Partnership for 21st Century Skills Learning and Innovation

Skills Framework and Michael Fullan's "New Pedagogy for Deeper Learning at its core. The 6 Cs:

Collaboration
Creativity
Critical Thinking
Communication
Citizenship
Character

National Association for Gifted Children

3.3. Talent Development. Students with gifts and talents develop their abilities in their domain of talent and/or area of interest.
3.4.1. Educators use critical-thinking strategies to meet the needs of students with gifts and talents.

3.4.2. Educators use creative-thinking strategies to meet the needs of students with gifts and talents.

3.4.3. Educators use problem-solving model strategies to meet the needs of students with gifts and talents.

STAGE 2: ASSESSMENT EVIDENCE

Understandings:

Students understand how to code by learning step by step thinking.
Students begin to create scenes that tap into their imagination.
Students realize that they can use digital tools to create exciting images and games.
Students learn to teach other students tech skills.

Essential Questions:

How can using a step by step process on my computer create images?
How can I create simple animations by coding?
How can I help other students learn to code and create using Scratch?

STAGE 3: LEARNING PLAN

Students access the Scratch Lesson plan available on Harvard University resources.

http://scratched.gse.harvard.edu/resources/scratch-lesson-plan

First, students learn Scratch and create various projects using the Scratch tools listed in the resources. Ample time is provided for students to experiment and create multiple samples to share with peers.

- Introduction

The children should be introduced to Scratch as an exciting area of ICT which lets them create their own computer programs which incorporate their own sounds and graphics. Show them the introductory video from MIT and explain that they are going to learn how to be computer programmers. You can demonstrate a variety of sample applications from our collection or download examples from the Scratch website. Try and show a variety of applications to generate interest from everyone in the class. Now you can begin the lesson plan which introduces most of the important aspects of Scratch. The children need some structured guidance at the beginning of each session but should be exploring Scratch or building their own projects for at least half of each session.

- Draw a Sprite and Background

Children make a sprite and experiment with different drawing tools, many of which may already be familiar to them. They can resize the finished sprite and duplicate it and move it around the screen. More sprites can be added and located on the screen before finishing off the drawing with a background. Sprites and backgrounds can be imported from existing graphics files located on the drive.

- Turtle Graphics

Turtle Graphics comprise Move and Turn commands which allow the child to move the sprite around the screen with simple control commands. These commands are an important way of introducing children to geometry when combined with the pen commands that leave a trail as the sprite moves. The idea is that the children can experiment themselves and discover how to draw a triangle, square, pentagon, and other shapes without necessarily knowing the angle required to draw each shape. This is an important principle of ‘constructivist’ learning that forms part of the power of the LOGO language used in education over the past thirty years. Scratch provides an easy way of getting children to use turtle graphics without the need for a physical robot.

- Moving and Sensing

The children should already have a good sense of how to move a sprite around the screen from the session on turtle graphics. Note that turtle graphics move the sprite relative to its current position and is a much simpler system to introduce to children than placing an object on a grid with X and Y co-ordinates. Scratch supports both approaches but we recommend that younger children stick to the relative movements and repeat turns of 30 degrees rather than learn the coordinates on a grid and angles. By all means use these features in Scratch if the children are already familiar with these concepts.

- Sounds and Graphics

Scratch makes it easy to import sounds and graphics into your application to use as effects or to create a complete multimedia presentation on your computer. This lesson shows children how to use the sounds and images provided with Scratch to create an interactive application which responds to the user clicking around the environment.

- Variables

Variables were briefly introduced in the session on turtle graphics and are a fundamental part of Scratch and computer programming in general. Variables are introduced as simple numbers which can be made available to the whole application or kept private for a particular sprite. The speed of a sprite might be a private variable whereas the score in a game might be available to all sprites.

- Broadcast and Receive
- Make a Game
- Build a multimedia presentation

Second, students go into all of the 4th grade classes, one class per week to teach all of their peers Scratch and share their samples during their GT class period. Students make a slideshow presentation to peers to point out various key aspects of the program and then they rotate through the classroom as tech support, helping their classmates create projects in Scratch.

Resources

Daly, James. (2009) Play to Learn: The Scratch Programming Language Sneaks Serious Fun into the Classroom. https://www.edutopia.org/scratch-programming-language-technology-tool

Scratch. https://scratch.mit.edu/

Scratch Junior. https://www.scratchjr.org/

Scratch for Educators. https://scratch.mit.edu/educators