# Unit 5, Hypothesis Testing

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## Title Section

## Department of Curriculum and Instruction

**Belleville Public Schools**

**Curriculum Guide**

# Statistics H, Grade 11,12

# Unit 5 - Hypothesis Testing

**Belleville Board of Education**

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## Unit Overview

In this unit students will learn the basic ideas of significance, the details of performing a significance test of a population proportion and the details about performing a significance test of the population mean. They will evaluate two mutually exclusive statements about a population to determine which statement is best supported by the sample data using hypothesis testing. They will understand that hypothesis testing will prove or disprove answers to particular questions. Students will define a hypothesis test formally and apply hypothesis testing in a variety of different situations.

## Enduring Understanding

A hypothesis test is a process in which an existing theory can be disproved.

A hypothesis test involves collecting and evaluating data from a sample to make a decision as to whether or not that data supports a claim made about a population.

A well-constructed sample will produce more accurate results. While conducting a hypothesis test we are not proving something is true, we are comparing a current hypothesis(we are assuming is true) against an alternate hypothesis.

## Essential Questions

How do we choose the correct inference procedure to test a statistical claim?Which type of hypothesis test is appropriate for a particular data set?

How can statistics be used to make decisions about a hypothesis?

What is the purpose of hypothesis testing?

What is the difference between a type 1 or a type 2 error?

## Exit Skills

Hypothesis Testing.

Null hypothesis. Alternate hypothesis.

z test for mean.

T test for mean.

z test for a proportion.

Test for variance or standard deviation.

Test the difference between two means.

Test the difference between proportions.

Test the difference between variances

## New Jersey Student Learning Standards (NJSLS)

| | |
|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| MA.K-12.7 | Look for and make use of structure. |
| MA.K-12.8 | Look for and express regularity in repeated reasoning. |
| MA.S-IC.A.1 | Understand statistics as a process for making inferences about population parameters |

| | |
|---|---|
| | based on a random sample from that population. |
| MA.S-IC.A.2 | Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. |
| MA.S-IC.B.3 | Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. |
| MA.S-IC.B.4 | Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. |
| MA.S-IC.B.5 | Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. |
| MA.S-IC.B.6 | Evaluate reports based on data. |
| MA.S-CP.A.4 | Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. |
| MA.S-CP.A.5 | Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. |

## Interdisciplinary Connections

| | |
|---|---|
| 9.3.12.BM.1 | Utilize mathematical concepts, skills and problem solving to obtain necessary information for decision-making in business. |
| 9.3.12.FN.1 | Utilize mathematical concepts, skills and problem solving to obtain necessary information for decision making in the finance industry. |
| 9.3.ST.2 | Use technology to acquire, manipulate, analyze and report data. |
| 9.3.12.BM.6 | Implement, monitor and evaluate business processes to ensure efficiency and quality results. |
| 9.3.ST-SM.2 | Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. |
| 9.3.ST-SM.3 | Analyze the impact that science and mathematics has on society. |
| 9.3.ST-SM.4 | Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data. |
| 9.3.GV-REV.3 | Design, develop, operate and review data analysis systems and procedures to minimize and eliminate revenue-related financial problems. |

## Learning Objectives

State appropriate hypothesis for a significance test about a population parameter

Understand and apply the definitions used in hypothesis testing.

State the five steps used in hypothesis testing.

Determine an appropriate null and alternate hypotheses for a given.

Interpret type I and type II errors and generalize consequences of each.

Use a CI to make a conclusion for a two sided test about a population parameter

Perform a significance test about a population mean.

Distinguish between independent and dependent samples.

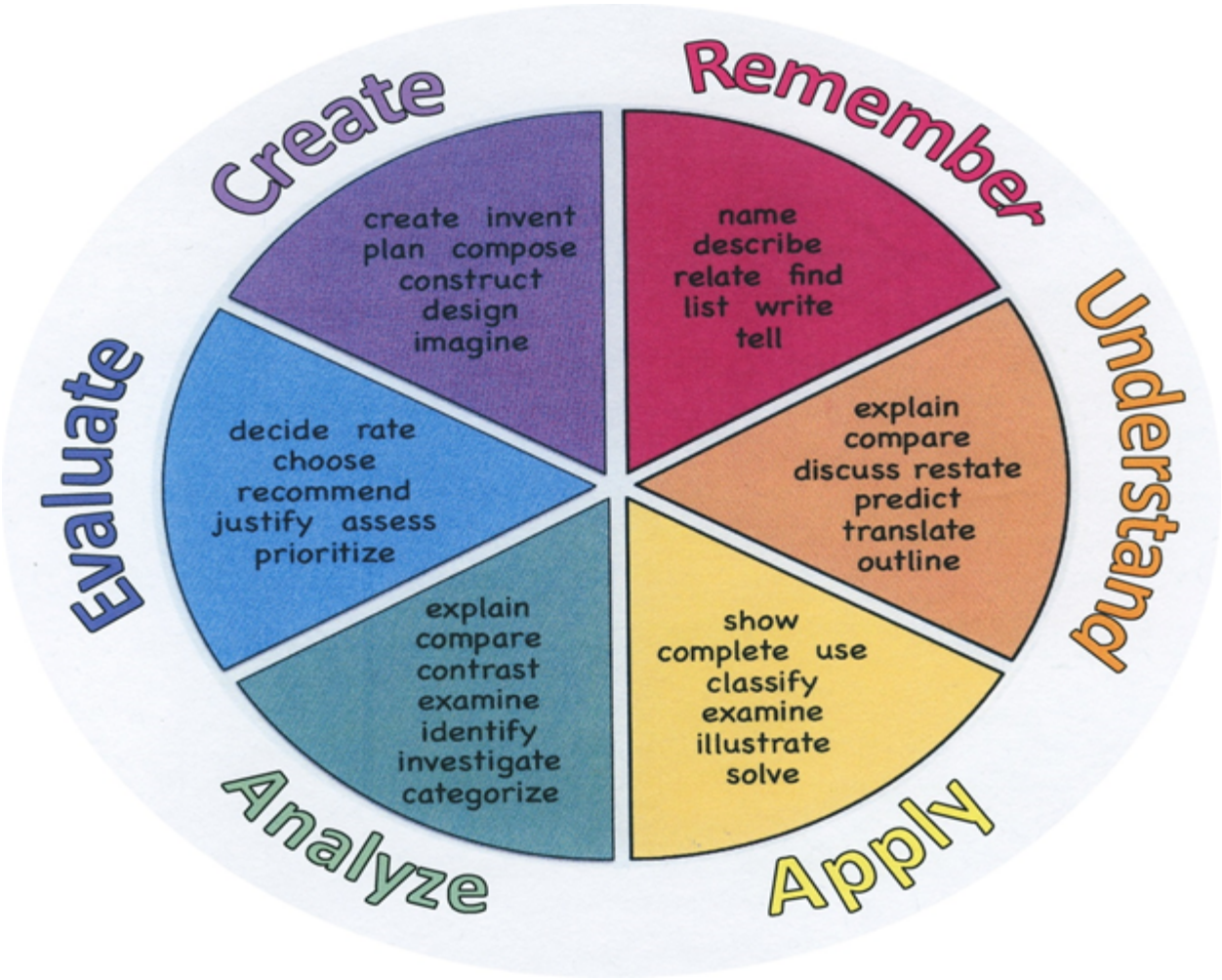
Perform matching pair t-test and interpret results.

Construct confidence interval for matched pair results.

Understand the cautions and limitations of hypothesis testing. Use paragraph method of conducting hypothesis tests.

**Action Verbs:** Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

| Remember | Understand | Apply | Analyze | Evaluate | Create |
|---|---|---|---|---|---|
| Choose | Classify | Choose | Categorize | Appraise | Combine |
| Describe | Defend | Dramatize | Classify | Judge | Compose |
| Define | Demonstrate | Explain | Compare | Criticize | Construct |
| Label | Distinguish | Generalize | Differentiate | Defend | Design |
| List | Explain | Judge | Distinguish | Compare | Develop |
| Locate | Express | Organize | Identify | Assess | Formulate |
| Match | Extend | Paint | Infer | Conclude | Hypothesize |
| Memorize | Give Examples | Prepare | Point out | Contrast | Invent |
| Name | Illustrate | Produce | Select | Critique | Make |
| Omit | Indicate | Select | Subdivide | Determine | Originate |
| Recite | Interrelate | Show | Survey | Grade | Organize |
| Select | Interpret | Sketch | Arrange | Justify | Plan |
| State | Infer | Solve | Breakdown | Measure | Produce |
| Count | Match | Use | Combine | Rank | Role Play |
| Draw | Paraphrase | Add | Detect | Rate | Drive |
| Outline | Represent | Calculate | Diagram | Support | Devise |
| Point | Restate | Change | Discriminate | Test | Generate |
| Quote | Rewrite | Classify | Illustrate | | Integrate |
| Recall | Select | Complete | Outline | | Prescribe |
| Recognize | Show | Compute | Point out | | Propose |
| Repeat | Summarize | Discover | Separate | | Reconstruct |
| Reproduce | Tell | Divide | | | Revise |
| | Translate | Examine | | | Rewrite |
| | Associate | Graph | | | Transform |
| | Compute | Interpolate | | | |
| | Convert | Manipulate | | | |
| | Discuss | Modify | | | |
| | Estimate | Operate | | | |
| | Extrapolate | Subtract | | | |
| | Generalize | | | | |
| | Predict | | | | |




## Suggested Activities & Best Practices

Graphing Calculators:TI-84 (Performing a one sample z test for a proportion,compute p values from t distributions, perform a one sample t test for a mean)

Starnes, The Practice of Statistics, 5e, Student Resources(online textbook, study guides, worksheets)

http://www.macmillanlearning.com/catalog/studentresources/tps5e

Statistical Lesson Resources:

http://www.apstatsmonkey.com/StatsMonkey/Statsmonkey.html

Actuarial Foundation lessons:

http://www.actuarialfoundation.org/programs/youth/hs-stats.shtml

Statistic Tutorials

https://stattrek.com/

Census Bureau:

https://www.census.gov/about/what.html

Videos:

http://www.learner.org/resources/series65.html?pop=yesd&pid=140#

apstatsguy.com

American Statistical Association:

http://www.amstat.org/

AP Statistic Resources:

https://apcentral.collegeboard.org/

Gallery of Data Visualization Best and Worst of Statistical Graphics:

http://www.datavis.ca/gallery/index.php

Desmos

https://learn.desmos.com/statistics

## Assessment Evidence - Checking for Understanding (CFU)

Starnes, The Practice of Statistics 5e, Asssessments (Summative)

Edulastic Formative Assessments (Formative):
https://app.edulastic.com/#renderResource/close/Mjk0MjE2ODUwOA%3D%3D

Exit tickets: Google Forms, Edulastic, paper & pencil (Formative)

Common Benchmarks on OnCourse:#4 (Benchmark)

- Admit Tickets
- Anticipation Guide

- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

## Primary Resources & Materials

Starnes, The Practice of Statistics, 5e textbook, ebook

The Practice of Statistics digital resources

## Ancillary Resources

TI-84 Graphing Calculator

ALEKS

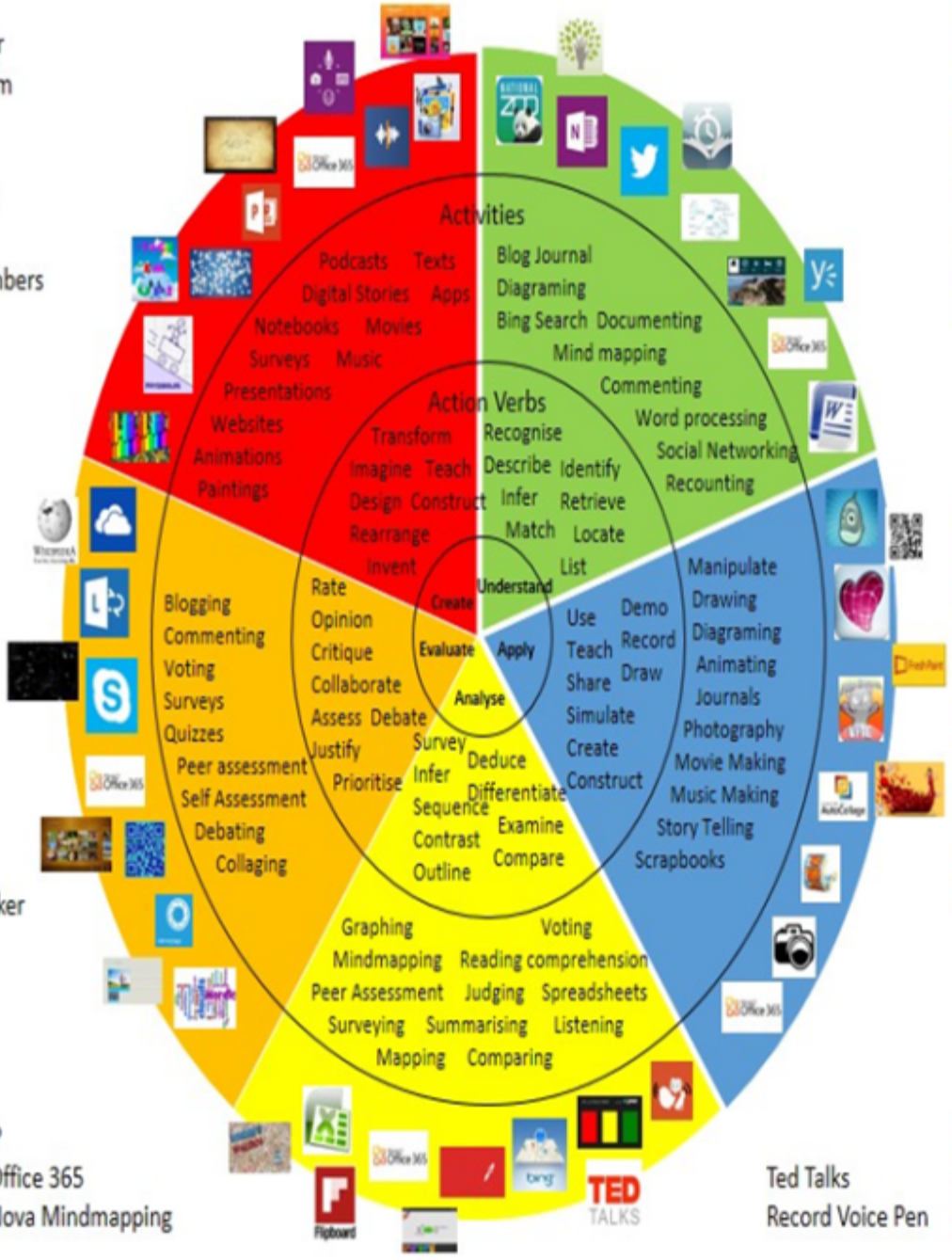
## Technology Infusion

- Youtube
- Khan academy
- Google Classroom
- GSuite
- Kutasoftware
- PodCasts
- Kahoot
- Twitter
- Ted Talks
- ALEKS
- QR Barcode Generator
- Calculator/Graphing calculator
- Flipgrid
- Peardeck
- Edulastic
- McGraw-Hill Education
- TI - 84 graphing Calculator
- Desmos.com
- Geogebra.org

# Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker




Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

## Alignment to 21st Century Skills & Technology

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

| | |
|---|---|
| CRP.K-12.CRP2 | Apply appropriate academic and technical skills. |
| CRP.K-12.CRP4 | Communicate clearly and effectively and with reason. |
| CRP.K-12.CRP7 | Employ valid and reliable research strategies. |
| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| CAEP.9.2.12.C.2 | Modify Personalized Student Learning Plans to support declared career goals. |
| TECH.8.1.12.A.3 | Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue. |
| TECH.8.1.12.F.CS1 | Identify and define authentic problems and significant questions for investigation. |

## 21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

## 21st Century Skills

- Civic Literacy
- Environmental Literacy

- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

## Differentiation

Graphing calculator(TI-84)

Differentiate by giving choice of assignments

Alternative assessments

Flexible grouping

Study Guides

Khan Academy statistics lessons

**Differentiations:**

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides

- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

**Hi-Prep Differentiations:**

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

**Lo-Prep Differentiations**

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

## Special Education Learning (IEP's & 504's)

Graphing calculator(TI-84)

Khan Academy statistics lessons

Use data visualization software to reason about any data variation observed

Modify data used

Verbal analysis of data

Alternative assessments

Flexible grouping

Study Guides

Choice of assignments(choice boards, choice tables)

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation

- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

## English Language Learning (ELL)

Graphing calculator(TI-84)

Khan Academy English or Spanish website https://es.khanacademy.org/math/probability

Use data visualization software to reason about any data variation observed

Modify data used

Verbal analysis of data

Alternative assessments

Flexible grouping

Study Guides

Choice of assignments

- teaching key aspects of a topic.  Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

## At Risk

Graphing calculator(TI-84)

Use of manipulatives and "hands-on" activities

Differentiate assignments giving choice of data based on student interest

Khan Academy Statistics lessons

Use data visualization software to reason about any data variation observed

Modify data used

Verbal analysis of data

Alternative assessments

Flexible grouping

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

## Talented and Gifted Learning (T&G)

Graphing calculator(TI-84)

Offer activities and problems that extend beyond the current assignments

AP Statistic tasks

Differentiate assinments giving more challenging one; or a task in which data is tailored to students' interests

Statistics software:

https://www.statcato.org/

Khan Academy Statistics lessons English/Spanish

Choice of Data:

http://www.statcrunch.com

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace

- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

## Sample Lesson

Using the template below, please develop a **Sample Lesson** for the first unit only.

Unit Name:

NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: