First and foremost this is a middle level mathematics unit appropriate for use in grades 6 through 8. The lessons are written to meet the demands of a 42-minute class period and multiple math classes. As a standards-based statistics unit, the key topics of study are: frequency tables and line plots, constructing and interpreting bar graphs, broken line graphs and scatter plots, surveys and sampling and in general the organization and visual presentation of data. This series of lessons was instructed as part of an interdisciplinary unit based upon the study of local forests. Written in partnership with the Marsh-Billings-Rockefeller National Historical Park, the focus of the instruction brings students to a better understanding of the historical use as well as future use of this now public land. With a substitution of data used, the unit could be adapted to other forest related sites.

The focus of the forest element is forest management and the science of forestry. Students come to understand the critical role mathematics plays when it comes to knowing the forest. The original worksheets are the result of much research. All of the data, tables, and charts supplied to the students came from the Vermont Department of Natural Resources and the National Park Service.

As a central element of the unit is learning how and why foresters count trees, local experts were called upon to share their knowledge with students. The county forester and the park resource manager conducted workshops and guided the students through their culminating activity, a circle sweep plot survey at Marsh-Billings-Rockefeller National Historical Park. Three field trips to the park, one of which was their field study, were critical pieces of the learning experience.

In the end students should have a deeper appreciation of how foresters use data, the importance of interpreting this data, and why it is necessary to present this information in meaningful ways. A suggestion for a related community service project is also included.

The essential and guiding questions which bring focus to this unit are:
Understanding Forest Management
Who counts the trees?
Why do they count the trees?
How do they count the trees?
## Essential Question:
Understanding Forest Management: Who counts the trees? How do they count the trees? Why do they count the trees?

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| 7.9 Students use statistics to:  
   aa. Create and interpret statistical tables and charts.  
   bb. Appropriately use measures of central tendency—mean, median, mode; understand the significance of frequency and distribution.  
   cc. Make conclusions and recommendations based on data analysis. | Construct and interpret frequency tables; line plots histograms, bar graphs, and broken line graphs.  
   Use and find measures of central tendency in appropriate ways.  
   Interpret data presented in tables and statistics.  
   Collect and analyze data.  
   Organize data and present data using the best possible representation.  
   Understand the basic concepts of forest management and the science of forestry.  
   Justify a proposal supported by data.  
   Create a useful and relevant product.  
   Perform effectively | Field Trip: "Adventure in the Forest," forest observation activities.  
   Lesson #1: Organizing data: frequency tables, line plots, and histograms -Parks for the people  
   Guest lecturer/slide presentation -"Vermont's Forests: Past, Present, and Future"  
   Lesson #2: Reading and constructing bar graphs -Vermont's forested acres -Looking at forest composition -Frederick Billings purchases trees for reforestation project | Hand-out: 1  
   Worksheet: 1A  
   Journal Entry  
   Worksheets: 2,3,8 | Quiz-answer key  
   Answer key  
   Answer key |
| 1.17aa Students represent data and results in multiple ways (e.g. numbers and statistics, charts, and tables.)  
1.20 Students use graphs, charts, and other visual presentations to communicate data accurately and appropriately.  
4.6bb Students demonstrate understanding of the | | | |
| 1.11 c. Students support proposals as appropriate through definitions, description, illustrations, examples from experience, and anecdotes. | on a team. Demonstrate tactful and responsive behavior. Make connections between mathematics and the science of forestry through direct experience. Complete circle sweep inventory. | we own? -How would this area compare to ownership in other areas in our country? Lesson #4: Constructing line graphs -Recreational uses of forests. -Foresters collect data to track park visitations. -Frederick Billings acquires land and builds his estate - Growth of NPS Lesson #5: Scatter plots -Looking for a correlation between the dbh and saw log height of sugar maples on stand 39 (MBRNHP). Lesson #6 Tree Sampling Simulation - how and why foresters count trees? -Line transect -Plot/quadrant survey -Circle sweep -Determining best sampling method for MBRNHP inventory; Workshop: Introducing the cruiser's stick | Line Graph Group work | Checklist Specified criteria Answer key Collection of data, class discussion Application Sharing data Rubric Unit Test Answer Key |
| 2.13 Students design a product, project, or service to meet an identified need. | | | |
| 3.10 Students perform effectively on teams that set and achieve goals, conduct investigations, solve problems, and create solutions (e.g., by using consensus building and cooperation to work toward group decisions.) | | | |
| 3.11 Students interact respectfully with others, including those with whom they have differences. | | | |
| 3.15 Students collect information about | | | |
careers, and experience Careers directly or indirectly through classroom work and community experiences.

1.14 Students critique what they have heard (e.g. oral presentation).

4.6aa. Students apply knowledge of local environment through active participation in local environmental projects.

-Windsor County forester instructs the use of the Biltmore stick.

Field Trip/Culminating Activity I Circle Sweep Survey at MBRNHP -Stand 39 field study - Compiling data

Lesson #7: Surveys and Samples - Designing a merchantable trail mix

**Culminating Activities:**
Activity 1: Circle Sweep Survey on site, Marsh-Billings-Rockefeller National Historical Park
Activity 2: Reception for community resource people, National Park rangers and staff and county forester, classroom presentations
Activity 3: Production and distribution of “Carriage Roads” Trail Mix
LESSON #3: Understanding Measures of Central Tendency

**Focusing Question:** The Green Mountain National Forest - who donates land, why do they donate, and how much land is generally donated each year to this public forest?

**Vermont Standards addressed:**

7.8 bb Students appropriately use measures of central tendency - mean, median, mode.

**Length of Lesson:** 1-2 class periods

**Resources/Materials:** Worksheet #4

**Procedure:**

1. **Focus:** Using worksheet #4, read the initial paragraph introducing the Green Mountain National Forest. Locate the forest on a state map. Introduce a discussion about public land, what are public lands? What are the purposes and uses of public land? Continue to focus on the need for management plans and the role of data when writing such plans.

2. **Opening the Lesson:**

Review the measures of central tendency, how each measure is found and how each is used to affectively represent data.

3. **Teach:** Using the data on worksheet #4 about donated acres to the northern half of the Green Mountain Forest, have students work in pairs to answer the worksheet questions. The lesson focusing question should be written on the white board so that students will answer this question as they sort the data.

4. **Practice:** Students should complete the worksheet and make a frequency table and line plot or histogram for the data. In addition, students should complete the investigation on the second page of the handout, gathering information on the land area of our homes.

5. **Follow-up:** Use the data collected through their investigation to focus a follow-up class discussion. Use this opportunity to reinforce our unique sense of place in Vermont, for example, how would this data look different if you went to school in Boston or Miami or Boise? Why do some of us own a great deal of land and others own much less? How is location a factor? How is land-use a factor? In addition, share with students why and how people donate their land for public use. (Currently there is a waiting list to donate/sell land to the Green Mountain National Forest. Many people donate or sell their land for tax purposes. In addition much of the land which is given or sold is not readily accessible for commercial use. Contact the U.S. Forest Service at the national forest for additional information.)
Assessment:

Students will: complete worksheet #4, construct a frequency table

survey 10 people about land ownership and organize data using the measures of central tendency

complete quiz on frequency and central tendency

Teacher will: facilitate all discussions

review worksheet (answer key)

assess quiz (answer key)
LESSON #7: Surveys and Samples

Focusing Question: Designing a "merchantable" Trail Mix: what are your favorite ingredients in a trail mix?

Vermont Standards addressed:

1.11 c     Students support proposals as appropriate through definitions, description, illustrations, and examples from experience and anecdotes.

2.13      Students design a product, project, or service to meet an identified need.

3.10    Students perform effectively on teams that set and achieve goals, conduct investigations, solve problems, and create solutions (e.g., by using consensus building and cooperation to work toward group decisions.)

3.11      Students interact respectfully with others, including those with whom they have differences.

Length of Lesson: Group Project, 3 class periods. (This project requires 3 class periods, but will span more than a week in time as students will need several days to collect the data from their surveys. It works nicely if students work on the graph of the history of the National Park Service at this time as each project requires out of class as well as in class group work.)

Resources/Materials: Group project sheets: 10 (2 sheets), 10A (recipe template)

Procedure:

1. Focus: Using worksheet #10, pose the question; what are your favorite ingredients in a trail mix? Have students share their likes and dislikes as a group.

2. Opening the Lesson:

Inform students that as part of a community service project, they will be collecting important data as it relates to developing a recipe for a “merchantable” trail mix. This trail mix blend will reflect the species diversity found in Stand 39. There are 10 species currently recorded in the northern hardwood stand.

Using worksheet “Lesson 10: Taking a Survey” provide instruction on representative samples and surveys.

The students will work together in groups of four to develop surveys. Before students begin to develop their surveys ask the following guiding questions:

- What types of people enjoy trail mix?
- What age groups enjoy trail mix?
• Where can surveys be taken or distributed in a fair and safe manner so that the data reflects a true sampling?
• How should the survey be written? Should it be able to stand on its own so that it can be distributed and collected without the surveyor being present?

Establish fair criteria for the surveying process, such as appropriate deadlines for collecting data, how many surveys each group should complete, and what minimum number of choices for trail mix. Ingredients must be included in the survey. It is important at this point to troubleshoot any special circumstances which the students may encounter.

3. Practice: Each student in the group should design and type a sample survey for homework. During the next class, the group members must choose one or a combination of the best surveys in their group. That evening the final survey must be typed and presented for Xeroxing the next day. Students should have several days to collect their data.

When the surveys have been collected, students should complete frequency tables for the ingredient choices. Have students share their group tables with the class and construct one class frequency table on large grid paper.

Student groups should then go on to: construct a graph representing their data, determine the percentage for each of their responses, and write a proposal for their group recipe. Set appropriate due date for typed and edited proposal, see criteria on worksheet #10.

4. Follow-up: Using the class frequency table and the worksheet #10A, develop a class recipe for the trail mix based on the most frequently named ingredients. (Complete unit cost only if the information is readily available.)**

**Making the trail mix itself was one of the culminating activities for this unit of study. The activity is described in the Outline of Lessons.

Assessment:

Students will: be effective and thoughtful members of a small team

meet all due dates in a timely manner

successfully complete all criteria of the project including a table, graph, and written proposal

will design a "merchantable" trail mix recipe

Teacher will: encourage teamwork within the groups

establish fair due dates and assist students with process issues throughout the project
create a class frequency table of data

assess project using grading guide and rubrics

administer Unit Test (answer key)