Title of Lesson Plan	Finding the Basal Area of a Forest Plot to Determine Stocking Levels
Prepared	Richard Eberly
City and State	New Buffalo, Michigan
Grade Level(s)	9-12 Science Applications Course for Michigan Environthon
Keywords (subjects covered)	Basal Area, forests plots, diameter breast height, stocking levels, plotting, graphing, carrying capacity, competition, thinning, replanting
Brief Description	Students will use Woodlot Management Graphs and Forestry Plots to measure Basal Area and Determine the Plot Stocking Levels
Total Time Required	2 days
Setting	Students will work in the field for the 1st 72 minute class measuring their plots basal area. Students will work in the classroom plotting stocking graphs and comparing their field data to the graphs to determine appropriate stocking action. This could include thinning, replanting, or no action.
Lesson Objectives/Goals	The students should be able to measure the size of a forest plot. The students should be able to measure the basal area of the trees in the forest plot. The students should be able to plot a stocking level graph given the data points. The students should be able to calculate 60% values of provided data points. The students should be able to compare collected field data to the data they have plotted on their stocking graphs.
Materials Needed	Regular measuring tape, Basal area measuring tapes, graph paper, data tables, clipboards, pencils, calculators
Standards Addressed	Michigan Biology Standard B1.2k Analyze how science and society interact from historical, political, economic, or social perspective. Michigan Biology Standard L3.p1A Provide examples of a population, community, and ecosystem. Michigan Biology Standard L3.p2B Describe common ecological relationships between and among species and their environments (carrying capacity, competition). Geometry Standard L2.3.1 Covert units of measurement within and between systems; explain how arithmetic operations on measurements affect units, and carry units through calculations correctly. Algebra Standard L1.2.4 Organize and summarize a data set in a table, plot, chart, or spreadsheet; find

	patterns in a display of data; understand and critique data displays in the media.
Procedure	This lesson is to immediately follow the measuring tape generation lesson plan. Students were lead through the following inquiry process questions: 1. How could you compare two plots of a forest? 2. Could you determine which plot is more productive or profitable? 3. Would the biomass of the forest be related to the profitability of the forest? How? 4. How might you be able to measure the amount of biomass in the forest? 5. Measuring the diameter of a tree would be helpful, but the basal area is the standard for the biomass of a forest. How could we develop a measuring tape that could give both the diameter of the tree for board footage calculations and the basal area in square feet for biomass calculations? Students will be lead through the following inquiry process questions and activities on the 1st day of this lesson plan: 6. Could we use our new measuring tapes to find the basal area of the forest? 7. Where should we measure on the tree to be consistent? 8. How would we ensure that we are comparing plots that should be compared? (They should be the same size.) 9. Measure the size of your forest plot. Calculate the portion of an acre. (Remember that all data is to be reported on a per acre basis.) 10. Count and measure all of the trees in your forest plot at 4 ½ feet high (dbh) for basal area using your basal area measuring tapes. Students will be lead through the following inquiry process questions on the 2nd day of this lesson plan: 11. Why would we want to compare biomasses or basal areas of different forest plots? 12. How could we use the data we found on our forest plots to make good forestry management decisions? 13. Students will make maximum and minimum stocking level graphs of the data provided from Independent Sawmill and Woodlot Management Magazine. Since they are all Northern Hardwoods in

<table>
<tr><td></td><td>the Lake States, the data points are as follows:
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<tr><td>Basal Area per Acre</td><td>100</td><td>80</td><td>75</td><td>60</td><td>55</td></tr>
<tr><td>Trees per Acre</td><td>60</td><td>100</td><td>130</td><td>200</td><td>275</td></tr>
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14. Students need to calculate 60% of the data points provided for maximum stocking levels and plot them on the same graph.
15. Students then plot their own measured data on the graph and compare it to minimum and maximum stocking levels. If the collected forest plot data is above the maximum stocking levels, then thinning is necessary.
If the collected forest plot data is below the minimum stocking levels, then replanting is necessary.
If the stocking level is between the minimum and maximum then no action is necessary.</td></tr>
<tr><td>Assessment</td><td>Students will be assessed on their collected data, conversions, plotted graphs, and graphing interpretations.</td></tr>
<tr><td>Literature Cited/References</td><td>Independent Sawmill and Woodlot Management, How Much to Cut?, Ben Hoffman, April/May 2007</td></tr>
<tr><td>Forestry Tour Attended</td><td>2008 Lake States</td></tr>
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