GREAT SMOKY MOUNTAINS INSTITUTE AT TREMONT

Smokies to Schoolyards

Curriculum to help teachers make learning more local, personal, and relevant

When Was the Last Time You Hugged A Tree?

Mean, Median, and Mode in the Schoolyard

This activity would be best implemented after the concepts of circumference, mean, median, and mode have been taught and practiced in class. Students will have a chance to use these concepts in the schoolyard to understand more about the world around them.

INVITE To start off this lesson, ask your students to answer the following questions in their journal: *When was the last time you hugged a tree? When you hugged it, were you able to put your arms around the whole trunk? Did you wonder how big around it was or what species the tree belonged to?* Next, explain to your students that, today, they are going to be able to hug and calculate the diameter of the trees in their schoolyard, just like professional foresters! Although your students will be using measuring equipment once they get outside, take some time to let them measure each other's arm span. Once they know the length of their arm span, they will never be without a measuring tool! Then, as a warm up to the main activity, use everyone's measurements to calculate the mean, median, and mode arm span for the class. Finally, invite your students to join you on an outdoor adventure to calculate the diameter of trees in the schoolyard and compare the collected measurements using the mathematical skills of mean, median, and mode.

Corresponding Science & Engineering Practices (SEPs):

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and Interpreting data
- Using Mathematics & Computational Thinking
- Engaging in Argument from Evidence
- Obtaining, evaluating, and communicating information

Corresponding Crosscutting Concepts (CCCs):

- Patterns
- Scale, proportion, and quantity

Corresponding Disciplinary Core Ideas (DCIs):

- Physical Sciences

EXPLORE your schoolyard with your students and identify trees that you and your students would like to measure. After you've identified a few options, have your students break into groups of 3-4 and tell each group to choose one tree to study. Then, choose a tree to use and model measuring a tree's circumference for your students, using a piece of string, a tack, and a yardstick. (If you do not have access to yardsticks, you can use a 12-inch ruler.) Explain that foresters calculate the standard diameter of a tree by measuring the tree's circumference at 4'5" from the base of the tree and then dividing that number by pi (3.14). Foresters refer to a tree's diameter at breast height as "DBH." Next, place a tack at the 4'5" height on your chosen tree and wrap a string around the tree. You can either cut the string or mark it where the two ends meet to make measuring the circumference easier. Note: If some of the trees in your schoolyard are crooked or leaning, the City of Portland has created a great resource to help you accurately measure trees that aren't growing straight. That way, you and your students can study all of the trees in your schoolyard, not just the straight ones!

WONDER Before your students start measuring their groups' trees, nominate one member in each group to act as a scribe and write down the data they collect for their tree. Distribute resources to help your students investigate the species of the tree that they are studying. For younger students, you may choose to give them a dichotomous key, like this one created by Penn State. Older students could be given an identification book or field guide for trees in your geographical area. Once the groups have determined what tree species they have, encourage them to reflect on the following questions and respond in their journals: *How old do you believe this tree to be? If your tree is not growing straight up, what are some*

factors that could keep it from growing straight? What unique characteristics do you notice about your tree, such as fungus or a bee hive or a split in the middle of the trunk?

CREATE Instruct your students to draw a chart in their journals where they can record the data collected by their classmates. The chart should include spaces for the different tree species names, the corresponding circumferences and diameters, and a space to calculate the mean, median, and mode of the trees that were measured in the schoolyard.

SHARE Allow each group to share their findings with the rest of their classmates. Next, work together to calculate the mean, median, and mode of all of the trees studied in the schoolyard. While students calculate and record their findings, create your own chart with all of the students' data on a large whiteboard or chart paper to take back to the classroom. Engage your students in a discussion about the findings, and compare and contrast the different species' data.

REFLECT Now that students have calculated circumferences of trees in their schoolyard, invite them to research their species' average diameter, as well as the diameter of their species' champion tree, in the United States. (The term "champion tree" refers to a living tree from any given species with the largest recorded diameter.) American Forests has a database of the most recently documented champion trees that students can use to search by species. Once these numbers are found, students will have three sets of data that they can compare and contrast. Have your students compare their schoolyard species' diameters to that of an average adult tree of the same species, and ask them to consider the following: *Is their schoolyard tree larger or smaller in diameter than an average adult tree of that species? If the schoolyard tree is smaller in diameter, is it because of age, location, or something else?* Use the champion tree diameter information to reference as the largest tree of that species. Give students an opportunity to write reflections in their journals about their classroom experience and what it was like to practice mathematics skills outside in nature.

As an extension to this activity, you can give your students an opportunity to measure trees around their homes in in their community for homework. Provide them with the necessary materials, and instruct them to measure at least 2-3 trees' DBH. Allow them to share their data in class the next day. Once everyone has shared, discuss the following questions with your students: *What patterns did you observe between the data you collected at home and in the schoolyard? What could be some contributing factors to these patterns? How similar or different are the DBH of the trees measured in the schoolyard to the trees measured at home?*

If you choose to do this activity with your class, please share your thoughts and your students' findings with Tremont Institute. We would love to hear how you implemented this activity and receive feedback on what worked and didn't work for your students.

Coordinating Academic Standards

Mathematics

6.SP.B.5.c – Give quantitative measures of center (median and/or mean) and variability (range) as well as describing any overall pattern with reference to the context in which the data were gathered.

7.SP.D.8.a – Give quantitative measures of center (median and/or mean) and variability (range and/or interquartile range), as well as describe any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

A1.S.ID.A.2 – Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

G.GMD.A.1 – Give an informal argument for the formulas for the circumference of a circle and the volume and surface area of a cylinder, cone, prism, and pyramid.

B.G.C.A.1 – Apply a variety of strategies to determine the area and circumference of circles after identifying necessary information.

English Language Arts

SL.PKI.4 – Present information, findings, and supporting evidence such that listeners can follow the line of reasoning; the organization, development, and style are appropriate to task, purpose, and audience.

SL.CC.2 – Integrate and evaluate information presented in diverse media formats, such as visual, quantitative, and oral formats.

Science

BIO2.LS413 – Interpret data supporting current plant classification schemes. Use a dichotomous key to identify plants based on variations in characteristics.