

## The American Chestnut and the CCPS Spiral Curriculum

The American chestnut (*Castanea dentata*) offers a compelling story of how forests change and why some management is needed to maintain native forests. A brief history of the American chestnut is well documented in a 2014 Scientific American article (Ferris Jabr) entitled, *A New Generation of American Chestnut Trees May Redefine America's Forests*. The article states, "Before the early 1900s one in every four hardwood trees in North America's eastern forests was an American chestnut. Together, chestnuts and oaks predominated in 80 million hectares of forest from Maine to Florida and west to the Ohio Valley. Every spring so many chestnut trees erupted in white blossom that, from a distance, the hills appeared to be draped in quilts of snow". The article continues to note key events that contributed to the demise of American chestnut trees:

- A New York City nurseryman named S. B. Parsons imported Japanese chestnut trees in 1876, which he raised and sold to customers who wanted something a little exotic in their gardens.
- These imported trees carried the pathogenic fungus *Cryphonectria parasitica*, known as blight, to North America. This fungus cuts off the transport of water and nutrients from the soil and leaves of susceptible trees causing the eventual death of the tree.
- Unaffected by the blight the Japanese chestnut trees thrived while the native American chestnut trees were decimated.
- First discovered in New York State in 1904, chestnut blight was soon spotted in New Jersey, Connecticut, Massachusetts and Pennsylvania. Within 50 years it killed nearly four billion American chestnut trees.

Using the American chestnut as a key species for engaging students from middle to high school in hands-on scientific exploration, civic tree plantings, and environmental awareness has been a goal of Carroll County secondary science for over a decade. During this time, Carroll County Public Schools (CCPS) have partnered with The American Chestnut Foundation (TACF) ( <http://www.acf.org/> ) to begin developing school-based groves of American chestnut and inquiry and hands-on experiences for students.

According to TACF founder and scientist Dr. Charles Burnham the time-tested method of "backcrossing" was proposed to bring out the best characteristics of both the American and Asiatic species in an effort to begin restoration of the American chestnut.

Additionally CCPS has leveraged partnerships with Maryland Department of Natural Resources (MDDNR) Forest Service, Maryland Sea Grant (MDSG), Carroll County Forestry Board, and a variety of other organizations to develop multi-faceted curriculum based on the American chestnut story. The approach utilizes multiple connections in science, technology, engineering and math (STEM) education as well as English and social studies concepts to teach and reinforce the need for a variety of mutually supportive skills to understand and help solve forest management and environmental issues. CCPS's approach integrates classroom, field and lab work to engage students in meaningful learning. Students emerge with an understanding that environmental issues require skills in biology, ecology, math, climatology, technology tools, socio/economic trends, as well as many other related topics.

Technology skills in gel electrophoresis, computer interface, sensors, web quests, and limited GIS and GPS mapping all enhance the learning experience. Students also enhance written and oral communication skills to support claims with evidence and reasoning. Common Core connections include

proficiency in reading technical passages and writing for science literacy. Students also become aware of how environmental issues in science relate to the political, economic, and social world around them. CCPS's American chestnut curriculum is aligned with the Maryland Environmental Literacy Standards and work will continue to align it with the Next Generation Science.

CCPS has over 20 American chestnut groves for scientific study and learning located on high schools and middle schools campuses, including a well-established grove at the CCPS's Hashawha Environmental Center with disease-resistant trees standing over 20 feet in height. With the support of the MDDNR Forest Service, TAFC, MDSG, University of Maryland Extension (UME) and the Chesapeake Bay Trust, CCPS has reported measurable results and significant outcomes from classroom and field activities related to forest management, restoration and stewardship. These partnerships have been instrumental in expanding: 1) tree planting and grove maintenance on school grounds at elementary, middle, and high schools, 2) seedling culture to high school biology, ecology, and research classes, 3) teacher professional development, 4) use of TACF's Chestnut Learning Boxes, and 5) curriculum review and revision. Since its inception in 1995, the CCPS American chestnut project has planted over 2500 trees creating more than 8 acres of new urban tree canopy. These tree plantings contribute to improved air quality by mitigating ozone formation with the Baltimore non-attainment area, and improved water quality through turf-to-trees conversion as defined by Maryland's Watershed Implementation Plan for meeting the Chesapeake Bay Total Maximum Daily Load (TMDL).

### The CCPS Spiral Curriculum

The CCPS spiral curriculum originated from a partnership with scientist Dr. Donald Nus (NIH Cancer Research) and the MD Chapter of the American Chestnut Foundation and a drive to expand student success with the Maryland State Department of Education assessments in middle and high school. CCPS felt it was important to expose all students to hands-on activities and topics relative to Maryland natural history and biotechnology as motivating factors. The original middle school activities focused on an introduction to the American chestnut story and the impact of blight on the American chestnut population. The high school activities focused on the use of gel electrophoresis to better understand genetics and disease-resistance in the American chestnut.

Since its inception in 2000, the spiral curriculum has expanded to include over 100 classroom and field activities generated by CCPS middle and high school educators. A unique extension of the spiral curriculum is the transition from a school based program to community outreach and stewardship events. CCPS "American Chestnut Jamborees" celebrate and share the successes of their students, teachers and the American chestnut project and spiral curriculum with the public through demonstrations and presentations.

CCPS's goal is to expand the American chestnut story in an integrated manner within math and science courses and to align the American chestnut spiral curriculum with the Maryland Environmental Literacy Standards, Next Generation Science Standards and Common Core.

## Moving The CCPS Spiral Curriculum Forward

In 2015, MDSG, UME, CCPS and the Allegany County Public Schools (ACPS) were awarded a grant from the Chesapeake Bay Trust to enhance the CCPS American Chestnut spiral curriculum and expand it into ACPS. The partnership with ACPS provides the opportunity to expand this curriculum model and demonstrate the value to other school systems that show an interest in project-based learning as a vehicle for meeting NGSS and MD ELit standards. This project strives to establish collaborative professional and student learning networks (PLN, SLN) involving educators, professionals and students from CCPS, ACPS, TACF, MDSG, UME, Frostburg State University (FSU) and Frostburg Grows (FG) programs. The network of professionals serve as subject matter experts to support the delivery and expansion of updated science curriculum and learning experiences for new staff and students. Students learn from research scientists, conservation professionals and teachers trained to deliver the redesigned American chestnut spiral curriculum. Students participate in classroom, online and field-based learning opportunities. School based American chestnut groves allow students the opportunity to conduct hands-on experiments, collect and share data and deliver findings to PLN and SLN partners as well as local and national level education and environmental organizations. Students serve as conservation advocates for the American chestnut tree and our interdependent ecosystem.

Grove plantings support effective environmental engagement well beyond the initial feel-good planting day, and create visible projects at schools that often are a hub for community involvement. The groves will act as environmental learning labs providing students with direct contact to field based projects that focus on genetics, disease assessment and diagnosis (blight), and general forestry best management practices.

### **References**

Jabr, Ferris. 2014. Scientific American, Vol. 310 / Issue 3. *A New Generation of American Chestnut Trees May Redefine America's Forests*. This article is part of a larger article by William Powell entitled The American Chestnut's genetic Rebirth.

Carroll County Public Schools, American Chestnut Spiral Curriculum: Grades 6-12. 2015

The American Chestnut Foundation, [www.acf.org](http://www.acf.org). *Restoring the American Chestnut Tree*.