



AgrAbility in the Classroom: Student Design Projects of the NC AgrAbility Partnership and North Carolina State University Biological and Agricultural Engineering



Michele Proctor, MID
Project Coordinator, NC AgrAbility Partnership
North Carolina Agricultural & Technical State
University
Cooperative Extension Program
coordinator@ncagrability.com

Dr. Gary Roberson, Ph.D., P.E.
Associate Professor & Extension Specialist,
Biological and Agricultural Engineering
Agricultural Machinery Systems Engineering
North Carolina State University
gary_roberson@ncsu.edu

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AgrAbility in the Classroom

Goal: to educate students on the unique needs of individuals farming with disabilities and participate in providing hands-on opportunities to practice understanding and accommodating these needs.

**NC STATE
UNIVERSITY**

College of Agriculture
and Life Sciences

Department of Biological & Agricultural Engineering



East Carolina University
Occupational Therapy



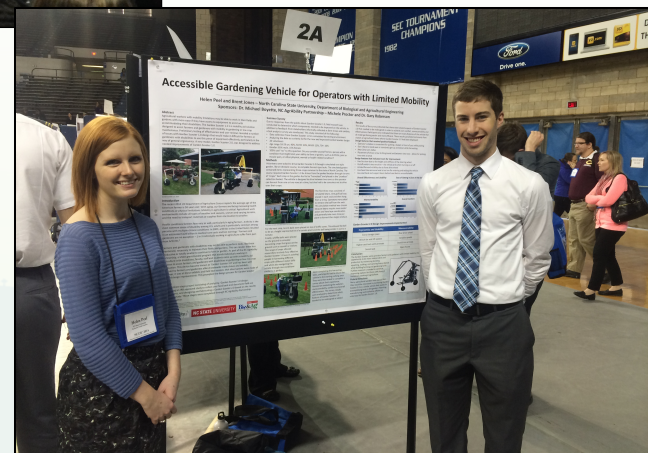
**NORTH CAROLINA AGRICULTURAL
AND TECHNICAL STATE UNIVERSITY**

Partners:

North Carolina State University
Department of Biological & Agriculture Engineering,
East Carolina University
Department of Occupational Therapy,
with assistance from North Carolina A&T State
University Cooperative Extension Program
and inclusive collaboration with Western Carolina
University Department of Physical Therapy



Students participate in competitions, conferences and other public education events.



AgrAbility in the Classroom

Students utilize curriculum skills, practice real-world application of these skills and understanding of end-user effects of design decisions and professional implementation.

Most student **project ideas** are inspired by **NC AgrAbility client cases** or **individual needs** but may also come from ideas for improvement on existing technology or suggestions from the community.



Projects vary in scale and are usually limited to two summer terms or one academic year.

AgrAbility in the Classroom

At NC State's Bio & Ag Engineering, students are introduced to AgrAbility **through in-class lectures and the undergraduate-required Senior Design** course. AgrAbility design proposals are submitted to a proposal pool for students to chose to work on.

Lectures include: "Intro to AgrAbility, Secondary Risk Assessment for Ag AT, Intro to Rehab Engineering and AgrAbility"

NCSU BAE Students Reached Through NC AgrAbility

Year	Lectures	Interns	Senior Design	Total
2011-2012	19			19
2012-2013	55	4	9	13
2013-2014	60	3	10	73
2014-2015	107	3	8	118
Total NCSU student reach to date since Jan. 2012:				223



Students are encouraged to seek expertise and advise from other faculty, staff and field professionals as well as product user or client input. Guest reviewers are also invited to attend presentations of work.



AgrAbility in the Classroom

Additionally, under leadership from **Dr. Mary Hildebrand at East Carolina University Department of Occupational Therapy**, Master of Occupational Therapy students have participated and conducted research in:

- Farm assessments
- Pressure mapping in agricultural equipment
- Effects of Arthritis on daily living, work and quality of life in farmers
- Competencies of farmers' needs in health care providers and students
- Understanding how farmers perceive and manage chronic pain
- AgrAbility outreach and education at events and conferences
- Counsel to NCSU BAE engineering design students on their project



AgrAbility in the Classroom

- OT/PT curriculum has been implemented since Spring 2012 for OT/PT classes through ECU Department of Occupational Therapy. ECU OT course includes farm assessment training
- Segments also presented at local, state, national and global OT/PT conferences as well as National AgrAbility Training Workshop
- Curriculum extended to other OT/PT programs in and out-of-state since 2013 including:
 - Washington University- St. Louis, MO
 - University of North Carolina at Chapel Hill- Chapel Hill, NC
 - Lenoir Rhyne College- Hickory, NC
 - Winston Salem State University- Winston Salem, NC



ECU MSOT students had the chance to learn about considerations for performing site assessments and talk one-on-one with their host and NC AgrAbility client.

OT/PT/PA Students Reached Through NC AgrAbility

Year	Lectures	Interns	Research Projects	Total
2012-2013	100			100
2013-2014	133	2	3	138
2014-2015	84	3	3	100
Total student reach to date since January 2012:				338

AgrAbility in the Classroom

Students are **challenged to pursue external funding sources** such as university undergraduate research grants or design competitions.

Projects used for research are used around the state for **educational tools and to raise awareness of assistive solutions** for the agricultural community.

“Team 4x4” worked to replicate an adapted chair design featured in New Mobility Magazine, increasing its terrain abilities. The base model was donated by a non-profit disability partner and modifications made with departmental research funds and undergraduate research grant. The chair is now used for education.



“Team Hydro” was able to secure independent funding to provide a water solution for a NC AgrAbility client. Students worked under close supervision of BAE engineering staff and faculty to ensure safety for both students and the end user.

AgrAbility in the Classroom

Students are challenged to investigate opportunities for **recycled or salvaged construction and do-it-yourself options**, in addition to using new or commercially available products.

These ideas are marketed as possible solutions through national and state project media outlets as well as publications in print and online.



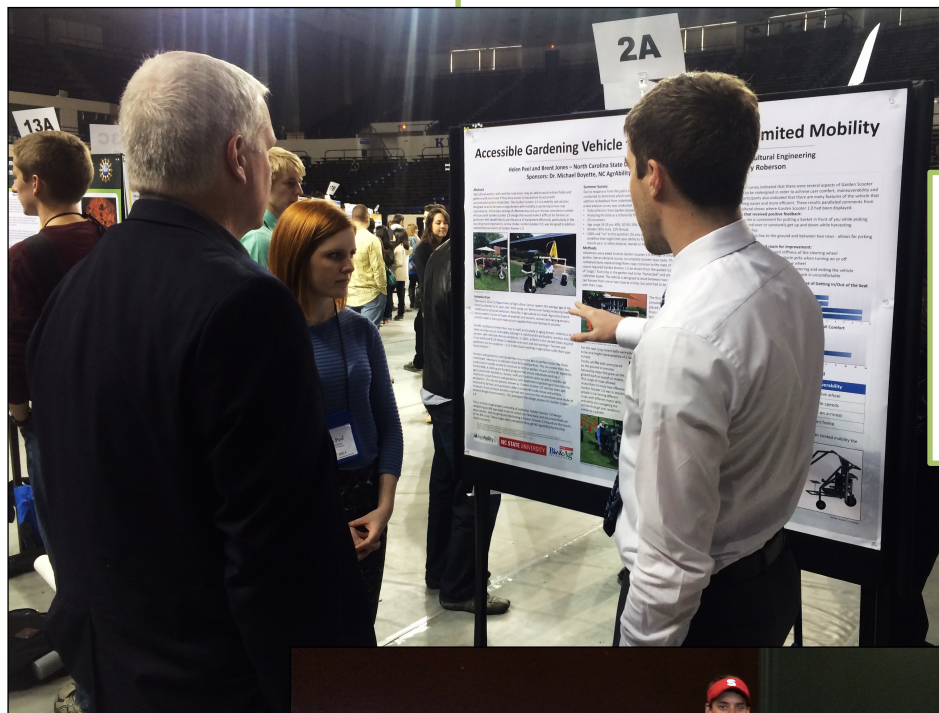
The Electric Jib Crane was designed for producers with lifting limitations to assemble their own adaptive solution by utilizing common, commercially-available components to assist farmers with everyday tasks such as loading or transferring loads. This idea was inspired by a NC AgrAbility farmer/veteran with a UE amputation. A publication on this design is available for free to the public at <http://www.bae.ncsu.edu/extension/ext-publications/#agricultural>

AgrAbility in the Classroom

Typically, 3 AgrAbility proposals are submitted to BAE senior design each year, with 2 of the 3 being selected each year since launch of the design projects.

Students have expressed this choice being based on “interest in helping real people” and “working on something different than other engineering projects”.

NCSU AgrAbility student design projects have been selected 3 years in a row for NCSU Undergraduate Research grant support. These projects are presented each spring at the university-wide research symposium.



In April 2013, students also presented at the National Conference for Undergraduate Research.



AgrAbility in the Classroom

Garden Scooter- Summer 2012, Class of 2013

The Garden Scooter 1.0 is a mobility aid designed by students and staff to assist gardeners and farmers with limited mobility or back pain in production of low-growing row crops.

The design eliminates or reduces walking, stooping, bending or squatting, and provides work space for carrying tools or harvest containers.



Garden Scooter 1.0 is battery powered, solar assisted and made entirely of recycled or salvaged parts. The back wheel assembly is adjustable to accommodate varying row widths.

AgrAbility in the Classroom

Garden Scooter- Summer 2012, Class of 2013

Due to the popularity of the design, students conducted ergonomic and usability studies through a usability survey in Summer of 2013 and presented their findings at the **2014 National Conference for Undergraduate Research**, sponsored by the NCSU Undergraduate Research Committee and at the **2014 NCSU Undergraduate Research Symposium**.

Garden Scooter has been one of the most popular design products with the public and has been presented annually at farm shows and events across the state.

Photos of Garden Scooter 1.0 have been provided to farmers at no cost to modify and/or build on their own.



NC AgrAbility Student Projects

In the community: Team Hydro
Class of 2013

“Team Hydro’s” solar-powered water delivery tower provides an alternative way to supply and deliver water to a farmer with disabilities garden and livestock.

- Students worked with local NRCS, CES and client to coordinate site installation
- Students responsible for fabrication and installation
- Paid for project costs with independent grant funds
- Worked under supervision of AgrAbility coordinator and BAE staff & faculty
- Required 2 site visits for mapping and water measurements
- 2-day installation



Key components:
Treated wood & steel frame
4' x 6' solar panel
200 gallon cistern
PVC piping
2 hp RV pump
Safety straps
Automatic shutoff ball float
Rechargeable batteries



NC AgrAbility Student Projects

In the community:

“Team Hydro’s” solar-powered water delivery tower provides an alternative way to supply water to a farmer with disabilities garden and livestock.

- Sustainably pumps water from a nearby stream in geographic area where drilling well not an option
- Reduces physical stress of dragging watering hoses
- Enabled client to integrate drip irrigation for better crop yield
- low cost* and minimal maintenance
- Story was featured in several state publications, videos and on RFD-TV in 2014
- For more on this story, check out this video:
[“NC AgrAbility by NC Farm Bureau”](#)

*compared to commercially available options or drilling new well



Market Lift, Class of 2014

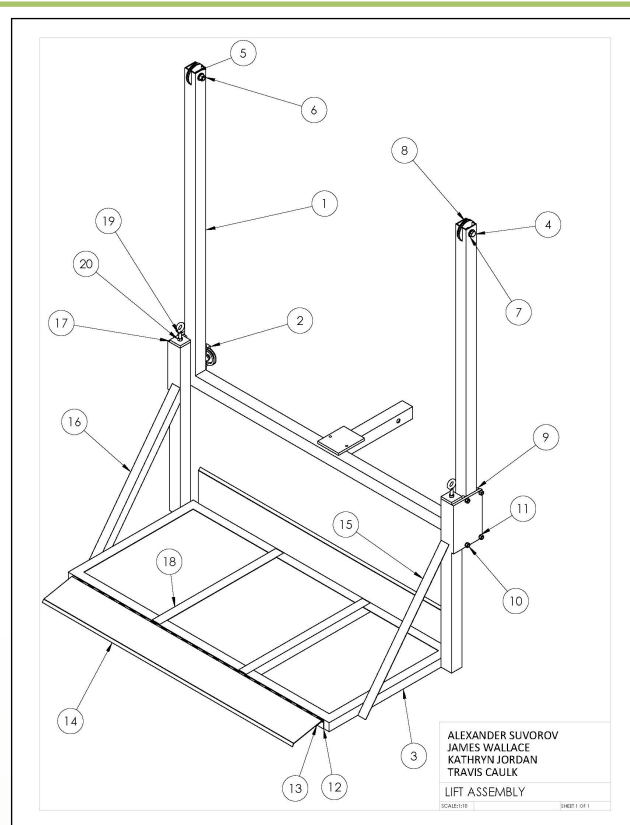
The Farmers' Market Lift is an assistive device designed to help farmers load supplies for farmers' markets or for transport in order to eliminate stooping, bending and lifting of heavy objects.

Users of large tents, produce boxes, or portable freezers were the inspiration for this project as trends in farmers participating in local food markets grow.

The Market lift attaches to a standard 2" square hitch.



Students researched National Transportation Safety Laws to guide them in assuring road worthiness and safety considerations. The Farmers Market Lift will be completed and presented in early May 2014.



Market Lift, Class of 2014

The market lift is battery powered and operates via remote control to be operated from a safe distance. Battery power can be from an independent source or linked through the truck's trailer plug.

The lift will lower to ground level, push ramp lowered, items slid onto loading platform and then lift items to truck bed level. Items can be transported on the platform or transferred into the truck bed via the opposite push ramp.

The lift's ability to lower to the ground also ensure safe, stable detachment without lifting or balancing to guide hitch pins.



NC AgrAbility Student Projects

“Team 4x4”, Class of 2013

Challenge: replicate a design featured in New Mobility Magazine, where a rural mechanic claimed used power chairs could be adapted to be more all-terrain.

All outdoor sportsmen, the student team used a powerchair donated by a community partner to try an meet the needs of a farmer or sportsman.

The students obtained other donated or salvaged chairs for parts to help keep cost down.



NC AgrAbility Student Projects

The Team 4x4 chair features all-wheel drive, zero turn radius, all-terrain capability and a pivoting storage space.

The students made [YouTube videos of the chair](#) in action.

With all that diamond plate attracting a lot of attention, the chair is a regular at the NC State Fair and the Southern Farm Show, and makes for a great education piece.



The Team 4x4 chair conversion is used annually at farm shows and fairs to raise awareness of options commercially available for all-terrain mobility options.

NC AgrAbility Student Projects

Team 4x4 Challenge:
All-Terrain Chair 2.0 vs. Wheelchair
Transporter

When two teams asked for the same project, we gave it to them with a twist:
same mission, one competition!

Team 4x4 2.0- redesign 1.0 model to be safer, easier to use and mechanically improved

Team Transporter- design a transport device for a manual chair user by modifying a recycled lawnmower

Teams will compete April 17 in an all-terrain obstacle course to simulate multiple outdoor situations and test the performance of their designs.

Final designs to be presented April 24, 2015



Both teams helped keep costs down by using recycled or salvaged parts and doing most of the welding and other fabrication on their own. Both projects are still underway!

AgrAbility in the Classroom

They don't always work out like we hope they will.
We've learned it's important to stress a few things:

- **Time management!** Graduation sneaks up on you and so does the end of the project.
- **Dream big.... Then rein in those ideas** and boil down what your primary goals are and make those priorities. Just because your wheelchair has diamond plate doesn't mean it's effective...
- **Money matters-** budgeting for projects is more than just weekend beverage money and these projects are not cheap!
- **Murphy's Law-** if it can go wrong, it will.
- **Document, document, document**
- **Team work means** understanding and **balancing each other's strengths and weaknesses**, not just expecting everyone to participate equally.



Oh no! My phone is at 30% battery!!

I don't think that was on the plans...

Did he say 3 feet or 3 inches...?

Oh boy....





Thank you! Questions?

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