

# **Pedagogical Guide: TECHknow High School Units**

## **Agriculture and Biotechnology**

### Description/Overview of the Unit:

In this unit students examine the scope of agriculture/biotechnology. Students participate in selected activities that help them see the breadth of biotechnology and its impacts on people and implications for the future.

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

The activities in the agbio unit can be done in any traditional tech ed facility. Running water is needed along with a hot plate and thermometers but otherwise no special equipment is required.

### Equipment: general listing of the type of equipment needed to teach the unit.

Computers with internet access

Hot plate

Thermometers

DNA Separation kits

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

Demonstration and cooperative group learning predominate the teaching methods used. I would advise that teachers watch the instructional video provided with the DNA separation lab kits before doing this activity with the students. Creativity is encouraged via the evaluation rubric and allowing students to "do their own thing" regarding their presentations. Students are assigned specific tasks within each group and are accountable to each other and the teacher to follow through with the completions of each task. The teaching skills necessary are the same as for any teacher. Be sure you know what standards you're trying to teach before you forge ahead, and make sure your instruction addresses those standards. Don't be afraid to let the students try novel approaches to solving a given problem and keep an open mind about what the students are trying to accomplish.

### Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

Students gain self-confidence when they are allowed to try their own solutions to problems. They gain self-confidence from competition as well as learning time management skills and how to work with other people. What students work on with their hands and mind they appreciate and internalize what they've learned more effectively.

I have had numerous regional and state finalists and winners in TSA competition. As a result of their participation in TSA and technology education classes they have decided to pursue careers in education, engineering, trades, and medicine.

## **Desktop Publishing**

Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

An ideal setup would be a technology lab that has access to several computers, a printer and publishing and clipart software. The unit however can be taught without the use of computers using traditional means. Teachers who decide to produce a brochure through traditional means will need have access to a variety of art supplies such as colored pencils, markers, x-acto blades, photographs and reproducible clipart, etc.

Equipment: general listing of the t y e of equipment needed to teach the unit.

Computer

Printer

Clipart software

Publishing software

Samples of Brochures, different types of printing, newsletters, posters

A artist loop (high power magnifying glasses maybe sufficient)

Photographs

Colored pencils

markers

paper

Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

Provide students with samples but encourage them to think out of the box and create heir brochure based on the information in the unit. Remind students that what makes a good brochure is usually what looks appealing to the eye. Teachers need to remember that extra time will need to be taken to teach publishing software as the unit is not software specific.

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

Many of my students found the unit very rewarding. They were able to have a real-world experience by creating recruitment brochures for various courses in our school. Students often comment that they did not understand the detail involved in producing such items. Many found the color unit interesting. Others enjoyed exploring folding their brochure.

## **Film Technology**

### Description/Overview of the Unit:

15 hour unit describing film and video technology techniques, topics covered include: 3 phases of production, audio, lighting, editing, compression, and streaming

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

Standard class with movable desks

An office located near classroom – could be used for interviews voiceovers (quiet zone)

### Equipment: general listing of the type of equipment needed to teach the unit.

Digital video cameras

Tripods

Editing software and/or systems (Apple iMOVIE, Pinnacle Studio software for PC)

External microphones

Lighting (construction lights, photo lights, etc)

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

General teaching methods: minimum lecture, maximum demonstrations, hands-on approach

Tips for the novice: prep for class by doing each lesson before presenting to students....

Check hardware and software configurations

Practice editing with stock footage to learn edit theories such as continuity and complex editing

Creative problem solving:

Present a unit on problem solving before unit

Use lesson q techniques for idea generation. Have students make cluster maps for a variety of different topics and ideas.

Group instruction:

Team approach

Demonstration

Student team presentations to class

All students play and equal part in each phase of production

Design Challenges:

Each activity is geared toward a design brief format

Materials, statement of problem, challenge, and assessment should all be distributed to each student team

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

Had “films” aired on local access channel, develop promos for a documentary on “Alternatives to Open Lagoon Storage of Hog Waste”

Former student is now a successful news anchor, graduate of North Carolina State University

Former student studying mass communications at UNC Charlotte

TSA members very successful in the Film Technology competitive event – state and national winners

TSA competitive events have helped to develop leadership skills in and out of the classroom. They also teach students to be focused, organized and the importance of teamwork.

The important benefits from teaching using this approach is that students have great successes, develop teaming skills, learn to work as a team member of diverse groups, and the importance of doing your job well.

## **Manufacturing Prototype**

### Description/Overview of the Unit:

The Manufacturing Prototype Unit is to help students understand how ideas come into action through the design process. Teachers should be able to help students understand and how to invent and design new products that will be marketable to consumers by using brainstorming techniques, developing sketches and working drawings, mock-ups, along with designing and testing of their ideas. They should be able to prepare a plan of production based upon projects that are designed and utilizing the appropriate machinery and automation techniques. Students should also be able to distinguish and understand the differences in materials and their use along with the methods of production that may be needed to develop products. Individual marketing studies and focus groups should be developed based upon the different products that students may come up with to decide the final product that may be best suited for final production.

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

The process of developing manufacturing prototype would be best served in a joint lab consisting of classroom with computer access to research projects, develop research and development papers, presentations, and working drawings. A materials laboratory will be necessary that has access to desktop power tools, hand tools, simple fabrication and testing equipment along with a variety of materials to work with in developing mockups and prototypes. The development of prototypes needs both the access for research along with a developmental process utilizing

Integration of math and science concepts that may be presented in core curriculum classes. Understanding that the design process is having a good understanding of many concepts and individuals may utilize arranging them through a series of exercises to develop the best possible project should take a holistic approach.

### Equipment: general listing of the type of equipment needed to teach the unit.

Computers with Internet access, Microsoft Office for access to our CD and developing reports and presentations.

Sketching tools, and simple CAD programs to develop working drawings.

Safety Glasses and other appropriate safety equipment as needed based upon the space variety of desktop bench tools such as a drill press, band saw, miter saw, Styrofoam cutter, along with hand tools appropriate for cutting and fabricating such as hand drills, jig saws, sanders, utility knives, hammers, clamps (variety), tape dispensers, and screwdrivers. (Appropriate materials testing devices as you may need.)

Note: General shop equipment should be established upon the expertise of the individual teaching the program and the project they wish to develop, not some cookie cutter list.

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

## NOW THAT IS A REAL QUESTION!

Every individual has to develop their own teaching style based upon their individual expertise. As for tips, be calm, cool, and respectful of your students and do not be afraid to let them experiment with their own ideas. Be able to present good examples to guide them in a direction that may be acceptable to you, the school, and their parents. (Follow the National TSA guide and let the competitive events be your focus for each year but do not forget to let individual ideas thrive. You never know who will break the mold and invent the "N BT-Next Big Thing")

Prior to beginning any of the prototype development; get the basics out of the way first, like measurement, sketching, the computer programs needed to do the necessary research and presentations that you will require with each prototype. The process of understanding basic problem solving may be as simple as developing a prearranged product from plans such as bridge building, rockets, or mousetrap cars. These activities along with individual resourcefulness will be what motivates students and teaches them the process of how to manage time and group instructions. Some teachers prefer modules and some whole group activities. This will be a call for the teacher to work out based upon their comfort zone.

Good Luck and Have Fun at whatever you are doing with your students.

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

20+ years of teaching from the days of an old fully loaded Industrial Arts Shop, several years trying to impress individuals in industry and cooperative learning apprenticeship programs and countless students who have become far more financially successful than I ever will have led me to believe in one thing. "There is no perfect solution to any problem." Times change and so do you and your students over the years. What works this year may not work next year. Be flexible, adaptive, and willing to overcome the obstacles that you will have deal with. Remember that the most important individuals that you will ever come in contact with are not administrators or fellow colleagues, but the students that you see each day you open your door and TEACH. This is what should make things fun for you and gives your life a purpose.

## **Medical Technology**

### Description/Overview of the Unit:

Broad survey coverage of issues, implications, and practices in medical technology with emphasis on the impacts of this technology on society, culture, economics, politics, environment, and ethical decisions. Included is study of resources, practices, equipment, personnel, and other considerations.

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

A multi-purpose general-shop area is needed for production of student projects and prototypes. An internet-capable computer facility is needed for web searches, development of reports and papers, and production of Power-Point presentations. Video and audio taping equipment is needed for some activities.

### Equipment: general listing of the type of equipment needed to teach the unit.

Internet capable computers  
Audio and video taping equipment  
General hand tools (large assortment)  
Band saw  
Drill press  
Small lathe  
Small table saw  
Small jointer  
Radial arm saw (helpful, not required)  
Sander  
Hot wire cutter  
Presentation station with computer projector aid software  
Anatomical models (ear, eye, heart, kidney, torso, fetal development etc.)  
Demonstration skeleton

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

The first consideration is to be careful not to make this a full-hour lecture class! Each day should have a brief (ten minute maximum) presentation from the teacher concerning one of the topics in the text. Most of these should actually be lecture-discussions in which students also interact. Then, the remainder of each day's class should be devoted to problem solving, student work on their projects and reports, internet searches, and other learning activities monitored by the teacher. Seminars should be held regularly to allow students to share their work in-progress and gain guidance from their teacher and their classmates. Presentations at the conclusion or units of study should use technology, include tangible prototypes and models when possible, and go much further than the text or the teacher's lessons on any topics considered. The idea is to place most of the responsibility for learning on the students' shoulders. Groups should be used for many

activities while some should be individual efforts. Consult with teachers in the following areas and do team-teaching, collaboration, or actual integrated activities when possible: Mathematics, Health, Science, and Communications.

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

Students have reported gains in learning of factual information, understanding of concepts such as scarcity of resources and unfair distribution of the healthcare resources available. Some students discover interests which may lead to career choices in medical fields. Students become better informed consumers of health care technology and services. Students become more informed voters on healthcare issues. Some technical skills are also gained.

## RC Robotics

### Description/Overview of the Unit:

The unit has taken many different directions over the three years of its development. The information this unit can be used by any basic robotics program to better understand the many systems that make up a robot. Designed as an introductory resource for high school robotic design, the text does provide some advanced information that can be useful for even the advanced builder.

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

The ideal facility would be a general laboratory with a variety of stationary machinery. But all that is really needed is a band saw or scroll saw, drill or drill press, soldering iron and basic hand tools to successfully implement this unit.

### Equipment: general listing of the type of equipment needed to teach the unit.

RC equipment: Two or four channel radio/receiver, at least 2 servos, batteries, car chassis

Building supplies: Will vary depending on the project design, foam board, hot glue, wire, solder, fasteners, thin plywood, a variety of gears and pulleys.

Testing equipment: Multi-meter, testing leads, Visual tachometer (optional)

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

Ideally student participants need to be assigned into workgroups. To develop a working robot, each member of the group needs to assume some group responsibility that will be combined with other members of the team to assemble a final product. Usually there are not enough materials and resources to have each participant make their own robot. Working in groups forces the students to collaborate on their designs to develop one final robot.

Each member of the teams should have a basic understanding of all the robot systems, but they only need to become the group expert in one specific area of the robot project. For example one group member might be responsible for the locomotion of the robot. They would need to develop the drive train that will get the robot from point A to point B. Another student might be responsible for the guidance system. Even though these systems need to work together for the robot to function, each student will develop the best solution for the group's robot.

The group size should be kept to a manageable size with the minimum size being two. Each group member should be responsible for the overall robot content; each member should also be able to do advance research on their area of interest/assignment.

If there are enough materials to have at least 3 groups, then the final competition can motivate the group to excel beyond the basics.

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

In the past four years, we have gone from not having any RC robotic equipment to building and competing a number of different national robotic tournaments. Students learn from each other and from their own mistakes and successes. Competition is the key factor in getting students excited about learning. Winning is contagious, but it should not be the only goal of the competition. All students should find some success with a basic entry and the rule set should be designed appropriately.

Recently I have seen a number of doors open up for students that never considered engineering as a career option. After getting involved with robotics; they finally realized there really are practical applications for math, science and physics. They also learned that occasionally there is not a right or wrong answer to a problem, there are just better solutions.

## Scientific Visualization

### Description/Overview of the Unit:

This is a 15 -day unit in which students (working in groups) research information on simple machines and how they multiply force. Then they create 2D and 3D computer models and animations of a chosen machine. These graphics are designed to visually explain the mathematical relationships that explain how simple machines work. Virtual data is collected from the computer models and analyzed. An actual "real world" machine is built using the virtual machine as a blueprint. Data is then collected from the real machine and compared to the computer model. The information on simple machines, illustrations, graphs, animation and examples are then used to create a multimedia PowerPoint presentation on simple machines and how they make work easier.

### Facilities: general description of the type of facility required to teach the unit. What is the ideal facility/lab?

The best environment for this project is a computer lab equipped with Internet, and other software. (See below) Students will be creating machines such as pulleys, levers, incline planes etc. Data will also be collected from these machines so there should be ample room available for students to complete this work. The students should have Internet access for the research portion of the project. The CD that comes with the book has some helpful resource material. If the Internet is not available to students, they should be able to find what they need in the library or from textbooks. The more types of resource material collected the better.

### Equipment: general listing of the type of equipment needed to teach the unit.

The students will need some equipment for data collection. This equipment includes meter sticks, Newton meters (used to measure force), weights and strings. Expensive equipment is not required. For weights, textbooks can be tied together and attached to the machine. If Newton meters are not available, fishing scales found in any sporting goods shop work well.

There are several software packages available that can be used for the 2D and 3D graphics, modeling and animations. For the 2D work, students can use programs such as Corel Draw, Adobe PhotoShop, Flash, even MS Paint will work. There is also no reason why students could not draw their 2D work on paper with colored pencils and scan the images onto the computer.

For the 3D modeling and animation there are 3D Studio Max, TrueSpace, AutoCad Inventor, Pro Desktop and others. Check the Internet for these and other 3D modeling and animation programs. In the past vendors have offered free trial versions. This may help you decide which is right for you. For the graphing work, any spreadsheet program will do. Most computers are equipped with Microsoft Excel.

### Teaching Skills/Methods: the general teaching methods that are used to teach the unit, tips from experienced teachers, how to encourage creativity/problem solving, the

motivation of this approach, how to manage group instruction, what skills are needed to teach with design challenges in a standards-based program in technology education?

Students should be encouraged to gather as much information on their own as possible. The simple machines PowerPoint is your resource, feel free to present it to students after they have already spent some time researching and understanding their topic. It is important to keep in mind that students need to do almost ALL of the work themselves. They may find this frustrating at first, but in the end they will have greater pride in the final product.

The students should also be encouraged to build their machine from scraps found on almost any garage or shop. If pulleys are not available from the science department, they can be cheaply purchased at any hardware store.

For group work, pairs of students work well. This way it is harder for a group member to become uninvolved. If groups need to be larger try to find ways to keep everyone involved. Try to mix academic talent through out each group. The design brief will help because each student knows what they are responsible for.

Students should have total creative freedom for this project. Your role is more of a coach and cheerleader than dispenser of knowledge. The students should have fun working on this project. Encourage creativity. The final presentations need not be dry and geeky. They can be colorful and humorous. Just be sure color choice, backgrounds, fonts and everything else contribute to clarity. If slides are too busy and backgrounds and foregrounds clash and compete for the viewers' attention, the presentation will not be successful. Humor and creativity can be powerful elements as long as scientific accuracy is not sacrificed. The Internet is a great resource for finding tips on what makes a good presentation.

Students should use brainstorming techniques for problem solving.

Student Learning: specific examples of student success, anecdotal experiences, the educational benefit of this approach, what do students learn from design challenges and competition?

On the first day of this project I always say to my students...

"You have all studied simple machines in either middle school or 9th grade. What makes a simple machine work? Let's look at a lever for example. Most of you have changed a tire. Why use a jack? If you can't just pick up one end of the car by hand, what is going on with the jack that makes it possible to lift the car? Is it magic? Are there elves in there?"

Very few students have the correct answer that simple machines multiply force by sacrificing distance. When the project is complete they know and understand because they built, compared, made predictions, and explained the concept.

The greatest educational benefit to this project is the creative freedom the students have coupled with the fact that because they have done all the work, they own it. They have addressed specific national goals and objectives from science, math and technology. They have worked on research, communication, computer and group problem-solving skills. In creating the 3D models they have become intimately aware of the anatomy of simple machines. Because most students think 3D modeling is fun, they have enjoyed their learning. That makes it more likely they will better understand and remember things like engineering, graphical analysis, force, and energy transfer than their peers who did not participate in the project. But perhaps more importantly, some students they may discover that learning can be fun and something to be proud of.