

A close-up photograph of several green leaves, likely from a plant like a peace lily, covered in numerous small, clear water droplets. The leaves are vibrant green and have prominent veins. The background is dark, making the green leaves and white droplets stand out.

# **GREENHOUSES**

GROWTECH™ ARCHITECTURAL GREENHOUSE

A guide to our greenhouses.







# GET GROWING

**The garden  
suggests there  
might be a place  
we can meet  
nature half way.**

Michael Pollan



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# HISTORY

**Greenhouses have come a long way since the specula of ancient Rome, and their continued evolution shows no signs of slowing down.**



The history of greenhouses is a fascinating tale of human ingenuity and innovation in the pursuit of agricultural excellence. Greenhouses have been used to extend the growing season, increase crop yields, and protect plants from the elements through ancient civilizations to modern times,

The earliest known greenhouses date back to the Roman Empire, where wealthy citizens built "specularia" or "specula" - buildings made of mica or glass - to grow exotic plants and fruits. The use of these structures spread throughout Europe during the Middle Ages, with the wealthy and royal classes building large, ornate greenhouses known as orangeries.

As technology advanced, so did the construction materials used for greenhouses. The use of glass became widespread in the 17th century, with the development of sheet glass allowing for larger, more complex structures. In the 19th century, the introduction of cast iron and steel frames allowed for even larger greenhouses, such as the famous Crystal Palace in London.

The 20th century saw the development of new innovations in greenhouse technology, including the introduction of heating and cooling systems, automated ventilation, and hydroponic growing methods. These advances allowed for greater control over growing conditions, and the ability to grow crops year-round in any climate. Today, modern greenhouses are made from a variety of materials, including glass, polycarbonate, and acrylic. These structures can be customized to fit the needs of the end-user and the crops desired, with features such as automated irrigation, fertigation, and climate control systems.

While modern greenhouses have evolved to incorporate advanced technology and materials, it is important to note that they must also adhere to building codes and safety regulations. Architectural-grade greenhouse construction requires a level of expertise and attention to detail that is paramount for ensuring the safety and structural integrity of these structures.

Building codes and safety regulations for greenhouses vary by region and jurisdiction, but some common requirements include adequate ventilation systems, fire suppression equipment, and earthquake-resistant construction. It is also essential that the materials used in greenhouse construction meet safety standards and are able to withstand the elements.

Glass is still the most commonly used material for greenhouse construction, as it allows for the highest amount of light transmission and creates a natural greenhouse effect. However, polycarbonate and acrylic are becoming increasingly popular due to their durability and resistance to shattering. These materials also have the added benefit of being able to provide greater insulation and energy efficiency, reducing the amount of energy needed for heating and cooling.

Architectural-grade greenhouse construction also takes into consideration the specific needs of the crops being grown. Automated irrigation and fertigation systems ensure that crops receive the optimal amount of water and nutrients, while climate control systems provide precise temperature and humidity control. Lighting systems can also be incorporated to provide supplemental lighting in areas with low natural light, allowing for year-round crop production.

In addition to safety and code compliance, architectural-grade greenhouse construction also places a high value on aesthetics and design. Greenhouses can be designed to seamlessly integrate into their surroundings or stand out as architectural marvels, depending on the desired effect. Some greenhouse designs incorporate features such as curved glass or unique shapes, creating a striking visual impact while also maximizing the use of available space.

One notable innovation in modern greenhouse technology is the use of renewable energy sources. Many greenhouses now incorporate solar panels, geothermal heating and cooling systems, and wind turbines to reduce energy costs and decrease their carbon footprint.

Modern greenhouse technology ensures the safety and structural integrity of these structures. Architects and engineers today work closely with growers to create custom solutions that meet the specific needs of each crop while adhering to building codes and safety regulations. With continued advancements in technology and design, architectural-grade greenhouse construction will play an increasingly important role in meeting the growing demand for food production while minimizing our impact on the environment.







**FROM  
TO LA**

**To plant  
a garden  
is to  
believe in  
tomorrow.**

Audrey Hepburn







**SMALL  
LARGE**



# HOME & HOBBY









## There are no gardening mistakes, only experiments

Janet Kilburn Phillips



The design and functionality of a home are the most important features of a homeowner. A greenhouse is an excellent addition to any home, providing an exceptional space for home and hobby enthusiasts to grow plants and vegetables year-round. And what's more attractive than a custom greenhouse made of glass?

Glass greenhouses are the ultimate way to add elegance and sophistication to a home while providing a safe and practical environment for plants to thrive. Greenhouses made of glass offer several benefits that other materials cannot match, including natural light and superior insulation. Glass is also a durable and long-lasting material that will withstand weather conditions, providing a secure environment for plants.

When designing a custom greenhouse, the consideration of building codes and safety regulations is crucial. Glass greenhouses require tempered or laminated glass for safety, which ensures that the glass will not shatter into sharp pieces.

It's also essential to ensure proper ventilation in greenhouses, which

is crucial for maintaining an optimal environment for plants. Roof and window vents are often included in the design, even with smaller hobby greenhouses.

Homeowners use greenhouses for various purposes, from growing exotic plants and vegetables to creating a peaceful retreat for relaxation. Some homeowners even use their greenhouses as an entertainment spaces, hosting dinners and events in a serene and inviting environment.

One of the most significant advantages of custom glass greenhouses is the ability to tailor the design to the homeowner's preferences. Architects can create a bespoke structure that seamlessly blends with the home's existing design while fulfilling the homeowner's vision for the space.

A custom glass greenhouse is an excellent investment for home and hobby enthusiasts. It provides a luxurious and practical space for growing plants and vegetables while adding a touch of elegance to any home. Safety and building codes must be considered when designing the space, but the result is a stunning and functional space to be enjoyed for years to come.







# GROWING KNOWLEDGE









# GROWING MINDS



Architects and designers have the power to create spaces that can inspire and nurture young minds. One such space is a greenhouse. Greenhouses are an excellent addition to schools, providing a safe and practical environment for students to learn about agriculture, botany, and sustainable living.

Greenhouses made of glass offer several benefits that other materials cannot match. The natural light that passes through the glass creates a perfect environment for plants to grow, and it also helps students learn about the importance of natural light and photosynthesis. Glass also provides superior insulation, ensuring that the greenhouse stays warm even during colder months.

The safety of our children is of the utmost importance. When designing a custom greenhouse for schools, building codes, and safety regulations must be a careful consideration. Glass greenhouses require tempered or laminated glass for safety, which ensures that the glass will not shatter into sharp pieces.

Schools are increasingly using greenhouses to teach students about agriculture and sustainability. Greenhouses provide an incredible hands-on learning

opportunity for children, making them valuable addition to any educational facility. Greenhouses are a versatile tool that can be used to teach children about a wide range of STEM and STEAM concepts, such as biology, ecology, chemistry, and physics.

By using greenhouses as a teaching tool, children can develop a deeper understanding and appreciation of STEM and STEAM concepts. These hands-on learning experiences can help cultivate a love for science and encourage children to pursue careers in STEM fields. They can also help develop critical thinking and problem-solving skills, which are essential for success in any field.

Greenhouses in schools also offer a unique opportunity for community engagement. Community members can volunteer to help maintain the greenhouse or donate plants and seeds, creating a sense of community involvement and support for the school.

Classroom greenhouses are an excellent investment for schools. They provide a practical and educational space for students to learn about agriculture, botany, and sustainable living while creating a sense of community involvement and support.





**Tell me and I'll  
forget.  
Teach me and I'll  
remember.  
Involve me and I'll  
learn.**

Benjamin Franklin







# GROWING OPPORTUNITIES



When it comes to higher learning institutions, providing students with unique and practical experiences is key. Coursework often includes requirements for science credits. These courses include cover plant biology, sustainable agriculture, and horticulture. Incorporating greenhouses on a college campus provides numerous benefits that can enhance the learning experience for students while also serving as a visually stunning architectural feature.

Using glass as the primary building component has many benefits over other materials. Glass allows natural light to enter the space, which is essential for plant growth. It also creates a visually appealing environment that is conducive to learning. Glass is durable, easy to clean and provides insulation that helps maintain a consistent temperature. Additionally, the use of glass offers a more sustainable and







environmentally friendly solution, in line with the values of many modern college campuses.

Including greenhouses on college campuses can also benefit the institution itself. Greenhouses can serve as a space for research and experimentation, which can lead to breakthroughs in sustainable agriculture and other related fields. Additionally, greenhouses can serve as a marketing tool for the institution, showcasing its commitment to sustainability and providing a unique, visually stunning feature that sets it apart from other institutions.

Beyond the benefit of hands-on experience and developing a deeper understanding of plant biology and sustainable agriculture. A study published in the Journal of Environmental Horticulture found that incorporating

greenhouses into college curriculums improved student learning outcomes. Students who worked in the greenhouse had higher scores on exams and were more engaged in class.

Additionally, studies have shown that being around plants can have a positive effect on mental health and overall well-being. Greenhouses on college campuses can provide a space for relaxation and stress relief for students and faculty.

Overall, the benefits of including greenhouses on college campuses are numerous and well-supported by research. From improved student learning to sustainability and research opportunities, greenhouses can provide a unique and valuable addition to college campuses.



**What you  
plant today you  
will harvest  
tomorrow.**







# GREEN RESEARCHING



As the world population continues to grow and resources become increasingly scarce, the role of greenhouses in research has never been more important. From developing new plant varieties to finding ways to grow crops in harsh environments, research greenhouses have the potential to drive innovations that could revolutionize the way we feed and sustain ourselves.

But what sets research greenhouses apart from your typical backyard greenhouse? For one, research greenhouses are designed to maintain strict climate control, ensuring that the environment is consistent and conducive to the plants being studied. This is where glass comes in. Glass is an ideal material for research greenhouses because it allows for maximum sunlight penetration while also providing insulation to help maintain the desired temperature and humidity levels.

In addition to climate control, research greenhouses often feature advanced technologies and high-functioning systems that





allow researchers to collect data and monitor conditions in real time. For example, sensors can track temperature, humidity, and light levels, providing valuable information for experiments and helping researchers identify patterns and trends.

Research greenhouses also play an important role in addressing some of the biggest challenges facing the planet today. For example, researchers are exploring ways to use greenhouses to grow crops in harsh environments, such as deserts and Arctic regions. These efforts could help expand agricultural production and ensure food security in areas where it is currently limited.

Furthermore, greenhouses are also being used to develop new plant varieties that are more resistant to diseases and pests,

which could help reduce the need for harmful pesticides and herbicides.

Finally, research greenhouses offer exciting opportunities for collaboration and knowledge-sharing among scientists and institutions around the world. By working together and sharing resources, researchers can accelerate progress and tackle some of the most pressing issues facing our planet.

From climate control to advanced technologies and high-functioning systems, research greenhouses offer a unique and valuable space for scientific inquiry and innovation. And with the challenges facing the world today, the potential impact of research greenhouses is more important than ever before.



# NATURAL CONNECTIONS

**By pushing the boundaries of design and innovation, architects can use greenhouses to create spaces that enhance communities and the people who live in them.**

As architects continue to push the boundaries of design, greenhouses have emerged as a versatile and sustainable option for creating specialty spaces beyond their traditional uses in schools, commercial establishments, and research facilities. From botanical gardens and senior living centers to community gardens, greenhouses have become increasingly popular among architects looking to create unique spaces that connect people with nature.

Botanical gardens often use greenhouses to start and preserve plants. The greenhouse provides a controlled environment that allows for year-round plant growth, regardless of the climate outside. Botanical gardens are a perfect example of how greenhouses can be used to create specialty spaces that showcase different plant species from around the world. Places like Dow Gardens and Hershey Garden Conservatory have found that the greenhouse can offer a way to generate interest and revenue all year long. With an architectural greenhouse, visitors can be welcomed into a warm and inviting space that provides a unique opportunity to explore nature and learn about different plant species.

Greenhouses are also a great option for senior living centers. The elderly often struggle with mobility and may have a difficult time getting outside to enjoy nature. A greenhouse can bring nature to them, providing a space for residents to relax and enjoy the beauty of plants without leaving the comfort of their own facility. Additionally, gardening can provide therapeutic opportunities to benefit the mind and body as well as opportunities to socialize with peers.

Community gardens are another specialty use for greenhouses. Community greenhouses have become increasingly popular as a way to promote sustainability, education, and community engagement. These greenhouses are typically built and maintained by community members and are used for a variety of purposes, from growing fresh produce to hosting educational workshops and events. A greenhouse can provide a space where the community can come together and enjoy the benefits of gardening.

With the ability to create controlled environments for plant growth, architects can use greenhouses to create specialty spaces for people to gather and enjoy nature. By pushing the boundaries of design and innovation, architects can use greenhouses to create spaces that enhance communities and the people who live in them.









# Additional Considerations



**Benches and shelving:** A greenhouse needs ample space to grow plants. Benches and shelving can help maximize space and make plant care easier.

**Heating and cooling systems:** A greenhouse needs a heating system to maintain an optimal temperature during colder months, and a cooling system to prevent overheating during warmer months.

**Ventilation:** Proper ventilation is crucial for a healthy greenhouse environment. Ventilation systems can include fans, vents, and louvers.

**Lighting:** If the greenhouse doesn't receive enough natural sunlight, artificial lighting may be necessary to help the plants grow properly.

**Irrigation systems:** Plants in a greenhouse need consistent watering to thrive. Automated irrigation systems can help maintain proper moisture levels and save time and effort.

**Thermometer and hygrometer:** Monitoring the temperature and humidity levels in a greenhouse is important for ensuring optimal plant growth.

**Shade cloth:** During hot summer months, shade cloth can help reduce the intensity of sunlight, preventing plants from getting scorched.







## **Notable Greenhouse Projects**

- Dow Gardens Conservatory
- Arturo Community Gardens
- Washington College
- Cheyenne Botanical Gardens
- University of Wisconsin
- Wings of Wonder
- Bristol Community College
- Chariho High School
- Lincoln Elementary School
- Presque Isle Greenhouse
- Middle Tennessee University
- Wichita State University
- Maury River Middle School
- ELCO High School
- Minnesota Veterans Home
- Grayslake Senior Center
- Crestavilla Senior Center
- Defer Elementary School
- Wausau High School
- Blue Valley High School
- McPherson College

**Add your project to this list -  
contact us today to get started**

**316.838.0033**

**[CrystalStructuresGlazing.com](http://CrystalStructuresGlazing.com)**



# GROWTECH GREENHOUSES

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