

Student Greenhouse Project

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SGP Background

The Student Greenhouse Project began with the closure of the MSU Botany and Butterfly Greenhouse. This 22,000ft³ marvel contained a tropical room with a sixty-foot long stream flowing from a five-foot waterfall down a canyon to a small pond at the end. In the sub-tropical room there was a fishpond and more unique, exotic plants. The arid habitat room was full of large cacti and there was a 900ft³ butterfly house teeming with colorful butterflies.

Free and open to the public year round this green-space was extensively used for student activities: poetry readings, drum-circles, and concerts. The community used the greenhouse for weddings, health walks for heart patients from nearby hospitals, school field trips for K-12 students, and informal drop-in visits from many, many faculty, staff, families and students during the day.

Since the beloved facility was razed the Student Greenhouse Project has worked to create a new design that would encompass these social engagement functions in an advanced green technology showcase that will bring this unforgettable wonder to many communities.

In 2015 our Solar Gem Biodome design won an Energy Innovation Award. Here we combined building integrated transparent solar panels with passive solar thermal mass storage elements and seasonal evapotranspiration cooling capabilities.

In 2017 through 2019 we prepared a Preliminary Cost Assessment working through the building code requirements and American Disabilities Act standards, including the layout of the Ecological Communications Theatre.

In December 2021, we finalized our integrated water systems designs and submitted these into the EPA Campus RainWorks Challenge. The design configures the rainwater harvesting system and graywater recycling system throughout the facility. These supply the high efficiency drip irrigation system and internal pond and stream environmental system.

The experience of the former Botany and Butterfly Greenhouse proves how beloved a community greenhouse can be.

Biodome Technical Details

Estimated cost of project: \$10 million

Diameter: 150' (45.7 m)

Height: 75' (22.86 m)

Materials:

-3.5" Aluminum Stock Struts

-Triangular Double Strength Insulated Glass Panels/Transparent PV Solar Panels

Foundation: insulated poured concrete open ring to allow proper drainage

Solar coverage: 60% of the southern exterior will be clad in transparent photovoltaic solar

Water catchment: rainwater from the dome will be captured, and stored for watering

Biodome Engineering Summary

The Biodome -- is a technological innovation bringing in 20% more light through its larger panels than a conventional greenhouse and supporting a forest canopy height with no needed internal columns. It provides a natural space where the walls go up out of sight out of mind. It's low stress structural stability and extremely durable construction materials guarantee a century of low maintenance use.

Transparent Solar Panels -- integrated into the south face of the dome. Three different bands become progressively darker toward the peak providing increased summer shading and year round power output. The north entry building accompanying the dome also has standard solar panels on the roof for real time power output comparisons of five different types of commercial product lines.

Evapotranspiration Cooling/ Passive Solar Heating --Summertime comfort inside the dome is maintained by the up and out air flow, venting heat and humidity at the top of the dome while inflowing air at the base of the dome is cooled by evaporation from the plants and waterfalls. Low angle winter sun heat is stored by the thermal masses of the pond and the rock face cliff, which are shaded by palm trees to avoid heat absorption in the summer.

Rainwater Harvesting/ Graywater Recycling -- Water management on the site harvests rainwater, processing it for irrigating the tropical garden. Runoff pollution is prevented from reaching nearby rivers. The facility's graywater is also recycled for internal use.

Biodome Interior

The interior of the Biodome will be contoured like a small tropical valley.

In the north, the 14 foot high ridge has the taller of the two interior cascading waterfalls. The ridge is split in two by the canyon, which will be offset slightly west of the north entrance. Entering from the north, sunlight shining through the gap from the south provides mystique because the central area is not quite visible without rounding the bend in the trail. The central courtyard is where the high falls splash over the rocks to the pool below, at one end of the largest internal green space. The community room, overlook, upper bridge and surrounding ridge trail look into this area. Being centrally located under the dome, trees here will reach forest-like heights.

On the west end the horseshoe shaped ridge ends in a natural-stone cliff face. It is the backdrop for the Ecological Communications Theatre. Underneath this end of the ridge is the community room, which looks into the thick of the garden. Its position behind the theatre allows it to double as a 'backstage' preparation area for concerts, theatrical events and as a dressing room for weddings.

Interior Floor Plan

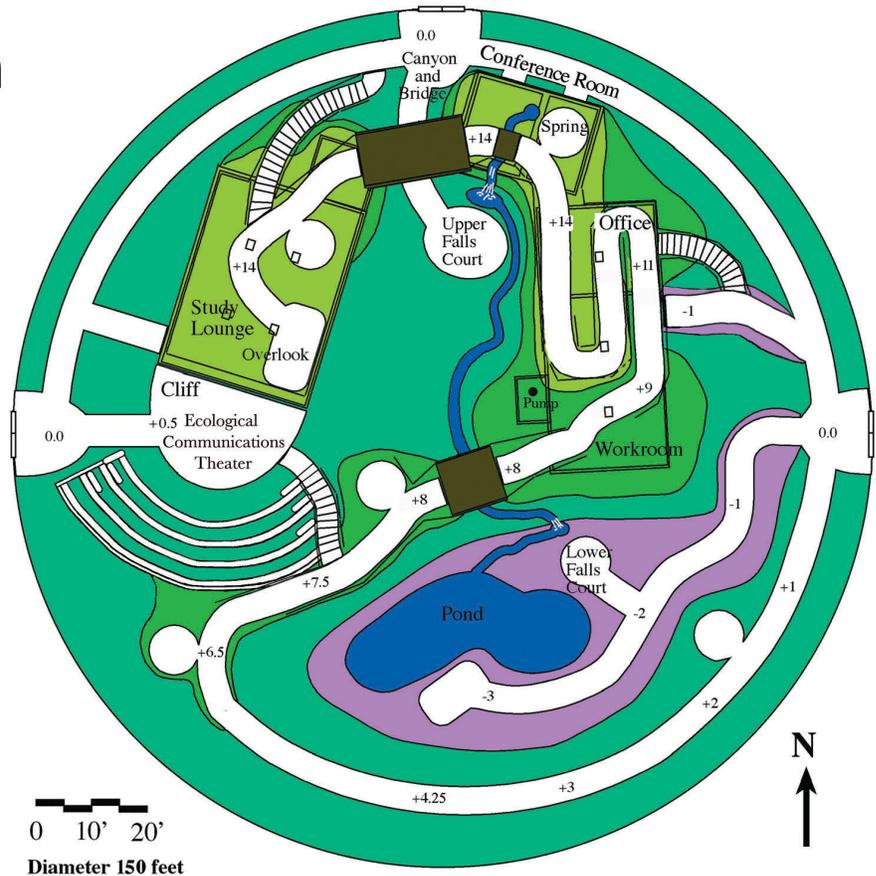
- Features**
-  Waterfalls 14 & 2 ft.
 -  Pond and Stream
 -  Bridges
 -  Paths
 -  Stairs

- Contours**
-  16 - 10 ft.
 -  10 - 5 ft.
 -  5 - 0 ft.
 -  0 - -3 ft.

+8 Height or Depth

Size

Study Lounge	28 x 36 ft.
Performance Area	28 x 17 ft.
Conference Room	12 x 16 ft.
Office	20 x 16 ft.
Workroom	20 x 28 ft.



The east end of the ridge slopes down to the lower falls and the southern pond. Beneath this section of the ridge is the conference room, the office and garden maintenance room.

The large southern pond and lower falls are situated below ground level, adding to the dynamic range of the contouring. By lowering this area, its separation from the encircling upward trail is increased, enhancing the out-of-the-way character. The quietness of the pond and lower fall is also maintained by the upward trail separating and screening activities at the theatre.

Distinctiveness of places within an environment adds to the impression of depth and extent. The highs and lows of the contouring create terrain features that are recognizable places. Within the interior design there are at least seven definable 'places'. These are the Upper Falls, Lower Falls, Pond, Spring, Cliff, Bridge over the Canyon, and the Overlook. Using contouring and waterscapes to create these features magnifies the dome's interior space in a

visitor's experience by adding context and separating the space into multiple places. Each unique configuration can be its own distinct experience.

The curved paths provide a 'what's-around-the-bend' quality of mystery that adds intrigue and imply an invitation for further exploration. The layering of different levels within the Biodome provides a variety of niches and destinations to explore. Mists and fog add to the mystery of a scene, so even the misting system, planned for maintaining the plants and cooling in the summer, can add mystique to a visitor's experience.

Fish and frogs, birds and butterflies all add to the fascination people feel in a natural setting. Interest in other living things contributes to getting outside ones own daily concerns and allows mental rest and rejuvenation. Watching a placidly swimming fish or the antics of a chipmunk, listening to the chirp of frogs or insects calling to each other begins the process of unwinding, lessens self-absorption and allows mental reflection, perhaps leading to a refreshed insight. The interior plan includes fish in the pond, birds, gecko lizards and other aquatic creatures.

Scientific research in environmental psychology has investigated meanings, attachment and defining characteristics of favorite places. Favorite places are often restorative environments providing a respite or break from daily concerns or a chance to find solitude or "get away". These are also frequently natural environments. Many studies have investigated landscape preferences and found mountain waterscapes, waterscapes in general and forests to be robustly preferred across cultures, classes and age groups. These have also been shown to be the most restorative natural environments. The interior of the Biodome is focused on producing the best facsimile of an outdoor environment with waterfalls, stream and pond, and a tall forest of trees. All of these the aesthetic aspects of a beautiful favorite place.

The overriding design principle of the interior has been accessibility. The size, depth, width and roundness of the dome are the minimum necessary to make the interior design work. The nearly 350-foot long giant S-curve encompassing the central region of the dome has a gentle slope for easy use. The length of this walkway allows the northern ridge to reach 14 feet for a significant waterfall and grand overlook. It also has adequate height to provide for required soil depth above rooms underneath. A careful balance between paving and plant space was maintained the final paved area in the dome at 31 percent. The bridges are ten feet wide, so that any one who wishes can stop and look out without disturbance while others can pass by unimpeded. All destinations are accessible, while the stairs allow various winding paths. The grade of accessible slopes and the path length required to gain height or depth have been the determining factor in the design's contours.

The Biodome's combination of beauty, efficiency and accessibility will provide a superlative garden experience. With curving paths to provide mystery just around the bend, fish in the pond and birds or other creatures, this oasis of year round vibrancy will revive one's spirit.