

Discovery Elementary School

Arlington Public Schools, VA



Setting a New Standard for a New Century

Discovery Elementary School is Arlington Public Schools' first elementary school designed in the 21st century. While built to address rapidly growing student enrollment in Arlington, the school was designed to meet a larger goal — to prove what can truly be achieved with a new public school facility.

Throughout a series of intensive community planning meetings, careful attention was focused on designing and building a school that supports how and where students learn. Every nook and cranny of the school is arranged to create a seamless integration between design, sustainability, and learning. Recognizing that students are the creators of our collective future, Discovery Elementary sets the stage for the development of the skills necessary for long-term stewardship of our world.

The school was designed to be a “zero-energy” building, meaning that the amount of energy produced annually by on-site renewable energy sources is equal to the amount of energy used annually. Discovery is the first zero-energy school in the Mid-Atlantic and the largest in the United States. As a carbon neutral producer of clean energy, the school offers a positive example of a solution to a global crisis — and along the way emboldens students with the expectation that they are creative participants in those solutions.



Community Context

Nestled near the nation’s capital, Arlington County is one of the fastest growing counties in Virginia and is rapidly urbanizing. Built in a residential neighborhood worried about losing its character, Discovery needed to be both contextually sensitive to the neighborhood scale while also able to meet the demands of heavy after-hours use.

To preserve space, the school shares the site with an existing middle school and has been master planned for future middle school expansion. Open, programmable space is preserved as much as possible by situating a full third of the building’s footprint on existing slopes. The school tiers into an existing hill to minimize the perception of its size while featuring exterior materials that are residential in nature and scale. Pre-K and Kindergarten students are grouped into three “kinderhouses” that mimic the size and spacing of adjacent homes.

To support ownership of the new school, the mascot, colors, and school name were chosen by a vote of the student body. The “Discovery Explorers” name reflects the forward-looking, inquiry-based learning that takes place in the building. The school name also serves as a tribute to John Glenn, who lived adjacent to the site when he became the first American to orbit the earth in 1962. In 1998, while still a sitting senator, Glenn returned to space as a crew member of the space shuttle Discovery, becoming the oldest person to fly in space.



Zero-Energy Design

Considerations for site footprint, solar orientation, building construction, and energy use were given top priority in the iterative design process. With a capacity of 650 students in grades Pre-K through 5, the 97,588 SF building is designed for an Energy Use Index (EUI) of 23 kBTU/sf/year – one third of the energy use of a typical County elementary school. This ultra-low EUI makes on-site photovoltaic energy generation possible within a traditional school budget.

Achieving an EUI of 23 involved meticulous evaluation of the way Arlington Public Schools (APS) builds and operates its facilities. Discovery's sustainable features include:

- 1,706 roof-mounted solar panels
- A geothermal well field
- Solar pre-heat of domestic water
- 100% LED lighting
- Ideal solar orientation and shading
- Insulated concrete exterior walls with high thermal mass
- Bioretention areas that clean and slowly release all of the water from the site
- A building dashboard system that tracks energy data in real-time and makes it available on every school device

Light is celebrated in multiple ways throughout the project, culminating in a rooftop solar lab that allows students to conduct real time and on-going experiments. Data from these experiments can be tracked and graphed using the school's building dashboard system, which is accessible on any device in the school connected to the internet.



Return on Investment

An equally-sized APS school accrues approximately \$100,000 in annual energy costs. By fully offsetting energy use through photovoltaic generation, Discovery helps redirect funds that would be dedicated to energy costs back to the APS operating budget, while allowing the school community to enjoy the environmental benefits of a fully offset carbon footprint.

Schools' operating dollars are some of the most precious of all public tax dollars – and are increasingly under strain. Savings from conservation alone are predicted to be \$52,000 in year one and \$1,400,000 over twenty years. Income from the solar array will cover the array's portion of the bond payment around year six and produce a 20 year annual average return-on-investment of 16%. As an all-electric facility, the building hedges against future energy inflation by offsetting all of its power consumption with on-site generation. In fact, the more electricity prices go up, the higher the return on investment for the school.

The school's entry canopy features an oculus that measures the movement of the sun – creating an opportunity for a solar calendar in the front plaza that allows students to track the time and the season. Connections to the sun – through the oculus, solar panels, and other design features – become learning tools throughout the school.

Entry Canopy with Oculus



Site Design

The school’s design takes advantage of the topography of the site to create distinct, tiered academic zones and separate exterior play spaces for early childhood, primary, and elementary grade levels. Discovery’s public spaces are defined by a large roof canopy with a cedar soffit that runs the length of the school and serves as the school’s “front porch.” In addition to shading large expanses of glass that provide a strong visual connection to the outdoors, the roof overhang provides covered outdoor dining and play spaces. At the main entry, the roof extends out as a canopy with an oculus, which allows the entry plaza to serve as a large solar calendar.

The street side of the school is accented with warm colors – reflecting their south-facing solar orientation. On the north side, the school uses playful arrangements of cool colors, such as greens and blues, echoing the natural expression of moss that grows on the north side of trees.



South



North

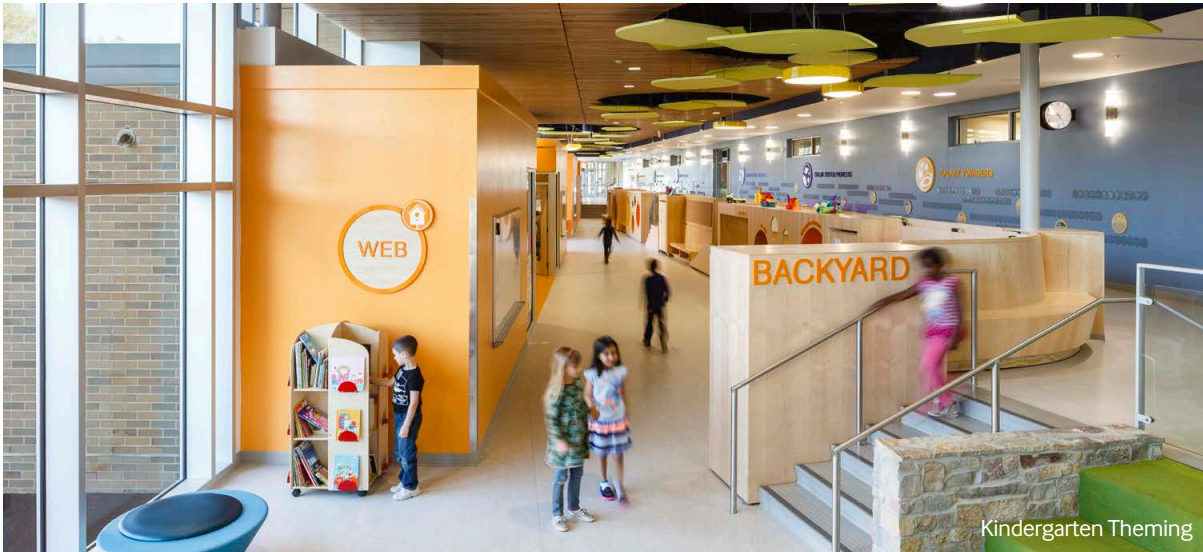


Theming + Graphic Wayfinding

The school’s wayfinding goes beyond basic navigation to support a larger vision of spatial organization that reflects each grade’s expanding curriculum and identity. This approach supports grade-level identity while also engaging and educating users as they interact with the building.

As students progress through the school, their “world expands” – with the first floor themed around animals found in earth eco-systems and the second floor themed around the elements of the sky and heavens. Students start out as Backyard Adventurers in Kindergarten and finish Fifth Grade as Galaxy Voyagers. This storyline is graphically communicated along an entry wall highlighting each Explorer grade level. On the first day of school, Explorers are able to “make their mark” in their expanding world by signing their name on the wall – and follow along as the mark moves down the wall over their six year journey at Discovery.

When students advance, so does the scope of their expanding world, both in graphics and in complexity of content. Educational signage connects the sustainable features of the building with factoids about the natural world. For example, water conservation is described in the Ocean; air quality is explained in the Atmosphere; and light and energy facts are featured in the Solar System and Galaxy, respectively.



Kindergarten Theming



Entry Wall

	K BACKYARD ADVENTURERS local fauna
	1 FOREST TRAILBLAZERS materials
	2 OCEAN NAVIGATORS water
	3 ATMOSPHERE AVIATORS air
	4 SOLAR SYSTEM PIONEERS light
	5 GALAXY VOYAGERS energy

Grade Level Wayfinding

Encouraging Expression + Flexibility

Discovery Elementary inspires students and teachers to use the building creatively to facilitate everyday learning and lifelong exploration. In order to accommodate change and support engagement across grade levels, the school offers an extensive array of exterior playscapes and flexible interior furniture including stools, bean bags, cushions, height-adjustable tables and chairs, and reading steps, among other options.

To encourage creative expression and student ownership, the school features a two-story slide that students may go down any time as well as “creativity walls” that mirror floor-based theming (1st floor = earth; 2nd floor = sky and solar system). Featuring cut-out white boards for students to draw/write/mark upon as desired, the creativity walls reverse the notion of “graphing” or “graffiti” as being a destructive act to one that, in the Discovery context, supports expression and creativity.

Expanses of glass and extended learning areas located outside of classrooms provide subtle security measures — allowing teachers the option to facilitate learning or supervise from afar depending on the needs of the students and pedagogical aims.

Slide with Creativity Wall



Extended Learning Area



Inspiring Learning + Creativity

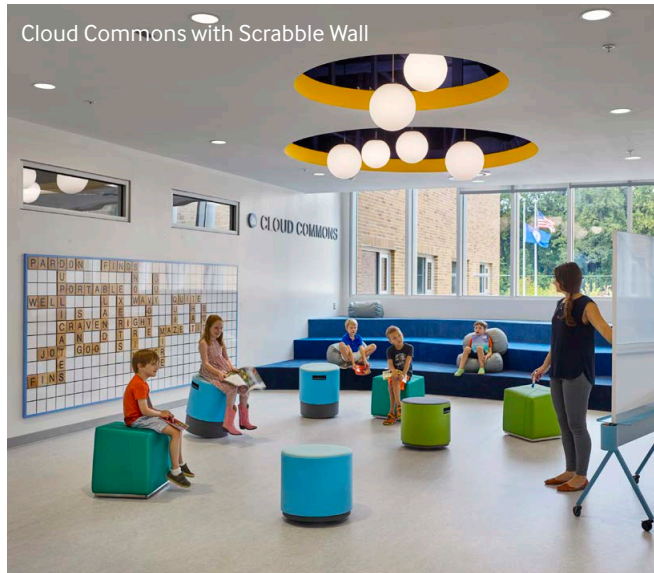
Inside classrooms, flexible details such as foldable partitions, retractable garage doors, and various furniture offerings support teacher collaboration and cross-pollination. Throughout the school, one-to-one technology enables research and collaboration to happen anytime, anywhere. Dry erase and magnetic creativity walls encourage student expression and ownership; Scrabble and Lego walls fuel linguistic and spatial exploration; and the “Hedge” (which encloses and defines the Kindergarten “Backyard”) provides nooks and crannies that buzz with activity before, during, and after school.

With a reconfigurable range of learning spaces, the positive correlation between learning, high performance architecture, and student engagement continues to find expression in all types of unanticipated ways – demonstrating that Discovery should continue to provide meaningful settings for educational practices that are always evolving.

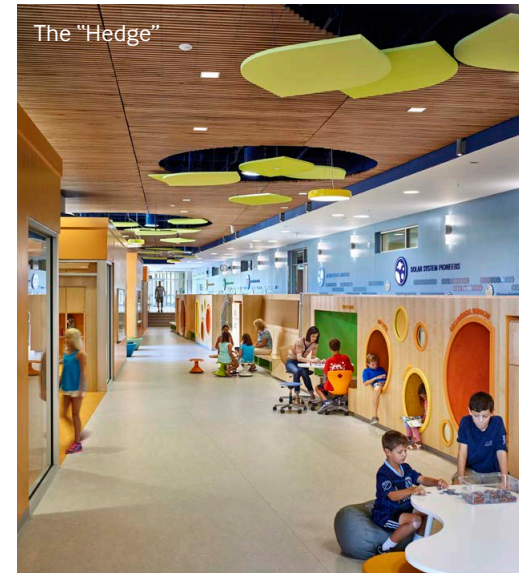
“Curriculum is just something the state gives to us and you can teach that anywhere, but with this space, we can really get creative, and experiment, and shepherd meaningful experiences.”

Erin Russo
Discovery Elementary School Principal

Cloud Commons with Scrabble Wall



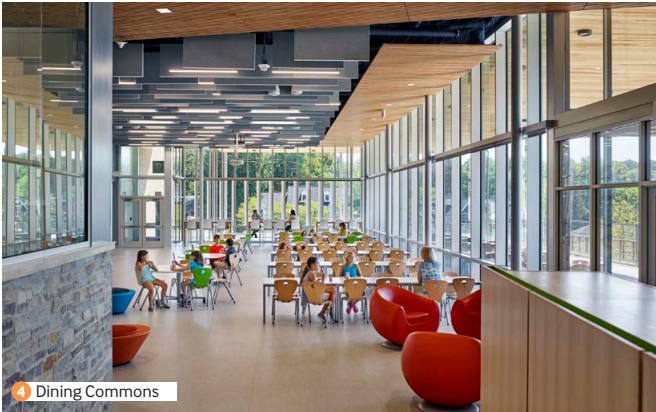
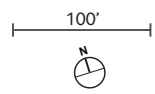
The “Hedge”



Classroom with Foldable Partition for Team Teaching



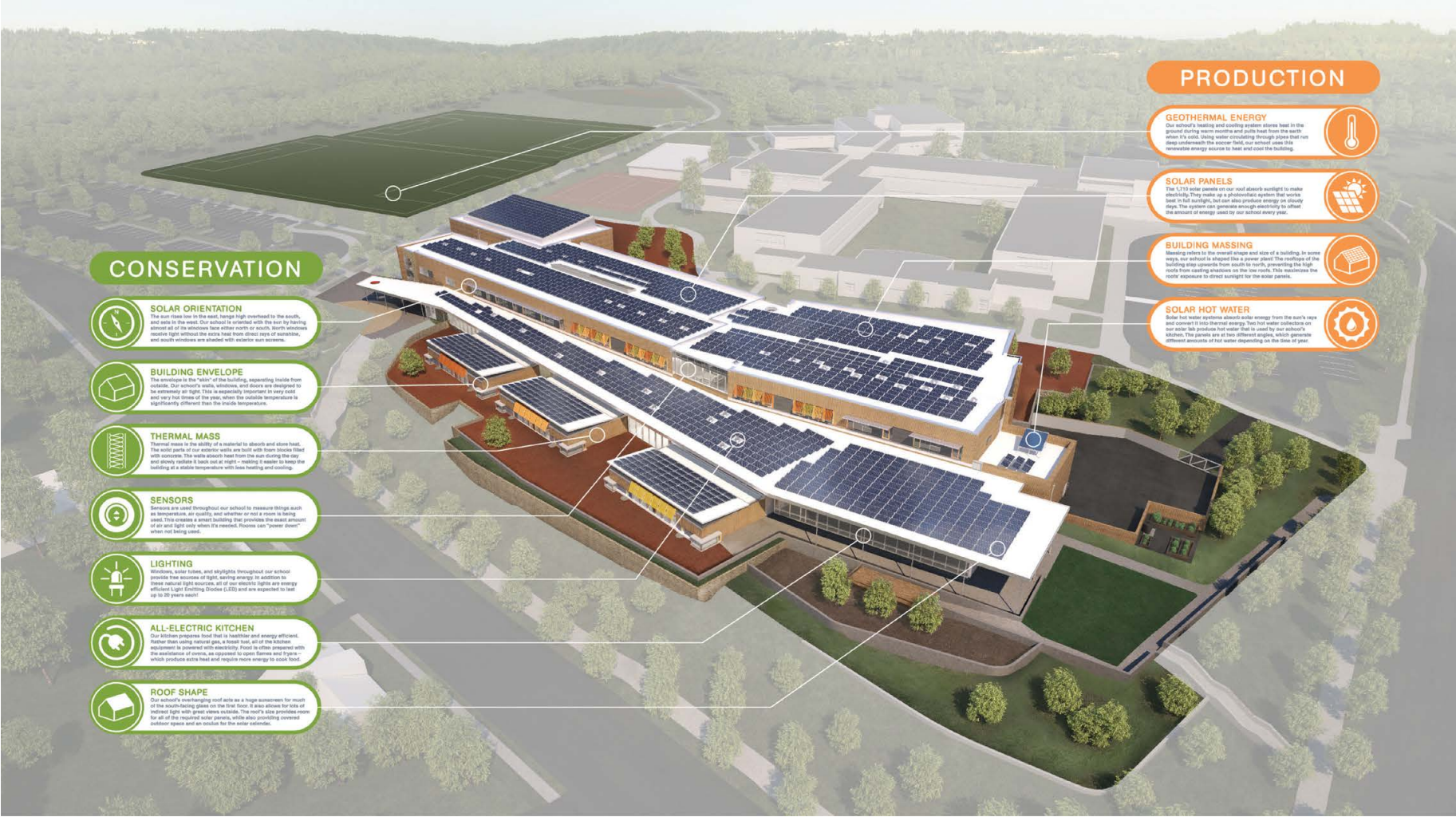
Floor Plans





Discovery Elementary School

Play Lawn Exterior and Building Section



CONSERVATION



SOLAR ORIENTATION

The main door has the most direct light overhead to the south, and sets in the west. Our school is oriented with the sun by having almost all of its windows face either north or south. North receives natural light without the extra heat from direct rays of sunshine, and south windows are shaded with exterior sun awnings.



BUILDING ENVELOPE

The envelope is the "skin" of the building, separating inside from outside. Our school's walls, windows, and doors are designed to be extremely air tight. That is especially important in very cold and very hot times of the year, when the outside temperature is significantly different than the inside temperature.



THERMAL MASS

Thermal mass is the ability of a material to absorb and store heat. The solid parts of our exterior walls are built with foam blocks filled with concrete. The walls absorb heat from the sun during the day and slowly release it back out at night - making it easier to keep the building at a stable temperature with less heating and cooling.



SENSORS

Sensors are used throughout our school to measure things such as temperature, air quality, and whether or not a room is being used. This creates a smart building that provides the exact amount of air and light only when it's needed. Rooms can "power down" when not being used.



LIGHTING

Natural, warm tones, and skylights throughout our school provide the sources of light, saving energy in addition to these natural light sources, all of our electric lights are energy efficient Light Emitting Diodes (LED) and are expected to last up to 75 years each!



ALL-ELECTRIC KITCHEN

Our kitchen project team did it healthier and energy efficient, rather than using natural gas, a fossil fuel, all of the kitchen equipment is powered with electricity. Food is often prepared with the assistance of ovens, as opposed to open flames and fryers - which produce extra heat and require more energy to cool food.



ROOF SHAPE

Our school's energy-efficient roof acts as a huge sunroom for most of the south-facing glass on the first floor. It also allows for lots of natural light with great views outside. The roof's area provides room for all of the required water panels, while also providing covered outdoor space and an outlook for the solar panels.

PRODUCTION

GEOTHERMAL ENERGY

Our school's heating and cooling system draws heat in the ground during warm months and pulls heat from the earth when it's cold, using water circulating through pipes that run deep underneath the soccer field, our school uses this renewable energy source to heat and cool the building.



SOLAR PANELS

The 1,170 solar panels on our roof absorb sunlight to make electricity. They make up a photovoltaic system that works best in full sunlight, but can also produce energy on cloudy days. The system can generate enough electricity to offset the amount of energy used by our school every year.



BUILDING MASSING

Building refers to the overall shape and size of a building. In some ways, our school is shaped like a power plant! The roofline of the building steps upwards from south to north, preventing the high north from casting shadows on the low south. This maximizes the north exposure to direct sunlight for the solar panels.



SOLAR HOT WATER

Solar hot water systems absorb solar energy from the sun's rays and convert it into thermal energy. Two hot water collectors on our soccer field produce hot water that is used by our school's kitchen. The panels are at two different angles, which generate different amounts of hot water depending on the time of year.





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Entry Corridor with Environmental Graphics + Grade-Level Wayfinding



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Dining Commons



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Two-Story Slide with Interactive Creativity Walls