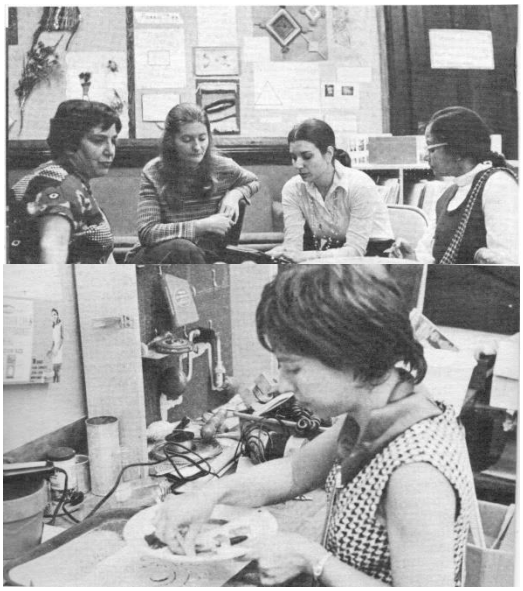
Main Street Strikes Again
By Michael Tempel

Through the 1970s I was teaching elementary school at PS75M in the Upper West Side neighborhood of New York City[1]. I was very fortunate to be part of the Open Classroom program led by Professor Lillian Weber at City College. The program included graduate study and an advisory team to provide support for teachers. The program was based at the Workshop Center for Open Education on the City College campus. It was, in today's jargon, a "maker space" and also served as a place for workshops, courses, and informal meetings and hanging out.



In their schools, teachers collaborated in teams. Students from two or more classes worked together, utilizing the corridor outside their rooms as well as the classrooms themselves. We emphasized hands-on, project-based learning. Some of uss had multi-grade classes, in my case, 5th and 6th grades, and in some years 4th, 5th, and 6th grade. Each student would be in the class for two or three years. Each year a portion of the class would graduate, and a new group of younger students would join. Older children mentored younger ones, and there was year-to-year continuity. This allowed major projects to span many years and develop their own histories.

My goal was to create interdisciplinary projects that were of broad interest and had learning opportunities in varied fields. A good project should have a physical presence in the classroom for the students to build and interact with.

An early project was The Pond, a large shallow tank that initially contained sand and water, with a pump to create circulation. This enabled studies of erosion and water currents. Later we stocked the pond with plants and animals brought in from various places including the ponds and lakes in Central Park.

The Pond was very much focused on science, which was an area of strength for me. But it did not provide well for connections to social sciences, arts, and humanities.

A few years later we began the Flight Project, which was somewhat broader, rich in history and with good connections to art and literature.

[1] *Being with Children*, by Phillip Lopate, first published in 1975 is about PS75.

The next big interdisciplinary project was called SCCAADSS, an acronym that my colleague Esther Rosenfeld dreamt up: Society, Cities, Culture, Art, Architecture, Design, Structures, Science. Esther's strengths were in humanities, art, and social sciences; mine in science and mathematics. We made a good team.

We studied the urban environment around us. This included looking at bridges, of which there are many in New York City. A field trip on the Circle Line, a tour boat that circles Manhattan Island, offered a great starting point. We also studied gothic architecture, with trips to nearby Riverside Church and Cathedral of St. John the Devine as inspiration.

We picked up on events and issues in our local community. A pair of old movie theaters on Broadway a block from the school was vacant and about to be torn down. There was debate in the community about what should replace them with most of the students opting for affordable housing and a bowling alley. In the end, a luxury high rise was built, without a bowling alley.

One night during the demolition of the theaters, part of the remaining structure collapsed – a newsworthy event that sparked studies of structural failure.

A major influence on this project was my work with Mario Salvadori, a professor of structural engineering at Columbia University. He was in the process of developing a project through the New York Academy of Sciences to teach mathematics and science through the study of architectural structures[2]. We began working together on a Teacher's Manual[3], with many of the activities in the book getting a first run in my classroom.

Another influence was a series of books by David Macaulay. The first was *Cathedral*, the story of the construction of a fictitious gothic cathedral in France during the 13th century. Lavishly illustrated and presented as a narrative, the book was enjoyable to read while offering a serious study of architecture and engineering, as well as the political, social, and cultural context in which the planning, design, and construction took place.

Other books in the series include *Pyramid*, set in ancient Egypt and City about the planning and building of a town in the Roman Empire. A somewhat different Macaulay book was *Underground*, which focuses on the part of the modern urban environment that we don't see very much: the infrastructure of water mains, sewers, electrical systems and the like.

The Pond and Flight projects relied heavily on models – streamlined little environments that students could study and manipulate in a controlled way. What emerged for SCCAADSS was a model street to be built in our classroom.

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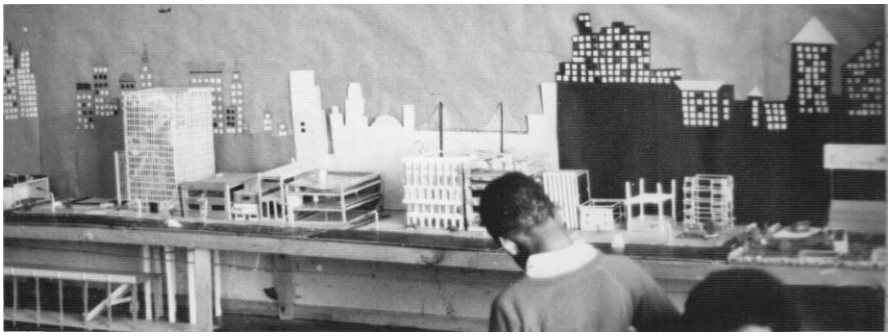
[2] Salvadori later founded the Salvadori Center to carry on this work. The organization remains active today.
[3] Originally published in 1983 by the New York Academy of Sciences, the book is currently available from the Salvadori Center.

Along one wall of the classroom was a set of cabinets. At either end they were about seven feet high and three feet wide. In between the high cabinets was a series of lower cabinets, about 30 inches high and 18 inches deep, forming a continuous platform. The wall above them was a bulletin board.

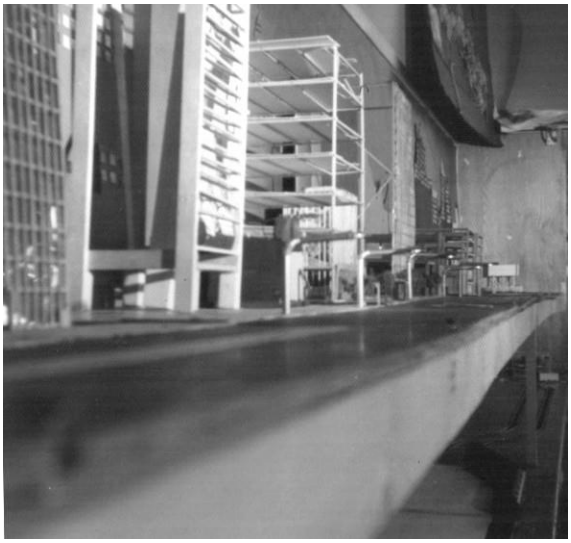
One day, alone in the room after school, I built the structure for the project: a wood frame about 15 inches above the low cabinet tops, with sections of particle board placed on the frame to form the street level. The idea was to have both the above and below ground spaces. The street ran along the front edge of the structure with building lots laid out from the street back to the bulletin board. The model was in a convenient 1:100 scale.

When the students came in the next morning, they saw the new structure. I said nothing and let them speculate for a while as to what it was. During class meeting I told them what I had in mind: that they could design and create a city, with buildings that would fit into the street and be visible both above and below ground. They could also think about water, sewer, and electrical systems, and a subway.

The students voted to call it Main Street.



Buildings were made mainly of wood and cardboard, with plastic, metal, mylar, and other materials included as needed. A building could be constructed away from the street by making a cardboard box foundation and assembling the structure inside that foundation. The model could be placed on a table and worked on from all sides. This practice also avoided crowding at the street itself.

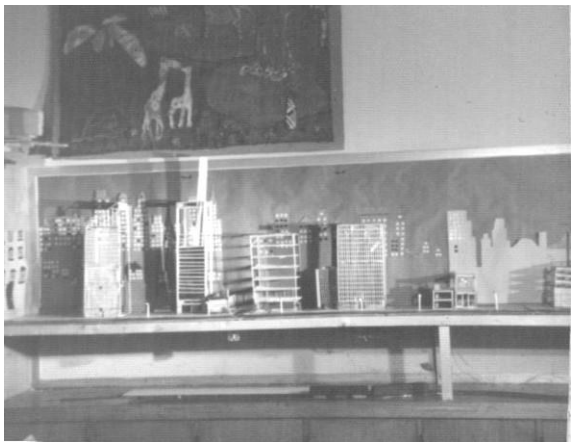


A hole the size and shape of the foundation was cut through the particle board and the building set into it with the foundation extending below the particle board. While a building was under construction it would be taken out of the street and put back many times.

Early on the street was fairly empty. One of the early buildings was a garage, built by Andrea.

Students usually worked on buildings in pairs or small groups. Sometimes they specialized. Esther and Louise subcontracted with Danny, who installed the elevator in their building.

The bulletin board behind the model street was decorated with a city scape.

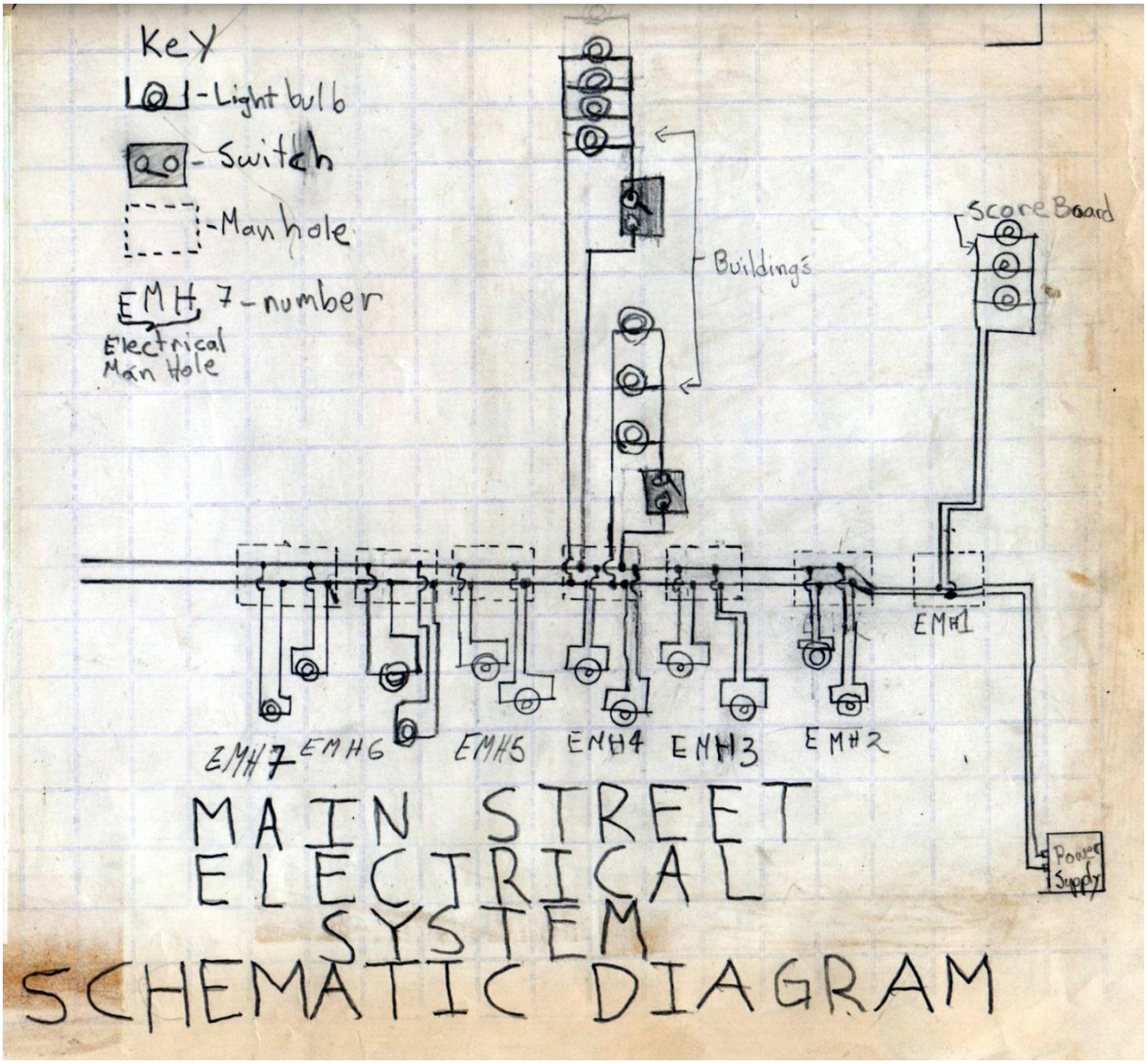


The idea of modeling extended beyond construction of the street to governance. We created a Planning Board, which had five members elected by the class. The Board wrote a building code and then approved or disapproved applications to build on the street. For a structure to be approved, it had to be deemed "worth building."

Planning Board meetings were open to the public, that is, everyone in the class, and minutes of the meetings were published.

Main Street had more than just buildings. At the west end there was a park surrounded by a stone wall. It included a stadium, a playground, a snack bar, and a swimming pool. Each of these components was built by a different group, working in coordination with the others.

An Electric Company was formed to provide power to streetlights and buildings.


Key
-Light bulb
-Switch
-Manhole
EMH, 7-number
Electrical Man Hole
Buildings
Score Board
EMH1
EMH2
EMH3
EMH4
EMH5
EMH6
EMH7
Power Supply
MAIN STREET
ELECTRICAL
SYSTEM
SCHEMATIC DIAGRAM

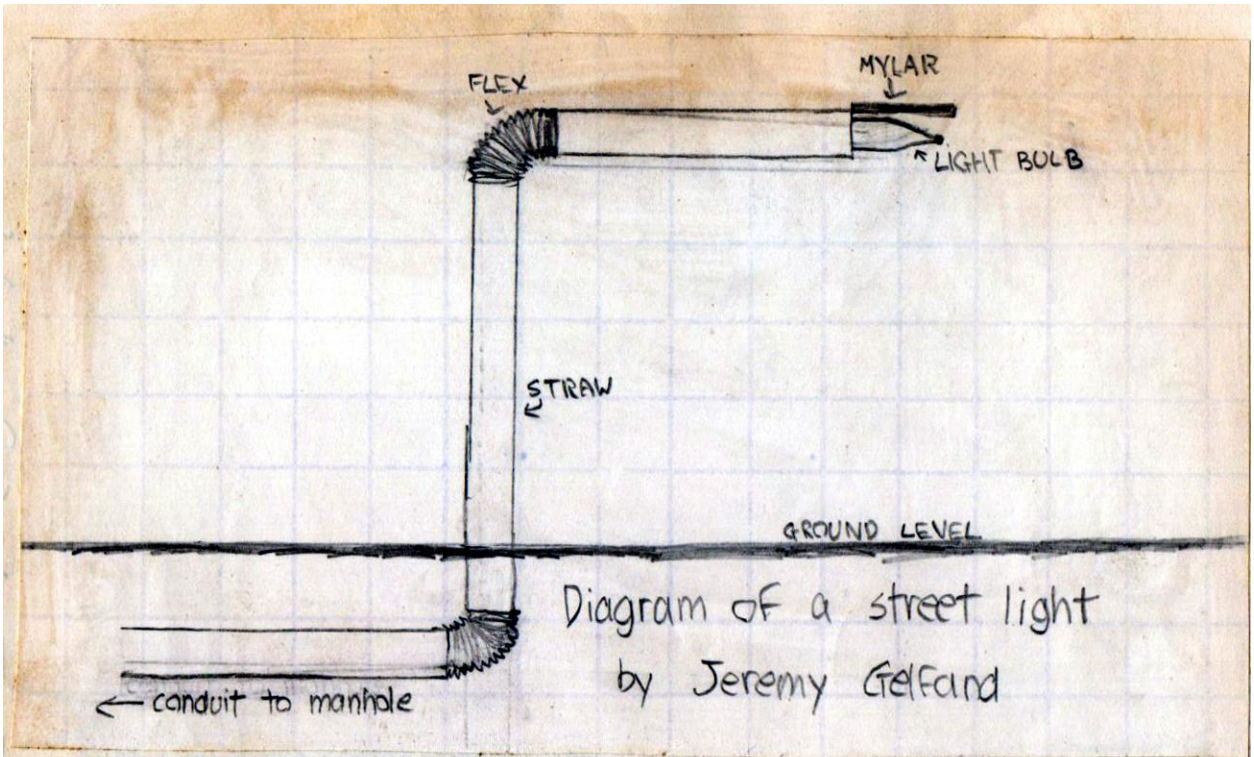
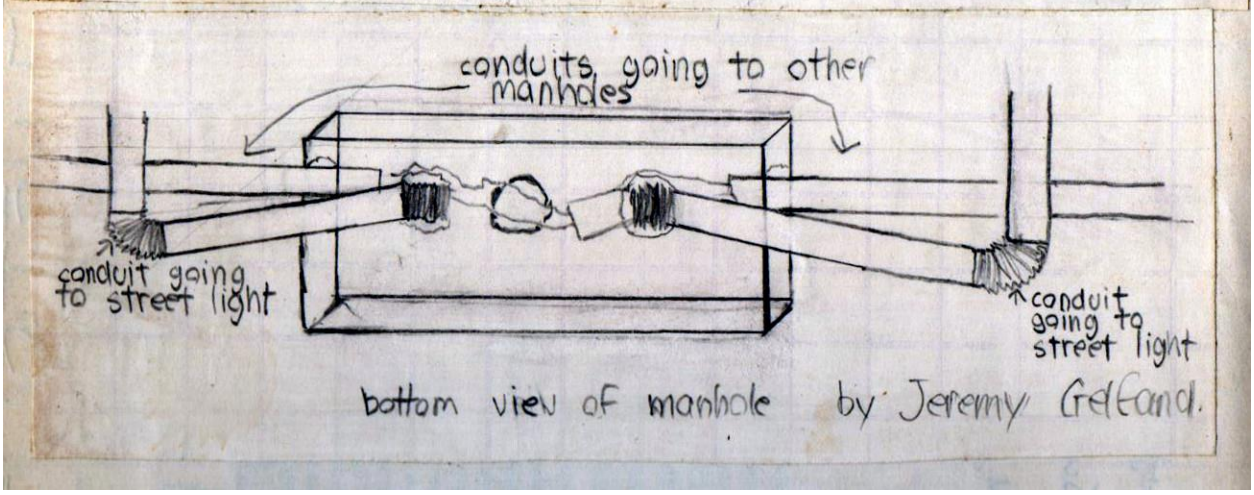
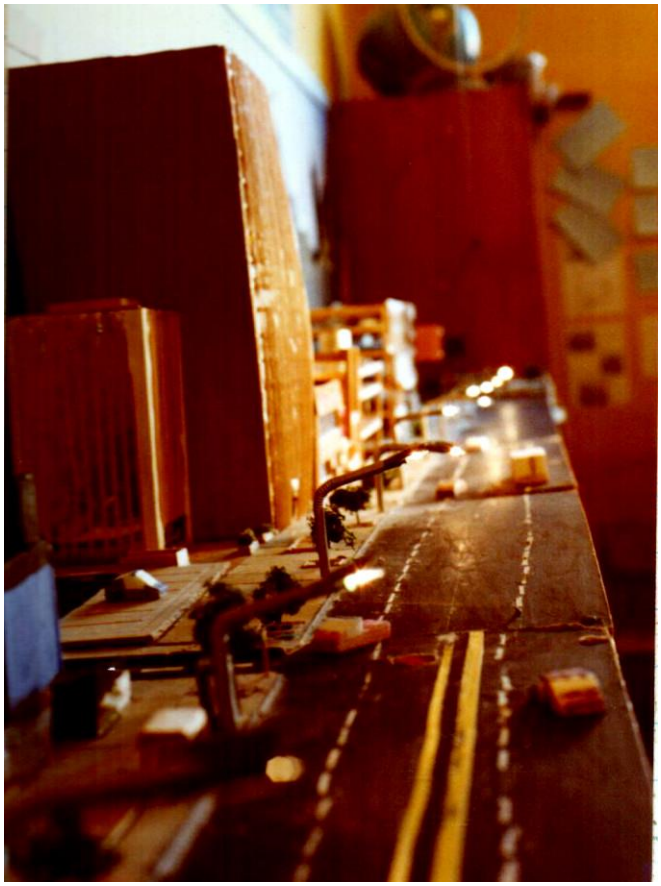


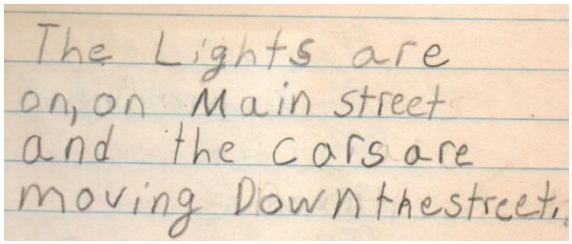
Diagram of a street light
by Jeremy Gelfand



bottom view of manhole by Jeremy Gelfand.

This is a veiw of a manhole with the manhole cover to the side.





The water system for New York City is a remarkable engineering achievement that dates back to the 1840s when the Croton reservoir and aqueduct were first built. The Croton system is evident in the school neighborhood with the Central Park reservoir and numerous manhole covers labeled Croton Water.

The students planned and built a working water distribution system, which like the New York City water supply, works by gravity. The reservoir was a plastic tank placed on top of the high cabinet at the eastern end of Main Street. Plastic tubing carried water under the street to a series of T connectors in manholes where water could be tapped. The swimming pool in the park was supplied by this system.

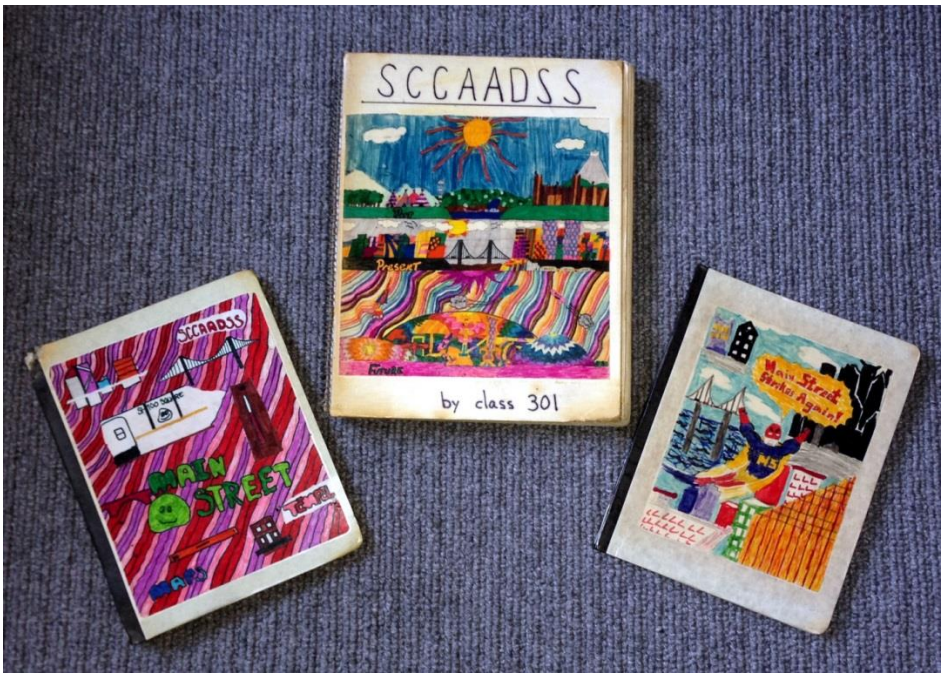
Another bit of history that was conveniently available to us in the neighborhood was the subway running under Broadway a block from the school. This line is the oldest part of the current New York City subway, having opened in 1904. And on 96th Street between Broadway and the school was one of the system's electrical conversion stations where alternating current was converted to direct current to run the trains.

The Subway under Main Street was built from a model train set. The HO scale of 1:87 was a bit off from our overall Main Street Scale of 1:100, but close enough to look reasonable.

The documentation of Main Street was kept in a set of Class Books. These were scrapbooks where we glued written descriptions of the work, stories, minutes of the Planning Board meetings and many diagrams and photographs.

By the time Main Street was begun there were already about two dozen such class books that had been created over the previous eight or nine years for a variety of projects, beginning with the Pond Book. These books became an integral part of the class library and were often off the shelves during quiet reading time. The books about projects that were still active were referred to as references for continuing work.

Initially Main Street documents were included in the *SCCAADSS* book, but when that filled up, the students decided that Main Street deserved its own book. As a class book approached being full, preparations began for a new one. First, a title was chosen. For the initial book in a series, the choice was simple, but what to call the sequels? So, for example, *The Flight Book* was followed by *Son of Flight Book*. In this case we had *Main Street* followed by *Main Street Strikes Again*.



The next task was to create decorative covers for the book. Students who chose to would draw a proposed cover. All the entries were displayed on the walls around the classroom for about two weeks. Then the class would vote on which one to use for the front cover, and then from the remaining designs chose a back cover and inside front and back covers.

What If?

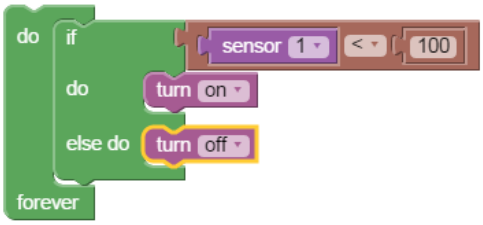
What would Main Street look like today? How would this project be different with contemporary digital technologies?

The most far-reaching difference would be in record keeping and documentation. Writing would be done with word processors. Some drawings and diagrams would still be done by hand, but others would be created with drawing and paint programs. There would still be plenty of photos, but there would be many more to choose from and they could be modified and edited. Video would be commonplace. Animations telling stories about life on Main Street would be created in Scratch.

This variety of documentation would necessarily go beyond that static class book format. While such books might still be created, their source material would be digital, and there would be strictly digital formats including web sites and collaborative documents.

Research would be via the Internet as well as from books. The Macaulay books would still offer inspirations and information. Some of these have also been made into PBS television shows and are now on You Tube.

On the Main Street model itself there are numerous opportunities to incorporate contemporary technology. One broad area is in sensing and control. Using a micro:bit, Arduino, GoGo Board, Hummingbird, or other microcontroller one can sense environmental factors and take action depending on the results. For example, the streetlights on Main Street could go on and off automatically. A light sensor would detect when the classroom is dark and turn the streetlights on. When the room is light, the streetlights go off. The program to do this might include code like this:



Using a similar approach, a moisture sensor could detect when the water level in the swimming pool has dropped below a certain level and activate a servo motor or open a valve allowing water to flow in. Then when the level reaches the sensor, the servo would turn in the opposite direction to close the valve.

The garden in the park could be automatically watered by having a sensor detect when the ground is dry and then turning on a pump until it is sufficiently moist.

The subway system could be fully automated to stop at the station, wait a while and then move on.

Another rich area is using Computer Assisted Design software to try out different ideas for buildings and other constructions. And with 3D printing and laser cutting and etching, turn these ideas into reality.

One needs to give careful thought as to when this kind of automated fabrication is appropriate and when hand crafting is best. A good candidate for 3D printing on Main Street would be the manhole covers. As with real manhole covers, the same pattern is reproduced may times. With the fabrication automated, the tedious task of making many copies by hand would be eliminated and attention would be given to the design. Lamp posts, park benches, colonnades, and repetitive elements of building facades are also good candidates for this approach.

But it's not just the technology of modeling that has changed – the world we are modeling is very different from 35 years ago.

The streetlights on Main Street were incandescent lamps. Today they would be LEDs. And LEDs open new possibilities for creative expression. With tricolor LEDS color can vary making for light sculptures and varying lighting color in response to various stimuli.

There is much more attention to renewable energy sources now than 35 years ago. Main Street could have solar panels that would charge batteries or capacitors to power lights after dark. As with the sensing and control mechanisms described above, the system could automatically switch from charge to discharge mode depending upon the level of ambient light.

Another rich area to explore is self-driving cars. A common student robotics project is to build and create a vehicle that can follow a line. Often these paths are circular, S-shaped, or otherwise challenging to navigate. Moving in a straight line on Main Street would be relatively easy. But, the vehicle must be able to sense a person suddenly running out into the street. This can be done with reflected infrared or ultrasonic distance sensors. The challenge for creating such a vehicle on Main Street would be doing it at the 1:100 scale of the street model as whole. A model SUV would be less than an inch wide and little more than two inches long. One way to approach the project would be to create a larger prototype using commonly available motors, sensors, and microcontroller board, and then work on miniaturization as a next step. This is a common product development approach for small electronic devices.

A whimsical addition to Main Street was a UFO. It was a Styrofoam flying saucer that was suspended above Main Street on a loop of string and could be moved back and forth by turning the pulleys at the ends. Today that UFO could be a fully functioning remote control drone.

Main Street was a great project with many ways to engage students with a wide variety of skills and interests. With contemporary digital technology the possibilities can be even greater while also overcoming some of the more tedious aspects of project development and documentation.