Madeira City Schools - PC Subteam Study Report
Topic: High School Science Lab Renovation

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Report Sections

1. Topic / Questions from BOE
2. Key Findings
3. Process Followed
4. Current Lab Space Uses
5. Data Collected
6. Future Trends
7. Recommendations
8. Lessons Learned (do's and don'ts)
9. Square Footage Comparisons with Peer Schools
10. Appendices (notes, photos, etc)

Topic / Questions from Board of Education

This study will examine our Madeira High School science labs to evaluate current uses and future needs. The high school science labs were last updated nearly 25 years ago.

- What are the current uses of the science labs?
- What are the current needs?
- What do other similar high schools have in terms of science labs?
- What are new trends or designs of these spaces that could enhance innovative practices and support student learning?

Key Findings / Executive Summary

Madeira HS lab spaces are aging, with inadequate utility services (electrical, water), poor layout, and outdated furniture. The classrooms and labs are also spread out in different ends of the school. This decentralization makes using and moving equipment challenging with impacts to teacher efficiency/collaboration. When the team compared our lab spaces to peer districts, an update is needed.

The "can do" nature of the teaching staff and excellent funding / supply of lab equipment have successfully compensated for these drawbacks and produced students who are well educated in science.

However, given the national emphasis on science and technology in education, relying on compensating factors to overcome weakness in the facilities is not seen as sustainable. Addressing these limitations should enable more teaching time (efficiencies) and an improved experience for students.

Recommendations: Fortunately, there are many issues critically important issues which can be resolved quickly / easily – these are identified those under **Phase 1**. The more difficult / disruptive (expensive) improvements are shown in **Phase 2**.

Greater detail is shown later in the report and is summarized here:

Phase 1

- Electrical (improve electrical outlet qty and capacity and flexibility for each classroom)
- Plumbing (add sinks, water sources, clean out stations)
- Countertops (need additional)
- Storage (cabinetry, dedicated storage closets, prep space and utilities in each space)
- Furniture (lab tables, classroom spaces, ADA concerns, window blinds)
- Demonstration stations (movable)

Phase 2

- Combine teaching areas vs. having them separated down the hall
- Collaborative spaces for students and teachers
- Separate but clear wall spaces for lab make-ups and student collaboration.
- Increase square footage: SF/student in line with benchmarked school systems and NSTA recommendations
- Where consistent with school safety, provide access to outside (greenhouses, other science demonstrations)

Do's / Don'ts / Lessons Learned

During tours, peer school districts shared recommendations about successes and things they would do differently. These are captured in detail later in the Do's / Don'ts section. Key messages are:

- Planning – engage with teachers in advance of design.
- Storage – cabinets and hallway space
- Furniture – moveable
- Sufficient water, electric and counter spaces for student experiments and cleanup.

Two next steps are identified:

1. A feasibility study with cost estimates should be undertaken. This will provide budget guidance and prioritization for the improvement areas identified in this report.
2. Madeira teachers should consider organizing a tour to see first-hand a subset of the schools highlighted in the report. This will aid them in formulating critical input to the design and planning process.

Process Followed

The Team established a process and distribution of effort which enabled it to:

1. Interview all Madeira HS science teachers
2. Review the Madeira HS current spaces

3. Document the current floorplan
4. Investigate future trends in teaching via national organizations and college-level interviews.
5. Tour / interview six peer high schools
6. Tour / interview one freshman university lab and professor
7. Convene multiple times to finalize report

Schools Toured / Interviewed

Indian Hill (similar)	Sycamore (big, new)
Seven Hills (few $ constraints)	Reading (new)
Mariemont (similar)	University of Cincinnati (Q: what are colleges seeing in students and future trends?)
Wyoming (similar)	

Limits of Study / Report

Importantly, this study focused on the lab spaces (classroom space) rather than the table-top equipment. Teacher interviews indicate that the equipment in the labs is in very good shape and is maintained through the annual science budget allotted to them.

Also, while the team is concerned about the ability of the current labs to handle the ~50% class size growth forecast in coming years, there is much we don't understand around scheduling and classroom/teacher utilization. Therefore, this Report assumes the current 5 classrooms will be sufficient for future class sizes, maintaining no more than 24 students per class period.

Current Lab Space Uses

Room #	Teacher	Subjects Taught	SF Estimate
213 "Bunker"	Karen Dougherty	Physical Science (all levels), AP Environmental Science	888
215	Suzy Tucker	Physics (all levels), AP Environmental Science	1008
218	Christy Barton	Biology (all levels), Forensics, sometimes environmental science	912
218 prep/storage within classroom	Christy Barton	Storage	130
216 Hallway storage	Social studies department, as well as Barton, Tucker, and Dougherty storage	This storage is shared with social studies. Mostly forensics, environmental science and physical science are stored here.	175
220 hallway storage/water source	Suzy Tucker and Karen Dougherty	Physics, physical science, and environmental science storage. This is also currently used to obtain water for room 213.	81

201 & 202 Chemistry classroom, lab and storage combined	Brett Becker	Chemistry (all levels), environmental science, sometimes forensics Classroom, lab and storage combined	1062
203 &204 Biology classroom, lab and storage combined	Margaret Miller	Biology (CP), and anatomy/physiology, sometimes forensics and chemistry Classroom, lab and storage combined	1062

Data Collected

This section shares the consistent themes and especially impacting findings from interviews and tours. The full notes and photos are available in the appendix.

1. Teacher Interviews:

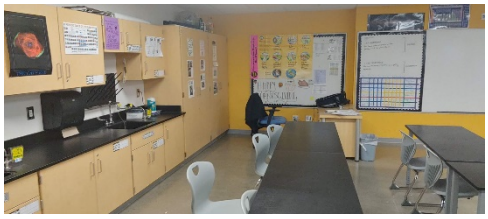
- Storage, storage, storage!
    - Current lack of space creates physical safety concerns. Currently, teachers store bins on top of cabinets due to lack of space and accessing these items creates a safety hazard.
- Need reliable electric and more water sources / sinks
- Having the science classrooms / teachers broken into separate areas of the building impacts teacher team dynamics, logistics, storage effectiveness, efficiencies, etc.
- Would like improved in-class room storage options (e.g., cubbies, taller cabinets)
- Current furniture inhibits collaboration and being able to “flex” the space to adapt to changing needs.
- Physics room: would like to have the ability to hang something from the ceiling for experiments.

2. School Tours: Wyoming, Indian Hill, Mariemont, Seven Hills, Reading, Sycamore, and University of Cincinnati:

Having flexible furniture (i.e., wheeled desks, chairs and the ability to raise and lower desks/chairs) allows for increased collaboration and more efficient use of space.

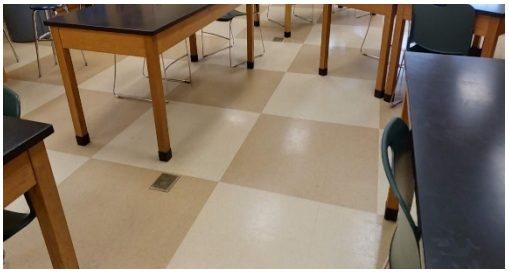


Sufficient storage (both in-class and out of class) space is crucial. There is very limited time between class periods so having to break-down and store materials in suboptimal spaces creates significant inefficiencies; time that could be better spent preparing for class.



Having a dedicated prep space with access to an ice machine, refrigerator, dishwasher and garbage disposal is a must-have: teacher time, .This helps declutter the classroom area.

Access to sufficient electrical outlets and sinks/water sources.



Having access to an indoor greenhouse is a major plus.

Future Trends

This section captures input from Madeira and peer school teachers, University of Cincinnati freshman science professor, journals, and national science teachers' associations.

Public domain resources utilized:

- National AP Biology Teacher Facebook group: https://www.facebook.com/groups/1430374047229038/
- National Science Teachers Association: https://www.nsta.org/
- Flinn Scientific: https://www.flinnsci.com/lab-design-guides/lab-design
- Sheldon Labs: https://sheldonlabs.com/
- National Institute of Building Sciences publication: https://nibs.org/
- OECD Data sources
- https://vlkarchitects.com/insights/design-fantastic-high-school-science-lab-inquiry-based-learning
- https://files.eric.ed.gov/fulltext/ED507915.pdf
- https://envoplan.co.uk/education-news/how-to-design-the-perfect-school-science-lab/

Future Trends Findings

- "Doing science" as a collaborative effort
    - Mobile furniture shaped to encourage collaboration (round pods vs. long tables)
- While primarily student-focused, collaboration also applies to teachers, so a teacher collaboration space is recommended.
- Lab Quality desks/tables to handle heat/chemicals/weights
- Science integration. The integration of science curricula is occurring at two levels.
    - First, the traditional boundaries between the life and physical sciences are being dismantled.
    - Second, the sciences are becoming more integrated with other disciplines such as math and history.

- Integrating technology within the space
    - Addition of plenty of electrical outlets
    - Safe places for laptops to be during a lab experiment
    - charging stations
    - upgraded internet signal services for labs
    - Video screens available to collaborate
- Storage
    - To increase easy access to equipment as it's needed (physical safety issue at times)
    - To accommodate large pieces of equipment
    - Counter space to keep equipment that is used frequently within a unit(s)
    - Space for on-going experiments
    - To enable keeping lab equipment and assemblies together vs. having to disassemble
- Separate space for lab and classroom
- Ample space for on-going experiments and experiments for different preps/classes
- Prep area for all lab spaces to make preparing a lab more efficient

Recommendations

The Team's recommendations are broken into Phase 1 (most important items which can be addressed without significant disruption / expense) and Phase 2 (those which are less urgent and should be incorporated into future plans which enable holistic changes (e.g., moving exterior walls). Fortunately, there are no highly urgent issues uncovered by the Team which fall into Phase 2. Phase 1 is further broken into "needs" vs. "wants".

Phase 1 - Most urgent / important and less expensive / disruptive

NEEDS		
	Electrical	Improve electrical outlet qty, flexibility, and capacity for each classroom
	Water	Increase sources (# sinks) Increase sinks / tubs for clean up Investigate brown water in rooms 201 and 204
	Furniture	Adjustable desk and chairs for ADA concerns Updated black out shades for "light" experiments
	Storage Solutions	Taller cabinets and drawers designed to fit lab equipment
	Hallway / Closet Storage	Dedicated large hallway closet spaces for storage Maximum storage efficiency via shelving / storage systems Closet spaces should have suitable counter space, etc. for prep
	End the Bunker Mentality!	Move Physical Sciences (213) to a different location with capabilities in-line with the other improved rooms. Keep close to other science rooms.
	Walls / Structure	Chemistry wing Retractable wall – block this in to reduce noise Hang stuff from ceiling for Physics to enable demonstrations and labs Lighting truss recommended above drop ceiling

WANTS		
	Electrical	Explore tower solution Microwave for biology and environment science prep rooms
	Water	Dishwasher, Refrigerator/freezer (currently have 1 of each, need 2) Garbage Disposal for each area
	Furniture	Movable furniture for lab and teaching spaces (e.g., demo cart) Furniture which enables collaboration (desks, other) Demonstration station (movable), and / or put camera on demo and let students observe via chromebook/laptop.

Phase 2 - Long term – harder to do, more expensive but highly impactful

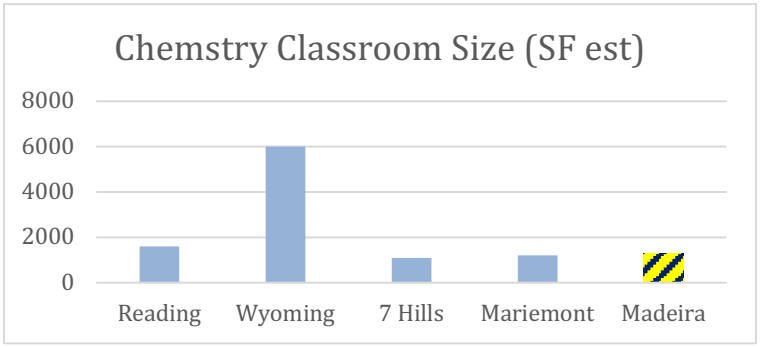
- Increase square footage SF/student in keeping with benchmarked school systems (NSTA recommendations)
- Combine teaching areas vs. having them separated down the hall
- Collaborative spaces (“lounge” space in center, breakout spaces)
- Huddle Rooms / Make-up spaces – small rooms with transparent walls so students can collaborate or make up a lab separate from other students with supervision.
- Access to outside
- Space for grow lights / greenhouse

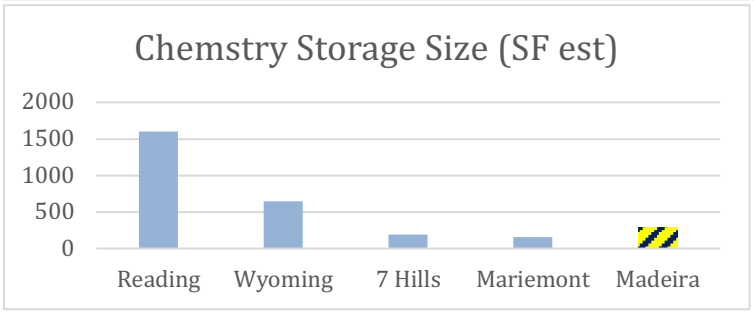
Lessons Learned (Do’s and Don'ts)

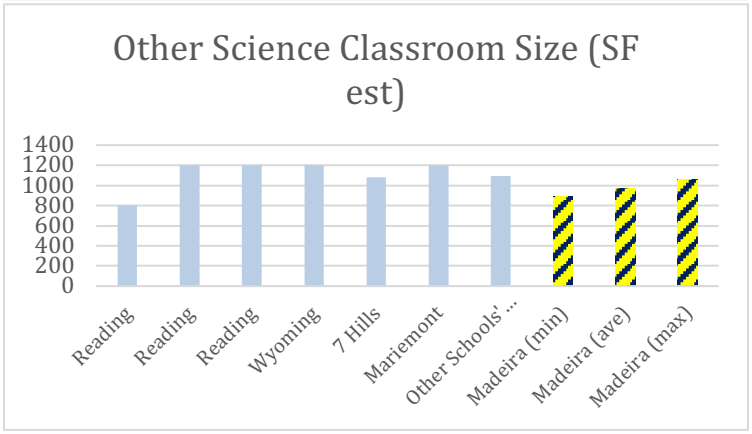
Teachers at Madeira and at peer school systems were very willing to share their lessons learned (both positive and negative). These are summarized below.

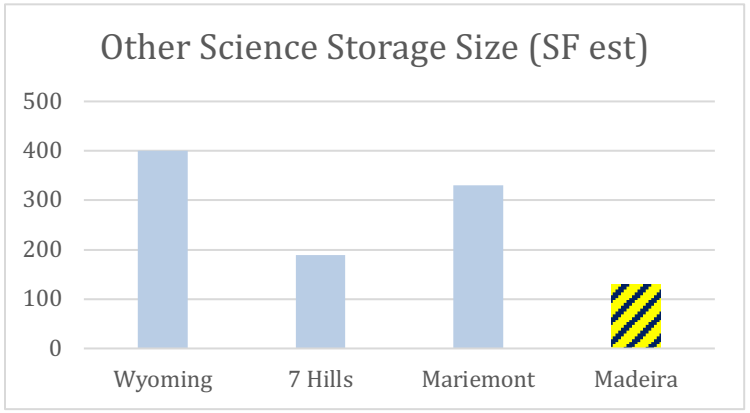
- It is highly important to build time into the schedule to review needs with each teacher before launching the detailed architectural design.
- Large hallway / closet storage is critical to enabling teachers to effectively teach their topics.
- Plan for flexible/mobile furniture.
- Use furniture and storage designed specifically for science labs and equipment. It’s important to measure materials and assemblies to be stored to ensure items will fit into cabinets and drawers.
    - Do not use kitchen cabinets and drawers as science equipment will not fit.
- Anticipate increased use of technology meaning space for charging and space for laptops. Multiple screens for collaboration at each station is ideal.
- Space should be ADA accessible (furniture and classroom space).
- Ensure there is adequate floor and counter space for ongoing experiments and large assemblies.
- Integrate prep and demonstration space into the plans.
- Hoods should be see-through so students can see demonstrations.
- Ventilation is important and difficult to add after the fact.
    - Do not rely on “amp’d up” HVAC system as a substitute for dedicated lab ventilation
- Plan for specific placement of electrical outlets.
    - Electrical outlets via drops from the ceiling is initially interesting, but proves to be inflexible and remains a driver for dropped equipment.
- Madeira has good quality equipment. It is important to protect the equipment with the space.
- Grouping classrooms together makes sense in terms of sharing equipment and supplies.

Square Footage Comparisons with Peer Schools









Lab Space SF Metrics
2-4-2022.xlsx

Appendix

Significantly more detail is available in the appendix to this report. It is currently housed on Google docs at:
https://docs.google.com/document/d/1c14QOm-OTI_JnPC7k6pHczny9_Ro4EVjOX-95mKMX2E/edit?usp=sharing

The team recommends downloading this in the near future to ensure it remains available to the Board and to school Administrators.