Developing Public Interest in the Natural Sciences at the ZHAW, Wädenswil, Switzerland

Interactive Qualifying Project Report completed
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By:

Meredith Juers

Spencer Keilich

Caitlin Walde

Advisors:

Professor Jerome Schaufeld

with

Dr. Tara Mann

Special Thanks:

Dean Karen Oates

Dr. Achim Ecker

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Abstract

This project, developed for the University of Applied Sciences in Zurich (ZHAW), investigated methods for the conservation and options for presentation of artifacts from 140 years of the ZHAW-Institute of Chemistry Institute. The presentation is meant to be conveyed to a broader audience, in order to foster an interest in the natural sciences. The artifacts were inventoried and analyzed based on condition and historical value. Through extensive research, museums visits, and interviews , we gathered information to best generate interest in the natural sciences. With the material collected, we were able to prepare a recommendation for an exhibition design, which incorporates all areas of the ZHAW collection. We developed implementation plans to conserve and convey the collection of samples and experiments. This plan is presented in multiple phases, so as to keep the project executable for the ZHAW.

Authorship

Each section of this paper was written and edited by all three members of our team. The initial research was divided by topics. Spencer Keilich used his German-reading prowess to research the history of the ZHAW, in addition to investigating artifact and chemical preservation and disposal techniques. Meredith Juers focused on conveyance designs, while Caitlin Walde concentrated on the history of chemistry in Switzerland. Each member was responsible for contacts in different regions; Meredith in Switzerland, Spencer in Boston, New York and Bern, and Caitlin in Worcester. During the interviews, we alternated taking notes and being lead interviewer. Caitlin and Meredith worked together on planning and scheduling many of the logistics of the project and stay in Switzerland. Each member was in charge of developing recommendations for a specific portion of the ZHAW collection; Caitlin the rocks and fossils, Spencer the chemical samples in vials, and Meredith the equipment and experiments. Caitlin and Meredith wrote the Shifting Perspectives section while Spencer researched fundraising in Switzerland and defined the conveyance methods. Spencer and Meredith wrote the museum visits and interview summaries. Meredith typed our notes from the museum visits and interviews for the Appendices. Spencer also sketched our design recommendations by hand. We worked together to write the Implementation Phase Plans, as well as the Conclusion, Executive Summary, and Introduction. Caitlin was in charge of compiling and formatting the final document.

Acknowledgements

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1. Executive Summary

Introduction

The ZHAW has a unique collection of artifacts which parallels the uniqueness of its history. In 2007, the ZHAW was formed from the union of several universities in the Canton of Zurich and the Chemistry Institute was relocated from the Winterthur Technikum to the University at Wädenswil. In this transition, many items that were kept in storage were uncovered. The legacy of the ZHAW, and its chemistry institute in Wädenswil, was preserved in the form of artifacts, samples, and experiments that survived the journey between schools. The ZHAW Chemistry Institute recognized the value of their collection and hoped to utilize it in an exhibition to garner the public interest in the natural sciences.

Over the course of this Interactive Qualifying Project (IQP), we developed and refined clear, achievable deadlines in order to complete our goals and objectives. In the time of seven weeks, we cataloged, inventoried, and analyzed over 2000 items. In addition, we developed ideas to display the most presentable of these items, and created a multi-phase plan so that the ZHAW can complete the implementation. In order to solve the interdisciplinary problem of developing public interest in the natural sciences, we conducted interviews and research, both online and in the field. Once we gathered our information, we developed a plan that best fit the needs and goals of the ZHAW.

Essential Goal

Convey the legacy of the ZHAW Chemistry Institute through the preservation and exhibition of its samples, artifacts, and experiments to generate public interest in the natural sciences.

Objectives

- Research means of conservation, conveyance, fundraising, and historical background
- Catalogue and conserve the items in the ZHAW collection
- Produce a feasible exhibition recommendation

Process for Exhibition Recommendation

We explored preservation, conservation, and presentation techniques for all forms of artifacts to familiarize and prepare ourselves for developing an exhibition recommendation. To better acquaint ourselves with the goals, objectives, and methodologies used by professional exhibition designers, we contacted experts in the field of science communication and visited several renowned museum exhibitions. The presentation techniques we explored included interactive, traditional, and travelling museum exhibitions as well as digital media and art.

Design Recommendations

Having determined the advantages and disadvantages for each presentation technique, we condensed our options and generated one final, feasible exhibition design. This idea is presented in multiple phases to keep the project executable for the ZHAW and within the scope of this project. Throughout all phases, we recommend continuous evaluation to assess the impact and audience response.

- Phase 1
  - Basic shelf display of equipment, in a sectioned bookshelf
  - Chemistry and ZHAW history on walls in framed posters
- Phase 2
  - Add Hiking Exhibition
    - Hiking clothing/equipment chemical components
    - Rocks/fossils associated with their geographical location on a map
  - Expand Bookshelf
    - Add new experiments/equipment
    - Add interactive display panel and specialized lighting; tailored to the language spoken and age of each visitor
- Phase 3
  - Expand Hiking Exhibition
    - Add interactive “sandbox” for searching and identifying rock samples
  - Expand Bookshelf
    - Add speakers and multilingual audio descriptions of each artifact
  - Add Periodic Table to wall
    - Includes physical examples of each (most) elements

- Phase 4
    - Expand Periodic Table
        - Add interactive molecule building set
        - Add Ionization chart to wall as reference for molecular interaction
    - Maintain all other exhibitions

Conservation Recommendations

A significant challenge was the uncertainty of the full extent of the collection contents prior to arrival. In order to familiarize ourselves with the collection, we assessed its constituents based on their condition, historical worth, and aesthetic nature. These evaluations enabled us to identify significant themes and organize the items into displayable groups accordingly.

Future Work

Although we utilize a large portion of the ZHAW collection, there are still unused items that have historical and scientific value. We recommend that future IQP's or other project groups incorporate them into other exhibitions. Future IQP's might be able to analyze the feedback from the surveys and then develop ways to improve and otherwise tailor the exhibitions to the visitors' responses.

Conclusion/Learning Outcomes

We maintained effective working relationships within our project team, with our project advisors, as well as with our project sponsors. We learned the importance of adapting our design ideas based on varying criteria obtained throughout the process. We cultivated skills in adaption, goal selection, communication, and research. These skills have helped us become more aware of how our decisions affect and are affected by other perspectives separated by time, space, and culture. We became more aware of personal, societal, cultural, and professional ethical standards, and thus improved our ability to work individually as well as in groups. By the end of this process, we identified a more finite vision of our task; to foster public interest in the natural sciences.

2. Introduction

In 2007, the unification of four main Universities in the Canton of Zurich created a new entity known as the Zürcher Hochschule für Angewandte Wissenschaften (ZHAW). The result led to the movement of entire institutes to new schools in different cities. The Winterthur Technikum was founded in 1874 and it's chemistry institute in 1875. With the recent unification, this entire institute was relocated to the University at Wädenswil. The IQP is part of the unique WPI's unique project focused curriculum; students from different majors work together to solve a real-world problem at the intersection of technology and society. The basis for our IQP started with the artifacts and samples that were kept in storage and were recovered by the ZHAW during the Chemistry Institute relocation. These artifacts lie at an intersection of science and society in the way that they embody history and can convey it to the public.

There were three main categories for these items: rock and fossil samples, a collection of chemicals, as well as antique equipment. These items were in danger of disposal due to a lack of housing, time, and interest. Their safety directly correlated to their place of storage. The experiments (i.e. the artifacts and chemistry equipment) are located in the corner of one of the newest chemical laboratories; a location that is not ideal for keeping artifacts for an extended time. The items kept here are obstructing usable laboratory space and are considered a hindrance. The head director of the ZHAW Chemistry Institute, Achim Ecker, emphasized that these items were our first priority. All of the items were kept in cardboard boxes and suffered slight wear from improper storage. The rock and fossil samples had the least ideal storage. Though they were not as at risk of disposal as the experiments, the rock and fossil samples were at the most risk for deterioration. These samples were kept in an off campus storage facility that did not have climate control and exposed the samples to the environmental elements. At first glance, some of the crystalline samples dissolved because of water leakage and others had begun to

oxidize. Unfortunately, alternative storage is difficult to find due to the collection's size and nature. The collection of vials were in the safest housing, but were not easily accessible. Their safety was ensured because they were locked in a fireproof cabinet near a loading dock, behind another workbench. .

Our IQP Team analyzed the collection in its entirety. We assessed the conditions of the collection and researched the items' historical and exhibitional worth. We studied various methods of generating public interest, including interactive exhibition, displays, digital methods, travelling exhibitions, as well as artistic means. In order to obtain this information, we conducted numerous interviews with experts and directors in the fields of museums and science communication. We also explored museums across Europe and America in order to expand our knowledge and stimulate ideas for our own materials. Additionally, we conducted scholarly research both in English and in German to ensure a well-rounded approach. Collecting this information allowed us to gain new perspectives and offered an opportunity to interact with different exhibition environments. With this information in mind, along with the collection assessment, we were able to develop multiple recommendations and designs for implementation by the ZHAW. These recommendations can be used by the ZHAW to garner public interest in the natural sciences.

The remainder of this report includes relevant background information, methodologies employed in the duration of our project, the onsite analysis of the collection, as well as our recommendations and conclusions. Following the references of this report are appendices containing collection inventories, interview notes, and notes from museum visits.

2.1 Sponsor's Goals/ Problem Statement

The Institute of Chemistry at ZHAW in Wädenswil provides teaching at the university level, applied research, continuing education courses, and services in the field of chemistry. Since their move in 2007 from Winterthur, an industrial city northeast of Zurich, Switzerland, to Wädenswil, a lakeside town south of Zurich, the ZHAW-Institute of Chemistry inherited a valuable collection of chemicals, minerals, and historical laboratory equipment dating back to the late 1800's. The artifacts and samples have been in storage. With these items, the ZHAW hopes to construct a public exhibition that will generate interest in the natural sciences. Executive Director and sponsor Dr. Achim Ecker, along with Claudia Weller and Dr. Marc Bornand, supervised our efforts at the ZHAW. To achieve this goal, our sponsors gave us full autonomy over the samples and artifacts. The basis for our project stems from our task of suggesting possible methods for conveyance to the public and evaluating individual items for value.

3. Background

3.1 History of Chemistry in Switzerland

In order to comprehend the significance of the equipment and samples, it was imperative to delve into the chemical background of Switzerland. Additionally, we felt that including historical facts about relevant chemical industries would draw potential sponsorship to help in funding an exhibition. Despite a lack of extensive natural resources, Switzerland became a hub for the Chemical Industry in the early 1800's. During this time, chemical companies developed in the Basel area. At the forefront were Ciba, Geigy, Sandoz, and Roche (Aftalion 2001). Basel was a prime location to develop industry because its location on the river Rhine allowed for easy trading.

The first chemical company to be established in Basel was Geigy. Founded by Johann Rudolf Geigy in 1758, Geigy originated as a small shop. In 1864, Johann Geigy, the founder's great-grandson, bought a factory in Basel and expanded the company to produce dyes for the textile industry (Fráter 2009). The second chemical company, the Company for Chemical Industry in Basel (Ciba), was founded in 1859 by chemist Alexander Clavel. He later sold Ciba to Bindshedler & Busch in 1873, which expanded the products to dyestuffs. By 1913, these factories were exporting 9000 tons of various dyes, and were in the process of expanding to produce pharmaceutical substances as well (Aftalion 2001).

The third major chemical company founded in Basel was Sandoz. In 1886, Edouard Sandoz, a businessman, worked with Dr. Alfred Kern, a former Ciba scientist, to create the dye company Kern & Sandoz. They primarily produced alizarin blue and auramine. In 1895, they expanded to produce pharmaceutical substances, mainly antipyrine; that same year the company transformed to the Chemische Fabrik vormals Sandoz. In 1970, Ciba and Geigy merged to form Ciba-Geigy Ltd. As they were both doing research and production in pharmaceuticals and insecticides, along with other products, this

merge made sense. In 1996, Ciba-Geigy Ltd. merged with Sandoz to form Novartis, one of the largest corporations today.

The fourth major chemical company founded in Basel was Roche. In 1894, Fritz Hoffman-La Roche founded a pharmaceuticals company with Max Carl Traub, Hoffman Traub & Co. They gained an international reputation of quality, but in 1896, Traub left the company; thus F. Hoffman La-Roche & Co was formed. Over the course of over 100 years, the company expanded its product and consumer base. Today, this company is known as Roche, and plays a leading role in healthcare. In 1959, one of their leading scientists, Leo Sternbach, discovered Valium (Aftalion 2001). As the primary chemical industry hub, Germany, boycotted foreign products and markets during the First World War, all of these companies struggled.

Whilst this was all happening in Basel, other parts of Switzerland were developing chemical industries as well. In 1777, Johann Heinrich Ziegler, Johann Sebastian Clais, and Johann Jakob Sulzer began construction of the first Chemical factory in Switzerland. Their building complex, The Laboratorium, was completed and opened in 1781. It was located in the town of Winterthur, and their primary product was vitriolic acid, which they provided to the textile industry in bleach products (Fráter 2009). The complex was destroyed in 1960, but its site was named a Chemical Landmark in 2009.

3.2 History of the ZHAW

The official inauguration ceremony for the foundation of the ZHAW was held on September 7, 2007. This may come as a surprise to some because it is so recent. The reality is that this inauguration signified the unification of several other universities under the same name, Züricher Hochschule für Angewandte Wissenschaften (ZHAW or Zurich University of Applied Sciences in English). This unification

was conceived by the Higher Education Council of Zürich (ZFW). The four universities that were united as the ZHAW are: Zurich University, School of Social Work, University of Wädenswil, and the School of Applied Psychology. The unification caused a very difficult transition period resulting in political hardship while whole institutes were moved between ZHAW Universities. Each university has its own unique identity and past This IQP addressed the history and artifacts of the Winterthur Technikum.

3.2.1 Technikum Winterthur

In the year 1874, the first Technikum was founded by a man named Friedrich Autenheimer. It was he who envisioned the first Technikum, a technical or engineering school, for all of Switzerland. Friedrich Autenheimer was considered a radical student in his youth due to some disciplinary issues. He seemed to do much better as he became a teacher of Mathematics in Winterthur 1850 and then in Basel 1853. In his spare time, Autenheimer was an engineer who supervised the steam engine and transmission industries. By 1857 he was regarded as an excellent professional for maintenance and efficient operation of boiler plants. He soon became very wealthy from his commissions for boiler inspections and expertise. Growing up in the Industrial Revolution inspired Autenheimer to found a school for engineering. In 1866, he left Basel to found the first technical engineering school in Switzerland. By 1874, the first semester of students began in Winterthur.

The Technikum Winterthur began with 5 schools and a total of 72 students in 1874. At first, the school was mainly for Mechanical Engineering. Another school was opened at the Technikum the following year for chemistry students, of which there were 8. As time progressed, the school continued to grow and continued to add newer and more diverse areas of study, such as: 1886 Electrical Engineering, 1900 Railway School, 1914 School for Civil Engineering, and more. One of the most renowned professors of the Technikum was Albert Einstein who taught at the Winterthur Technikum during 1901. By the Technikum's 50th anniversary it was well known in the city and had gained much support. The

Technikum adapted and changed with the new developments in technology and new inventions of modern day.

In the mid to late 1990's, the Technikum Winterthur began merging with surrounding universities and colleges as it expanded and became more well versed in subjects. In the merge of 1995, the Technikum gained the School of Economics, Business Administration and the HWV Zurich college was integrated in. With these mergers, the Technikum also became connected to the internet. By 1998, courses in computer science and communications were created. With these new courses came more schools: the Interpreter School of Zurich, the School of Economics and Business as well as Zurich University of Applied Sciences. The rapid growth and success of the Technikum came from its constant adaptations to world needs and practical applications. When all of these schools came together, there was also a need for new space, as class sizes were on the rise. This led to the most recent of merges and the move of the entire chemistry institute.

In 2003, the Higher Education Council of ZFW planned to merge four of the Canton's colleges to create a new university under one name (the ZHAW). These discussions were very heated and lasted for several years. It was decided in 2004 that the Technikum's Chemistry Institute would be moved to the University of Wädenswil.

3.2.2 Wädenswil: Cider Industry to ZHAW School of Life Science and Facilities Management

In 1942, a cider industry built a teaching facility to train men to produce better juice in Wädenswil. The industry was more interested in educating the men than actual production at this location. Therefore, newer research techniques ensued and the facility in Wädenswil became a training place for professionals in related fields. These fields included: brewing beer, wine fermentation, aromacology,

and botanies cultivation. The professional researchers brought more attention to the School at Wädenswil, so much so that by 1970 it was recognized as Höhere Technische Lehranstalt (HTL), a technical college.

The year it was deemed a technical college, there were 30 students attending. In ten years the class size had doubled and newer subjects began to be integrated into the curriculum. In 1988, food technology became a subject of study/research, 1994 Biotechnology, and in 1998 Facility Management. In 1998, there were 300 students attending and in the same year, the college was converted by the University of School Reform and was then known as the Wädenswil University.

Wädenswil University was selected by the Higher Education Council to be a part of Zurich University of Applied Science in 2004. The Council deemed that Wädenswil University would be for the institutes of Chemistry and Life Sciences. The Chemistry Program was initiated in 2006 and Wädenswil University joined the other colleges as a part of the ZHAW in 2007.

The establishment of the ZHAW School of Life Sciences and Facility Management in Wädenswil forced the chemistry institute of the Winterthur Technikum to move its equipment and machinery there. During the move, several collections of samples and artifacts were uncovered. These are the items that our IQP group analyzed and for which we gave recommendations. The items were from 140 years of the Winterthur Technikum Chemistry Institute.

Today, the ZHAW School of Life Sciences and Facility Management in Wädenswil has many new future directions and goals. The school focuses on goals similar to its founding; being cutting edge. There are current projects in aromacology, 3-dimensional printing of tissues/organs, robotic devices, ink decay prevention, and other innovative design. They have also begun a global outreach program. This program has a focus mainly on the European Union (EU); however, it has already branched out to schools in the United States. This outreach program has sent several students on studies abroad, created joint

projects between countries, and more. Our IQP is an example of this initiative. Both WPI and the ZHAW have similar goals in globalizing their projects and connections.

3.3 Preservation and Disposal of Artifacts

A good portion of the items in the ZHAW collection are chemicals or elements inside glass vials. They exist in powder and solid metal forms. The vials must be maintained and transported properly. While the samples are stable alone, they are reactive with other elements and the environment. The other artifacts include a series of drawers with rock and fossil samples, as well as boxes of antique equipment. The restoration and maintenance of these samples, as well as their safe transportation, is vital to the exhibition. Another responsibility involves the disposal of any unsafe or unpresentable item. The samples were unclean and / or were in need of repair. It was our team's responsibility to select items to be restored and preserve these items for future public display to ensure that they are well kept.

3.3.1 Inventory

Initial inventories are paramount to identify the extent and size of a collection as well as any damage to the samples (O'Brien 1997). To ensure that no artifacts are missing, it is imperative to perform regular inventories or periodic checks for deterioration of samples, dust/dirt accumulation, and to ensure that no artifacts are missing. It is very time consuming, but is vital to collection management. A recommended method of categorizing an inventory sheet contains: accession #, lot #, site, object, description, amount, current location, and condition (O'Brien 1997). We created a sheet which had the object's description, condition, number, location, action, whether the action was completed, and other columns for information. This method is well organized and is a good reference tool for collection

inventory. With this, the ZHAW Chemical Institute can easily access the collection while it is still in storage.

3.3.2 Restoration and Preservation

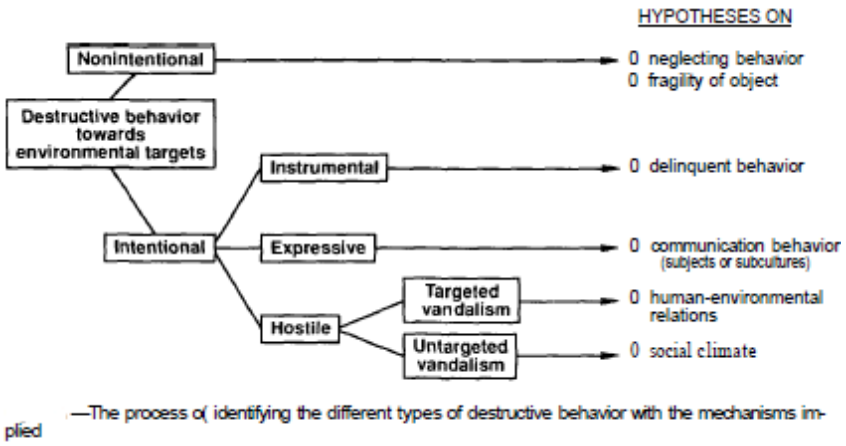
The physical or chemical treatment of artifacts to prevent deterioration or degradation and to stabilize artifacts is defined as conservation. In order to treat an item, its material and deterioration processes must be understood. If an object is improperly handled, it could be damaged or further deteriorated. A basic form of conservation involves simply cleaning an object before it is housed (O'Brien 1997). The removal of dust, dirt and other grunge will make the artifact more appealing to the eye and will aid in deterioration prevention.

One of the most revolutionary restoration and conservation methods was developed very close to our project site, at the Institute of Inorganic Chemistry of University of Zürich in 1987 (VepÅek 1987). Its processes uncover the minutest details of metal objects and reveal more about an artifact with less cost and labor than other methods (VepÅek 1987). As a metallic artifact is left to endure the sands of time, it is exposed to the elements as well as physical wear. The process involves plasma chemical (agglomerate) treatment inside an air sealed apparatus. The crust surrounding the artifact is stronger/harder than the metal underneath, so the ions in the plasma/chemicals will remove the layers of crust, since it is mainly composed of silicates and silica (VepÅek 1987). The artifact is then placed in molten wax, at 80 degrees Celsius, which coats the artifact and creates a barrier with the environment (VepÅek 1987). This process removes thick outer layers of grunge, rust, and corrosion so that the original surface of the object is revealed as well as its finite surface details. If any of the items in the ZHAW's collection need restoration, this is a potential option.

Another aspect to consider is vandalism, which is defined as a voluntary act of damage or degradation of the environment (Higgins 1992). There are two main categories with regards to vandalism: reparation or

prevention. Figure 1 describes the various types of vandalism and hypotheses on why it occurs (Higgins 1992). The key to a successful exhibit is to find the harmony between modern society and the historic artifacts in the exhibit. The more precious items should be either out of reach or inside a protected area such as a glass casing. If rock or other textured samples are within reach of the public, they will then be touched which will lead to wear and the object will overtime diminish in texture or vibrancy. Barriers are necessary to preserve the state or condition of the artifact (Higgins 1992).

Figure 1: Hypotheses Regarding Artifact Condition



—The process of identifying the different types of destructive behavior with the mechanisms implied

3.3.3 Cataloging

Cataloging is the indexing and organization of objects by assigning each item a unique number. The numbers should be long enough to be able to distinguish similar artifacts of the same group and individual artifacts that stand on their own. Cataloguing is done on a basis of physical attributes of that artifact (material, condition, color, type of artifact, dimensions), as well as provenience, date of recovery, person or company of manufacture, and any other pertinent information determined through research and examination (O'Brien 1997). The numbers are a form of identification for a single item within a collection. O'Brien advises waterproof ink (polyvinyl acetate PVAC mixed in reagent-grade acetone or alcohol) for cataloging items, that way the numbering is protected from accidental removal,

but is still capable of being removed intentionally. Before actually labeling artifacts, they must first be sorted and ordered. That way all items are accounted for in their catalogued group.

3.3.4 Transportation and Storage

There is a multitude of different conditions and environments that must be created so that the samples are not harmed or become hazardous. The proper packaging and housing of all artifacts is a basic step taken to help deter and minimize hazards (O'Brien 1997). If the artifacts are not protected, they will be damaged. The objects should be kept in a space that is safe physically and chemically. The Anthropology Division uses methods that wrap artifacts in special acid-free buffered or neutral tissue paper and place them inside a polyethylene bag, lignin-free box, or tray, or a gelatin capsule for very [small] objects (O'Brien 1997). These packaged objects should then be placed in a location which acts as an archive and keeps the items safe.

US Patent 6,336,340 B1 is owned by Ralph Henry Laby and describes a storage container for precious vials that are sensitive to heat and are breakable. The invention itself is basically an insulated bag with several removable parts for storage or various cooling compartments. Though Laby's invention is more for live biological samples that need to be kept alive during transport, it pertains to our chemical samples because of the size and reactivity of our chemicals in glass vials.

3.3.5 Safety in Handling

Safety in handling refers to the people working on the project. It was imperative for us, as well as those who will follow our work, to understand how to handle these materials safely. Direct exposure to some of the chemicals in the vials could cause bodily harm if ingested, put near the eyes, direct skin contact, or inhaled. That is why it is very important to always wear gloves when handling the samples and to wear safety glasses at all times. If an accident does occur and a sample has been spilt, it is imperative to

be careful. Certain elements react explosively with water and those which are acid will react with soap (basic substance). Therefore, if a sample has spilt it is vitally important to know what it is before attempting to clean it up. However, if a substance is spilt on bare skin or is in the eye, it should be flushed out with plain water.

A contrast material is a substance to which the body reacts adversely with a variety of effects depending on the material and the individual (Maddox 2002). These reactions range from mild inconvenience (such as itching or hives) to a life-threatening emergency. Some substances even have renal toxicity. These substances are most deadly because they affect the kidneys and can cause kidney failure or severe damage. The main concern is the awareness of the individual working with these elements (Maddox 2002).

Early recognition and response is vital to avoiding accidents and recovering from them with minimal harm. The United States Department of Labor possesses a document with thousands of compounds and agents as well as the warning labels and precautionary information that correlates with each. The Globally Harmonized System of Classification and Labeling of Chemicals (GHS), is an internationally recognized system for categorization, naming, and labeling of chemicals (Department of Labor 2010). This document contains universal symbols for all different kinds of materials and makes use of pictograms so that their meanings are not misconstrued (See Figures 2 and 3). If the ZHAW will use any of their chemical samples in an exhibition, this information is vital to those handling the substances.

Figure 2: Labeling Elements

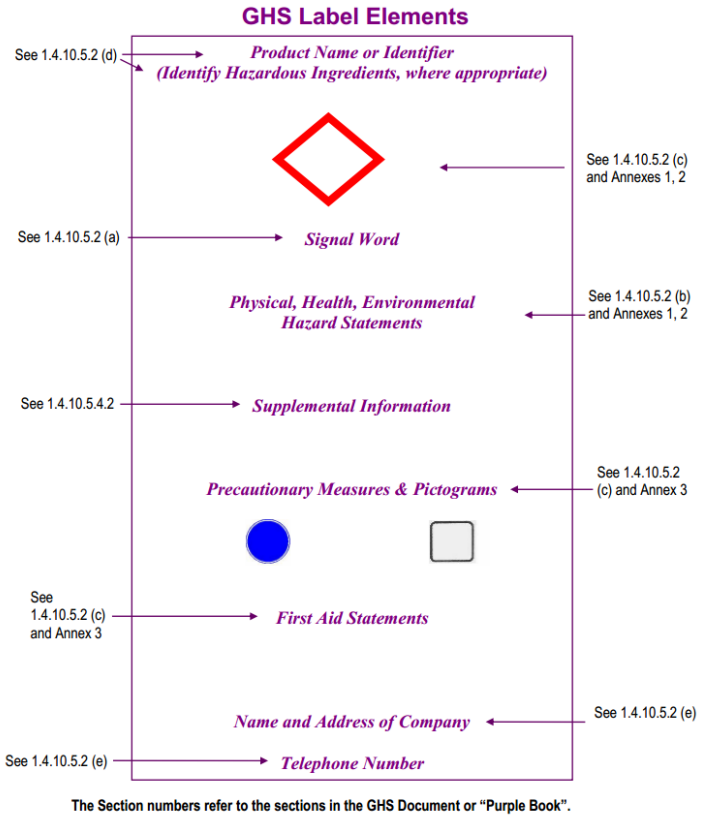


Figure 3: Hazard Classifications and Transportation Requirements

GHS Pictograms and Hazard Classes		
• Oxidizers	• Flammables • Self Reactives • Pyrophorics • Self-Heating • Emits Flammable Gas • Organic Peroxides	• Explosives • Self Reactives • Organic Peroxides
• Acute toxicity (severe)	• Corrosives	• Gases Under Pressure
• Carcinogen • Respiratory Sensitizer • Reproductive Toxicity • Target Organ Toxicity • Mutagenicity • Aspiration Toxicity	• Environmental Toxicity	• Irritant • Dermal Sensitizer • Acute toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritation

Transport "Pictograms"		
Flammable Liquid Flammable Gas Flammable Aerosol	Flammable solid Self-Reactive Substances	Pyrophorics (Spontaneously Combustible) Self-Heating Substances
Substances, which in contact with water, emit flammable gases (Dangerous When Wet)	Oxidizing Gases Oxidizing Liquids Oxidizing Solids	Explosive Divisions 1.1, 1.2, 1.3
Explosive Division 1.4	Explosive Division 1.5	Explosive Division 1.6
Compressed Gases	Acute Toxicity (Poison): Oral, Dermal, Inhalation	Corrosive
Marine Pollutant	Organic Peroxides	

A study on "Employee Attitudes and Safety in the Chemical Industry" showed that decreases in safety performance were due to attitude and work ethic (Donald 1994). The correlation between accidents and attitude towards safety was statistically significant according to Donald's study. If proper safety protocols are followed, the ZHAW decreases their chance of an incident while the substances are in storage or incorporated into a display.

3.3.6 Disposal

Our sponsor and project overseer, Dr. Achim Ecker of the ZHAW, granted our group full autonomy to analyze their samples and make decisions about which ones were worth keeping and which ones were unconservable. They offered to help with disposing of the unsalvageable items. In Switzerland, recycling is a major part of their daily routine. Therefore, it is imperative that we follow their practices on disposing of unconservable artifacts and potentially hazardous chemicals. The determination of whether or not to dispose of an item lies in its condition; damaged or broken artifacts may be unsafe or eye sores. Those which can be restored, fixed, or turned to hide any damaged sides are kept for display. However, objects that are unsafe and/or cannot be restored should be removed from the collection and disposed of accordingly.

3.4 Conveyance Design

Creating an exhibition is a multi-faceted process. After interviewing multiple museum directors of design and professionals in the field of science communication, we discovered that this process has many elements. The two main pieces are the idea that must be conveyed and the sponsor to financially support this idea. If the idea comes before a sponsor, a rough design must be presented to gain the sponsors support. However, if a sponsor comes forward with an idea, then the design process is begun. Either way the design process is essential to the project. Construction of the exhibition is then proposed and executed.

The idea is the center of every exhibition; it is the information that the viewers should take away/learn from their experience. The idea can be as simple as instilling an interest in the natural sciences or can be more complex (Viviani 2013). The idea or concepts must be the same for the designers, the sponsors, the constructors, as well as viewers to some extent. If the viewers are unimpressed or uninterested, then the exhibition will fail. It is essential for there to be a common idea of what needs to be portrayed throughout the project.

The sponsor of the project plays a critical role in the project and its outcome. If the sponsor loses interest in the project or is dissatisfied, the project could be cut or lose funding. In order for the project to be implemented, it must please the sponsor. Gaining a sponsor can be very challenging. The sponsor is meant to fund and support the convention of a shared idea or shared information. Therefore, the sponsor must be in agreement with the direction of the project and be appropriately funded. Typically it takes 6-12 months to get the full support of a sponsor (Santosh 2012). A sponsor's full support is access to their resources, funding, and support. It is not enough to just have a name or a promise. Most sponsors or their representatives will want to see something before they commit to a project. The ETH completed their collection's display and restoration without a financial sponsor. The money was fundraised and came from the faculty members working on the exhibition; this process took five years (Brauckmann 2013). Dr. Ecker is the official overseer of the collection at the ZHAW and is already in contact with potential sponsors. Ideally the ZHAW's exhibition implementation would take less time.

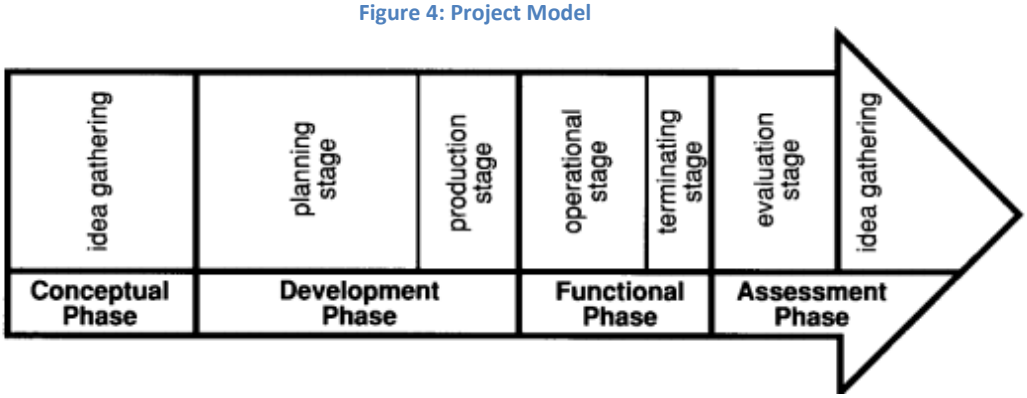
The design is the skeleton of every exhibition. Design prototypes are used to attract sponsors to an idea and give a visual representation of how the information will be conveyed. Designs are a combination and correlation of what the sponsor wants and what will please the most viewers. This is most often not a 50:50 split, depending on the sponsor. The designing process includes the creation and rejection of multiple models and prototypes. This process decides everything and ranges from what information is

being conveyed and its medium, to what should be the color and font of the text. We found that creating a design that was most successful took multiple exhibition design professionals 3-12 months depending on the scale of the exhibition.

Implementation is the fruition of the idea into a physical or digital media that can be explored by viewers. Implementation is performed by an outside third party. This third party is usually hired contractors or outside consultants. Implementation or construction is overseen by designers and paid for in majority by the sponsors.

In order to suggest a conveyance method to garner public interest, we will follow the project model in Figure 4 (Dean 2002).

Figure 4: Project Model

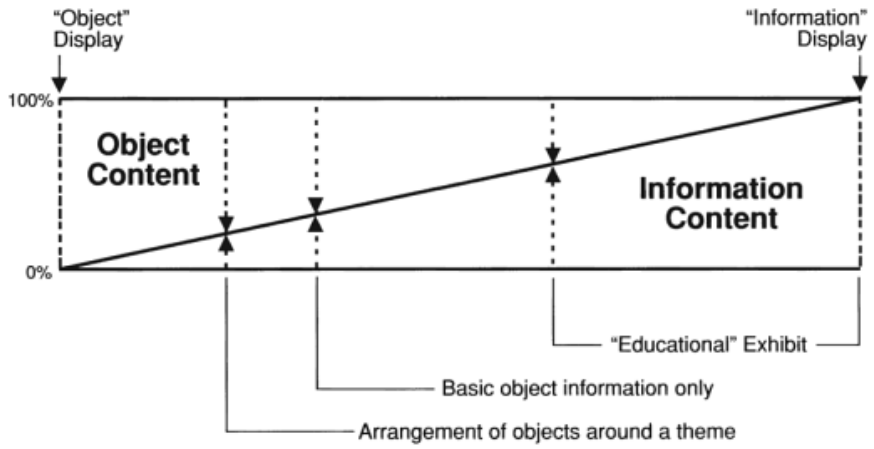


During the conceptual phase we defined an exhibition as a method of conveying science objects and information through a multitude of mediums including: physical, digital, and audio. We conducted our research, visited various museum exhibitions, and began to collect ideas for potential display. In the development phase, we began to set goals for conveyance, discussed prototypes, and developed a plan for the rest of the project. Our exhibition recommendations were presented to the ZHAW by the end of this phase. During the functional phase we presented further suggestions on a regular basis and gained customer feedback. Over the course of this phase, it was occasionally necessary to terminate a plan or idea for a more suitable option and revert back to the development phase. The final stage is the

assessment phase, when we evaluated the designs and gathered new ideas for future improvements, changes, and further exhibitions (Dean 2002).

When creating an exhibit, it is important to determine the type of content being conveyed. If the exhibit primarily contains information content then it creates an educational experience for its viewers. These exhibits usually do not present objects, but instead feature text and graphics. This type of exhibition can be described as a "textbook on walls" and is not recommended for instilling public interest (Loring 2013). Contrarily, if the exhibition primarily contains object content, it offers an interactive experience for its viewers. The purpose of this type of exhibit is to present the audience with the physical object and to let the object speak for itself. This is the type of exhibition is highly recommended for creating public interest (Loring 2013). Figure 5 illustrates the different types of exhibit displays (Dean 2002).

Figure 5: Exhibit Display Content Relations



In many cases, it is the job of the exhibition designer to balance the types of content that are appropriate for its audience. In order to determine if an exhibit should be more object or information orientated, the designer must consider the degree to which an object can communicate itself to viewers. The designer must also determine which is more prominent, the story of the object or its emotional impact (Dean 2002).

In order for learning to occur, science exhibitions must attract, compel, and engage visitors for a sufficient amount of time. In 1984, a study conducted by Bob Peart, a member of the consultant planning team at I.L. E Consulting determined that visitors were more easily attracted and engaged by the most interactive exhibits. This exemplifies that pictures, sounds, and interactions with objects were preferred over written descriptions and object viewing. It is essential to provide visuals and give visitors the opportunity for a tangible experience so that they can be fully immersed. If visitors immerse themselves in the display, the amount they learn from the exhibit is much greater (Rodley 2013). Ways to increase attraction and holding power of an exhibit include: having an exhibit interpreter present, requiring visitors to actively participate in an activity as well as adding lights and sound effects while visitors interact with the exhibit (Boisvert and Slez 1995).

A study performed in the "Human Body Discovery Space" of the Boston Museum of Science analyzed the impact of different exhibit styles on its visitors. The styles incorporated various interaction levels of different complexities in exhibits that presented information in both concrete and abstract ways. The attraction index was calculated from the percentage of visitors who observed a particular exhibit for more than five seconds. The average holding power is a representation of the time a visitor spent either looking at or interacting with an exhibit. The average engagement level was indicated when a visitor paid attention, read, touched, or discussed any aspect of the exhibit. The results of the study are as follows (Boisvert and Slez 1995):

From Table 1, it is clear that attraction, holding power, and engagement levels were the highest for style three – exhibits with a staff member present. This proves the effectiveness of an exhibit interpreter on the visitor's experience. Style four utilized "discovery boxes" for visitors to open and close. This was not particularly attractive and did not hold visitors for long. However, it had a high level of engagement. Style five included computer data bases and libraries which seemed to interest few visitors at the

museum. Styles one and two were simple exhibits of varying levels of interaction (Boisvert and Slez 1995).

Table 1: Interaction Levels for Each Exhibit Style

Attraction, Holding Power, and Engagement Levels for Each Exhibit Style

Exhibit Style	Attraction Index	Average Holding Power (seconds)	Average Engagement Level
Style 1: low interaction, concere, simple	40	32	1.5
Style 2: high interaction, concrete, simple	35	47	1.6
Style 3: high interaction, concrete, complex	46	106	2.0
Style 4: high interaction, abstract, complex	19	38	1.6
Style 5: low interaction, abstract, complex	8	45	1.0

In order to increase the number and time of exhibit views, it is important to understand how people normally maneuver through the space. An exhibit designer must determine multiple variables in their design. Location is essential because if the exhibit is centrally located, visitors are more likely to spend time interacting with it. However, if it is in a passing location, visitors are more likely to only glance at the exhibit. The interactions (opening drawers, touching display objects, and discussing the exhibit) are also determined by how much time the viewer has available to them (Ciolfi and Bannon 2002).

An example of an exhibition for antique chemistry equipment is the “Soviet Display of Chemical Equipment at the ‘Chemistry-70’ Exhibition”, which contained multiple pieces of chemistry equipment which were on display in roped off sections so that visitors could see the devices without touching them (Golovin 1970). This form of exhibition had similar pieces to our own collection of artifacts, yet serves as an example of what we do not want to do with our collection. The artifacts in the “Soviet Display of Chemical Equipment at the ‘Chemistry-70’ Exhibition” made a display of objects that did not hold an audience’s attention and were not creatively shown.

If we choose not to design a physical display for the collection, we may recommend that the ZHAW creates a digital exhibition. Museums across the world have implemented this design tactic in order to convey a collection to a greater audience and in various languages. Digital exhibitions allow for the integration of text, images, sounds, videos, word documents, and excel spreadsheets. These additions increase viewer attraction and increase the exhibitions holding power. The Canadian Museum of Civilization Corp. began creating an online exhibit database in order to make their collections accessible to a large audience and so they could easily translate their display to English and French. Also, the museum was able to convey over 80,000 records and 250,000 that were originally being displayed in The Canadian Museum of Civilization and the Canadian War Museum (Meckbach 1999). This type of display was most suitable for the museum because of the large extent of their collection and their goals for conveyance. In addition, an advantage of a digital display is there are no limits in terms of space (Qureshi 2011). The majority of a collection can be displayed in one location and all items can be easily observed and identified. This prevents overcrowding a display area, but still exemplifies the extent of a collection.

Artifacts act as social agents because they carry the character of human agency through their material culture (Shanks 1998). There should be emphasis on the greater meaning in artifacts beyond a date used to chronologically sort them. Two main times exist in archaeology, a date for when the artifact was created and one for its usage period (Shanks 1998). However, there is a life cycle of relics and how each item has a birth, use, and eventual death/recycle. The truth of an object's interpretation is a battle between simple human interaction and the complexity of its meaning (Shanks 1998). Artifacts are a vehicle or intermediary for communication. Moreover, a true artifact never dies, it forever possesses the ability to tie together the past and the present (Shanks 1998).

The materials-based perspective is a method of archaeology and historical record keeping, which embodies the prominence of culture in artifacts. The emphasis relies on all examples of material culture to carry importance, culture, and life (Odegaard 1995). Previously, only objects designated as sacred, potent or culturally sensitive were considered of importance. Every item from our past carries importance and meaning, not just objects considered to be sacred or holy. There is an emphasis to attempt to display all objects equally without showing favoritism or significant bias. The life cycle of relics discusses how certain artifacts give rise to the creation of others or are vital in human interaction (Shanks 1998). Similarly, when artifacts are being conserved or restored for show, the object is displayed with its original intent or cultural meaning. This is called the artists' intent, which is subject to the bias of the artist and can often misconstrue the perception of the object (Odegaard 1995).

This material is relevant to our IQP because it expands our knowledge on how different types of exhibitions are perceived by the public. It informs us on the best methods to attract and hold an audience's attention. With this information, we can make the best possible recommendation for the ZHAW based on their target audience.

4. Methodology

4.1 Shifting Perspectives

Over the course of the semester designated for this project, our perception of the task shifted. Through discussions with our advisors and sponsors, interviews, museum visits, research, and our own opinions, we defined our project purpose. This was a challenging and extensive task; however, we feel that the learning outcomes outweigh the obstacles. We cultivated skills in adaption, goal selection, communication, and research. These skills have helped us become more aware of how our decisions affect and are affected by other individuals separated by time, space, and culture; become more aware of personal, societal, and professional ethical standards; and improve our ability to work individually as well as in groups.

Due to the ZHAW being on winter holiday during a large portion of C-term, we were unable to regularly contact our sponsors in order to more fully understand the extent of their collection. This was one of the largest, and first, obstacles we encountered. Planning was difficult because we were unsure of the collection's contents, the condition of the items, and project direction. Our sponsor's goals were also broad, which made it difficult to create a specific project plan prior to arrival.

When we finally did make contact with our sponsors at the ZHAW, our first perception of the project was that we would design and construct a glass-case display exhibit in a space of the ZHAW highlighting certain artifacts from their Chemistry Institute's collection. Initially, we felt as though the sponsors wanted this completed before we finished our project. In addition to the artifacts, we knew that there were over 700 vials of chemicals and chemical compounds that the ZHAW sponsors wanted displayed. With this in mind, we began researching museum display techniques and contacted professionals in the museum field. Our research included online investigations of preservation and display techniques as

well as history of chemistry in Switzerland and ZHAW. We also conducted research about displays at various American museums and planned visits and interviews with European counterparts. All of this was very beneficial, as we gained a foundation in designing a physical display and background information on where the artifacts we were to encounter originated. However, we realized that we were limiting ourselves to only a physical display and expanded our options.

In this realization, we expanded our methods for display to include digital media, including websites and short, informational films. Our first thought was that this method might be best suited for use with the vials, since there were so many of them and we assumed that they were not viable for outright display. At this point, we had developed a project plan for our time in Switzerland with the main disadvantage being that the plan was very generic until we knew of what the collection was comprised.

Upon arrival at the ZHAW, we had our first glimpse of the collection. We saw the boxes of assorted equipment and experiments, the bureaus of rocks and fossils, and the cabinet of chemical vials. We were very surprised by the extent of the collection and the absence of information about any of the contents; the entire collection was neither completely inventoried nor organized. We realized that in order to know what was available for us to use, we would need to spend several days organizing, inventorying, and familiarizing ourselves with the contents of the collection. We then did spend several days completing these tasks, and have made our resultant documents available to the ZHAW for future use. It was at this time that we realized we would not be incorporating the entirety of the collection into an exhibition. After consulting with our advisors, we determined that it was infeasible for us to produce an entire exhibition within the timeframe and scope of this project. Therefore, we shifted our focus to generating multiple, quality design recommendations. In order to achieve this goal, we thought these recommendations should include a matrix that is dependent on the audience, budget, content, and display medium.

We decided to expand our exhibition options to alternative displays. After our interview with Pia Viviani of Science-et-cité, a company in the field of Science Communication, we were able to gain insights into these options. We began to consider options such as traveling exhibits, café talks, and suitcase sets. These options offer a more unique approach to garnering public interest in the natural sciences and make information more accessible to a larger audience. Briefly after this interview, our focus then revolved around creating a mobile exhibition from the collection at the ZHAW. However, this did not coincide with the goals of our sponsors as this type of exhibition does not attract visitors and instill interest in the university.

Our next perspective change occurred during a meeting with our sponsors when they expressed their concerns about the experiments. We realized that using these items was most important to them because they felt their legacy was most apparent in these artifacts. In order to determine which experiments would be used for display, we first worked with our sponsors to identify the experiments and equipment, and then sought logical groupings for them. With these groupings in mind, we narrowed our displayable equipment based on condition, historical value, and visual appeal in order to create a variety of display recommendations.

Over the course of this process, we learned how to identify and satisfy the customer's needs. We learned the importance of adapting our design ideas based on varying criteria obtained throughout the process. By the end of this process, we identified a more finite vision of our task; to encourage visitation to the ZHAW and to instill an interest in the natural sciences in those visitors.

4.2 Museum Visits and Interviews

4.2.1 Museum Visits

In order to expose ourselves firsthand to different types of exhibits, we visited multiple museums. Due to its proximity to WPI campus, we first visited the EcoTarium in Worcester, Massachusetts (Appendix C-2). The EcoTarium was a good choice for our first visit because the museum incorporated many different types of exhibits. The museum displayed live animals, taxidermy, interactive exhibits for families, the traditional "textbook on walls" as well as a library resource area. One of the main goals of exhibit designers at the EcoTarium is to tell a story with their displays. In order to share the collection's story, exhibit designers at the museum aim to engage viewers in real phenomena and to attract multiple generations. After personally engaging with the museum's exhibits, we determined that the interactive exhibits held our attention for a longer period of time than the older, more traditional exhibits.

The Hartford Science Museum consists primarily of interactive exhibitions (Appendix C-4). Their main goal is to immerse visitors in the science phenomena. This method of learning works well with younger audiences as well as older. We witnessed the younger audiences playing with the exhibitions while the adults read information from the walls; they would then explain the exhibition to the children. This interaction between family members led to a deeper and more meaningful experience. The subject matter and the way it was conveyed cultivated the public interest quite well. This is a great example of ways to design family friendly exhibitions. We felt that if we could portray our collection's information in a similar form, it would have great success. The phenomena conveyed here were very similar in subject matter, science, and intellectual level to the ZHAW collection.

In order to gain perspectives of museums in Europe, we first visited the Technorama in Winterthur, the Swiss Science Center (Appendix C-6). The Technorama offers a wide array of exhibits that encourage visitors to touch and interact with science and technology. We found the exhibits attracted visitors of all

ages and engaged these visitors on different levels. The displays catered to children in that they were fun, able to be touched and played with, and offered educational lessons even to young minds. However, the displays also offered an educational experience for adults and visitors that already have an appreciation for science phenomena. The museum presents a brief explanation of how to interact with the exhibit as well as a larger, more in depth explanation of the science conveyed by the display. We found it very helpful that these explanations were offered in four different languages (German, French, Italian and English) to cater to Switzerland's diverse culture. There were a few criticisms that we had for this museum. The dim lighting in the majority of the museum's exhibitions made it very dull and colorless. Even though the rooms were large and full of many exhibits, the ceilings seemed uncomfortably low in the sense that it felt crowded.

In addition to these, we visited the Deutsches Museum in Munich, Germany (Appendix C-1). This large museum encompassed over 50 different exhibition areas, each displaying a different aspect of science and technology. One particular exhibit that particularly captured our attention was a collection of rocks placed with a background map that displayed the locations of origin for these samples. We believed this was a unique way to display a collection that otherwise may not have been deemed interesting. The museum incorporated many tactics in to their spatial design. For instance, the museum utilized space on the ceiling in their science exhibitions to display three dimensional molecules and glassware such as test tubes with colored water. Many of the Deutsches Museum's exhibits incorporated cut outs of items on display in order to provide viewers with greater insight to the object. These cut outs revealed the inner workings of more complex mechanisms. The museum also employed 360 degree glass display cases to enable visitors to view from all angles. In order to emphasize these exhibits, the museum used colored carpeting surrounding displays. We took note of these tactics because we believed they helped to better our experience at the museum and may be aspects for us to consider while designing an exhibit.

Our visit to the historical Pharmacy Museum in Basel, Switzerland was most relevant to our project (Appendix C-5). Many of the items on display there, such as the glassware and antique equipment, were similar to those found in the ZHAW collection. We were greatly impressed by the extent of the collection at the museum. However, we believed there were better methods of display that the museum could have implemented. The exhibits that told stories of old apothecaries and recipes for various medications were engaging. They allowed us to connect the artifacts with a story of the progression of pharmacy technology. On the other hand, we found exhibits simply displaying old glassware and experimental equipment to be dull and not engaging. We were not engaged by the conveyance methods employed by this museum, and this experience served to steer our suggestions and recommendations in a different direction.

Eidgenössische Technische Hochschule (ETH) Zürich has a private collection of artifacts (Appendix C-3). The ETH has a similar story to the ZHAW because they also had artifacts uncovered during an institute move to a new location. Similarly the artifacts of the ETH were going to be disposed of but were conserved for exhibition instead. They utilized display cases in a setting similar to the one available to us at the ZHAW. The items in these displays shared subject matter and historical value with the ZHAW collection. We feel that there was a lack of engagement between the materials and the audience, but the similarities between the collections are too significant to ignore. Thus, we recognize the feasibility of this type of conveyance method.

4.2.2 Interviews

Interviews were a crucial part for us in determining how to research and suggest a design of conveyance for a target audience. During the planning process at WPI, we spoke with our sponsors Dr. Achim Ecker, Claudia Weller, and Dr. Marc Bornand to determine the desired outcomes of this exhibition. Then, we interviewed multiple directors of American and European museum exhibits as well as professionals in

the field of science communication. These interviews were beneficial for determining how best to present the exhibit to a target audience. The purpose of these interviews was to gain perspective on exhibit development, design, presentation, and perception. We found the opinions and input of these directors very beneficial. The notes from these interviews are given in Appendix B, and our guiding questions can be found in Appendix B-1.

We used a semi-structured style for our interviews, preparing guiding questions in advance and having a conversational dialogue with the interviewees. This allowed us the freedom to listen to the interviewee present their opinions and knowledge, while asking our structured questions. We asked all the museum directors similar questions regarding exhibit development; this enabled us to compare answers and compile the most useful exhibit design for the ZHAW. During these interviews, Spencer took notes, and we each took turns asking both structured and impromptu questions. Initial contact with these individuals was split amongst the group.

Our first interview with Betsy Loring, Manager of Exhibits and Collections at the EcoTarium in Worcester, entailed a discussion of display methods as well as a guided tour of the museum (Appendix B-8). Loring conveyed the idea of two major types of museum exhibits; those centering around the experience and others the history. In her words, the EcoTarium is a hybrid of experience and history implementing both "science play" and "textbook on walls" display methods. As part of our tour, Loring demonstrated many of the interactive exhibits in order to exemplify the EcoTarium's goal: to engage visitors in real phenomena. She also explained how different audiences interact with these exhibits. Young children generally do not want or need instruction but rather just play with the exhibit, older children often read the instructions on how to interact with the display, and adults are the most likely to read the scientific background on the exhibit. The hybrid of exhibits at the EcoTarium aims to appeal to these various audiences. In terms of our project, Loring gave us advice to avoid displaying a lecture on a wall with only

text, to target a specific audience, and to test our prototypes in real world situations. She told us to focus on the message we want to convey and on determining our audience.

Our phone interview with Ed Rodley, Exhibit Developer of the Boston Museum of Science, opened our eyes to different components of the design process (Appendix B-9). For instance, he encouraged us to think about cultural differences between Switzerland and the United States and the cultural translation of a display. Rodley also pointed out the importance of being explicit with objects, pictures, and text because unlike a book or a class the display is usually a onetime stop for visitors. He mentioned that visitors often like to see pictures or real demonstrations because this is proof of the importance of the displays relevance. These interactive displays help keep visitors engaged which prevents disappointment, the most deadly visitor emotion. After describing our project to Rodley, he believed one of our greatest challenges would be deciding which objects we would leave out of our exhibition. He believed we would see many opportunities for display in the items we encounter. Some exhibit designs he suggested include having model molecules, a periodic table with the elements, flip up labels with the rocks below, and a video displaying an experiment such as a hydrogen explosion demonstration. Finally, he stressed the importance of staying conceptual with the display because this will ensure maximum comprehension for visitors.

Andrea Durham is the director of Exhibit Development and Conservation at the Boston Museum of Science (Appendix B-3). She had a phone interview with Spencer about our project and how we should proceed with our materials. Durham was adamant about many things. She specifically wanted to make sure our group didn't rush into a project without prior planning and that we had set goals and ideas in mind before we started.

Dr. Mark Siddall is the Curator and Professor of Invertebrates at the American Museum of Natural History (Appendix B-11). We spoke with him about his latest exhibition regarding science technologies.

Siddall explained that his exhibition was designed so that viewers could walk through a working laboratory, or see actual research being performed from the other side of a glass wall (for safety purposes). The ZHAW Collection was not like the modern day robotic arms and technologies in the chemistry laboratory. However, Siddall put us in contact with Vidya Santosh, the woman who designed his exhibition.

We held another phone interview, this time with Vidya K. Santosh, Graphic Designer at the Museum of Natural History in New York City (Appendix B-10). She works mainly with placement of items and collections within the museum. Her role is to design an exhibition and create many different prototypes after a sponsor and an idea have been secured. The museum splits up jobs within the exhibit design process among a team of designers to utilize each team member's strengths. Santosh estimated the process for creating an exhibit to be approximately two years from the formulation of an idea to the completion of the construction phase. For our project, Santosh suggested narrowing our focus to two or three different conveyance methods and then expanding on those. Her suggestions for exhibitions included arranging the elements into the Periodic Table and having visitors build molecules in order to encourage visitor interaction. Santosh told us the most important resource limitations to consider while choosing a conveyance method include time, money and manpower to create the exhibition. Her final advice was to narrow our focus to determining the exhibition's target audience and the story we want to share with the collection.

While in Switzerland we made a trip to Bern, the country's capital, in order to interview Pia Viviani, the Deputy Head of Science-et-Cité Management (Appendix B-12). She was able to give us insight to past projects she has worked on as well as other methods for conveyance. For instance, she gave us the idea of café talks, informal discussions between sciences and the common man held in locations such as restaurants or bars. Viviani also shared the conveyance method implemented by a company named

ExploreIt that sends science suitcases to schools so students can perform experiments. In terms of our project, Viviani was interested in the possibilities for a traveling exhibit. However, she was also interested in the Periodic Table display, exemplifying which elements make up modern day items, and an element quiz. Viviani stressed the importance of finding a method of conveyance that would allow the artifacts to speak their story. She suggested the possibilities of incorporating the voice of a story teller into an interactive exhibit.

We had the opportunity to meet with Barbara Brauckmann, Departement Chemie und Angewandte Biowissenschafte, on two different occasions (Appendix B-2). Our first meeting was held at the ZHAW where we gave her a short introduction to our project and showed her the collection available for display. For our second meeting we met Brauckmann at the ETH so she could show us the chemistry and pharmaceutical display at the university. During the tour she gave us insight to the design process, cost, and implementation of an exhibition design. Brauckmann gave us advice to act quickly and start designing an exhibition for the items most in danger of being disposed. She also encouraged us to begin gathering potential sponsors. Since the ETH's exhibition did not gain sponsorship it took approximately five years to execute the design and implementation processes.

Towards the end of our time in Switzerland, we contacted administrators at the ZHAW in an attempt to find an architect who could generate a computer image of our exhibition recommendations. Spencer met with Vera Narodnitzkaia and Karin Widner and conducted the meeting bilingually in a combination of German and English. (Appendix B-6). The first and essential step in the meeting was to explain the nature of our IQP and establish clear objectives for our project. The main purpose of this meeting was to find an architect who could create some kind of digital image of our exhibition sketch. After the explanation of the project, Narodnitzkaia and Widmer sent an email to a ZHdk student in Zurich who would later become our architect.

Sandro Lochau is an art student at the Züricher Hochschule der Künste (ZHdk or Zürich School of Art) (Appendix B-7). Lochau is skilled with interior design, architecture, 3-dimensional modeling, computer aided design, and many other areas. Spencer met with Lochau, who very quickly realized how he could help us by creating a digital representation of our exhibition model. Lochau promised to try to match the exhibition to an actual room at the Zurich University of Applied Sciences down to the floor tiling and window lighting. He also was convinced that he could create something that could satisfy our needs/wants based on our sketches.

Laura Hanlan coordinates undergraduate curriculum-integrated research education at WPI (Appendix B-4). She serves as liaison to many of WPI's projects and is very knowledgeable in the field of Information Science. Laura met with both IQP groups and with our group one-on-one to discuss how to conduct appropriate research and write the project report. Hanlan was essential to our group because she helped us to setup many of our most valuable accounts such as EndNote and SharePoint. These programs allowed us to share documents and to automatically save and cite our sources. She also showed us tools that would aid in our research process.

In preparation for our departure to Switzerland we visited swissnex in Boston. We met Sebastian Hüg, Project Leader of Higher Education and Partnerships, and Junior Project Managers Sabina Tresch and Claudia Rüegger (Appendix B-5). Hüg opened our meeting with background on himself and on swissnex Boston. He provided us insight to the train system, Swiss laws, emergency phone numbers (police, firehouse, and ambulance), political system, and holidays/celebrations. After introducing our project to Hüg, he recommended we visit the chemistry exhibit at the ETH in Zurich, research chemistry companies in Basel, and visit the pharmaceutical museum in Basel. Claudia mentioned that we may want to utilize the HBZ, a main library in Zurich, and Sabina gave us a potential contact named Pia Viviani, the Deputy

Head of Science-et-Cité Management as well as the Deputy Head for the Swiss National and German-Speaking Switzerland Team.

4.3 Collection Assessment

In order to design a method for preserving the materials and information of the ZHAW Chemistry Collection, we first needed to familiarize ourselves with the contents of the collection. Upon our arrival it was imperative to take the time to assess the items in the collection. There were three main sub-categories of the collection that required assessment: the minerals, the fossils/rocks, and the experiments/equipment.

The most pressing material, and the first assessed, was the experiments/equipment. Over the course of two days, we inventoried and catalogued the equipment/experiments. The equipment/experiments were stored in a corner of a ZHAW Chemistry laboratory, both in boxes and loosely kept on the ground. We worked in the lab so we did not have to transport the antique and fragile items. We used an assembly line-like system to maximize efficiency. Meredith unloaded each box individually onto the workspace and took pictures of the items, while Caitlin then kept the items in the same order and described them to Spencer, who recorded the information in an Excel Spreadsheet. A lot of the equipment was usable glassware that we were able to integrate into the Chemistry laboratory. In the evening, we compiled PowerPoint slides so that the pictures of each item could be easily associated with its description (Appendix A-1). We then worked with professors of the ZHAW Chemistry Institute to identify the experiments and equipment, as much of it was not labeled. The collection was then evaluated so that we could determine the best pieces for exhibition.

We then turned our attention to familiarizing ourselves with the rock and fossil samples. These were kept in an off-campus storage facility. Over the course of several days, we digitized the catalog cards into an Excel Spreadsheet and took pictures of the samples for our records. We each digitized a portion of the cards, and Spencer and Meredith took pictures of the rocks and fossils, reading their names off, as Caitlin checked them with the spreadsheet. Due to improper storage, some of the crystalline samples degraded. Additionally, all that is known about these rock and fossil samples is their name. Some have a location of origin associated with them, but none have dates. The spreadsheet now corresponds to organized folders of the named pictures in a digital file, so each sample is easily located (Appendix A-2).

The final piece of the collection is the vials of chemicals and samples, which was stored in a locked chemical closet in a laboratory storage room. The ZHAW already had an extensive inventory of these items, including the overall charge of the sample, the components of each mixture, and the chemical formulas for each. We used their inventory file to familiarize ourselves with the vial collection and found the advanced chemical information beneficial. However, there were some missing samples from the cabinet and the document, so we updated the records (Appendix A-3). We did find, though, that a majority of the vials were sealed, but their contents have been degraded to the extent that they are no longer usable. We believe that this is due to moisture or other environmental contamination.

These items originated from the Technikum Winterthur and are now currently overseen by Dr. Achim Ecker of the ZHAW Chemistry Institute in Wädenswil. Once we familiarized ourselves with the contents of the collection, we began to develop methods of conveyance.

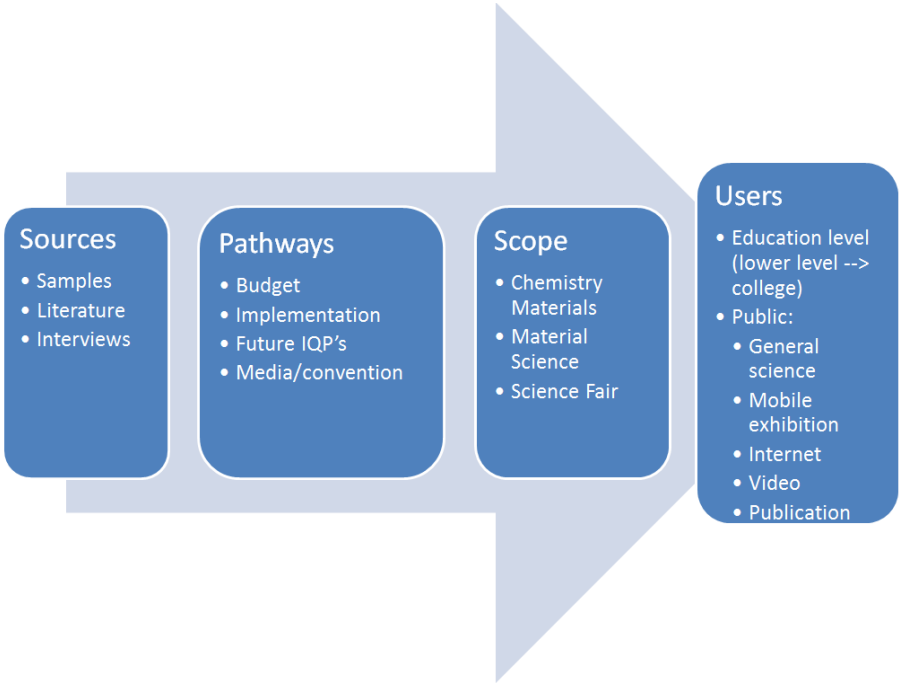
5. Results and Analysis

5.1 Conveyance Ideas

5.1.1 Definition

There are four main parts to a suggestion for a Conveyance Idea: Sources of Information, Pathways for that Information, Scope of the Pathways, and the Users of the Information (See Figure 6). In our project, there are three main sources of information: the samples from the collection at the ZHAW, the literature and research completed, and the interviews conducted. Various pathways such as budget, implementation, future projects, and mediums for conveyance helped to define these sources. In combination, the sources and pathways inform varying project scopes whether large-scale museum exhibitions or smaller scale displays. Users are the people who visit the exhibition. They are defined by the scope (reach) and receive the sources' information via the pathways provided. In all of these options correlating the type of display to its intended audience is paramount.

Figure 6: Project Direction



5.1.1.1 Museum Exhibitions

There are several different types of Museum Exhibitions, which correspond to varying audiences. Museum exhibits can either be interactive or displays. Designs depend highly on the target audience, their background knowledge, as well as their level of interest. In exhibitions, there is a correlation between information content and object content; the more objects in an exhibition, the less information and vice versa. There are also five main styles for exhibitions as described in the next paragraph. Museums use a variety of these styles and combinations.

The first style of exhibition is meant for low interaction and to be concrete and simple. This type of exhibition is of less interest to younger audiences and is meant for higher information levels. This style encompasses object displays, display casing, and has very limited interaction. This type of exhibition is meant to be simple with the information given in a watered down form and spoken in the common man's tongue. That way the average person will understand the concepts without going too far in depth with the information. This style is meant for displays that cannot be touched or handled.

The second style of exhibition is meant for high interaction and is also concrete and simple. Children's museums follow this style because there is much more interacting with the material and the information is kept simple for easier understanding. This type of exhibition is not appropriate for viewers who already know a lot about the subject being displayed and is mainly meant for younger audiences to explore the phenomenon.

The third style is also high interaction, but involves complex learning. The target audience for this style is expected to at least have some sort of background on the subject matter. Younger audiences will understand less information at these exhibitions but will enjoy the high level of activity whereas the more educated persons will have better understanding and will be able to experience the phenomena first hand. The Technorama in Winterthur, Switzerland is the perfect example of this style because it

had multiple exhibits that mimicked college chemistry laboratories on an interactive museum level. Both younger and older audiences enjoy playing with the exhibition, but the older audiences could connect the information to what they learned in their schooling.

The fourth style is very similar to the second and third but is very abstract rather than concrete in its approach. The abstract nature is meant to approach a topic from another perspective. This is less successful in attracting audiences but has a higher holding power than simple displays.

The fifth style has low interaction, complex information, and abstract learning. This method is reserved for educated audiences who are interested in the subject matter. It is meant to inform the viewer with lower object content and with a much higher level of information. We call this type of exhibition the "text book on walls" because it is mostly information with little to no interaction. This exhibition is of little interest to most audiences.

5.1.1.2 Traveling and Mobile Exhibitions

The country of Switzerland has many beautiful and glorious museums. However, the majority of these are located in the country's larger cities. This means that in order for the exhibitions to be seen, individuals must travel to these cities from their smaller cities, villages, or mountainside towns. The most successful exhibition for the more remote audiences is travelling or mobile exhibitions because the exhibition is brought to them in their own communities.

The "suitcase exhibition" is employed by a Swiss company Explore-It (See Figure 7). Their concept is to put scientific experiments and items to analyze into a suitcase that is ordered by a school classroom. The "suitcase" is shipped to the classroom to utilize with instruction; the set is then returned after use. Our group loved this idea and felt as though it was an amazing way to reach out and convey our objectives and information to people farther away. The drawbacks of this type of exhibition are that it is

very small scale and could potentially be lost or damaged in transit. The other main problem lies in advertisement because audiences must have heard of the exhibition in order to order it.

Figure 7: Explore-it Traveling Suitcase

Similar to the "suitcase" is the idea of a van/bus/train car exhibition. All of these examples are on a larger scale than the "suitcase". The exhibition could be set up in a venue for a week or weekend or on display at a fair ground. This method would allow the information to be conveyed across a larger audience that wouldn't normally travel to the bigger Swiss cities. The train car could go anywhere the tracks could lead, and could even be viewed in transit depending on its design/content. However, it would be limited to the normal travel of the SBB train system and would need an engine to move it to locations.

Other forms of traveling exhibitions include café talks. These take place in local bars or cafés. Three scientists or professions will lead a discussion with whoever is in the bar, prompted by a person who keeps the information simple enough for the common man to understand. This prompter would get people excited about the topic and bridge the gap between scientific research and the average working man in the bar/café.

5.1.1.3 Online and Digital Media

Beyond the boundaries of physical experiments is the digital world. The possibilities are endless when it comes to digitizing information, but the main focuses for science communication involve websites, mini-movie/documentaries as well as interactive games.

Websites can be as simple or as complex as the designer wants them to be and the intended audience warrants. For example, a website might be a collection of scientific journals and have mainly paragraphs of text. It could also be mainly pictures, with captions for audiences to identify the items shown. The correlation between objects (pictures) and information (text) applies very strongly for websites, because of space reasons. Website can include video clips explaining concepts, audio clips, games, and quizzes. The possibilities are endless, so long as the website is readily accessible to potential viewers.

Movie documentaries are another great possibility for media conveyance of scientific objectives. However, movie/documentaries created on the university level may not be seen by many in outside communities. The trouble with making a film or documentary is finding a venue in which people can view it. For example, a documentary film goes very well with a museum exhibit because it gives visitors a chance to sit down and learn from the displays. A limitation to a film, especially in Switzerland, is finding a common spoken language; however, this may be overcome through the use of subtitles.

5.1.1.4 Artistic Design

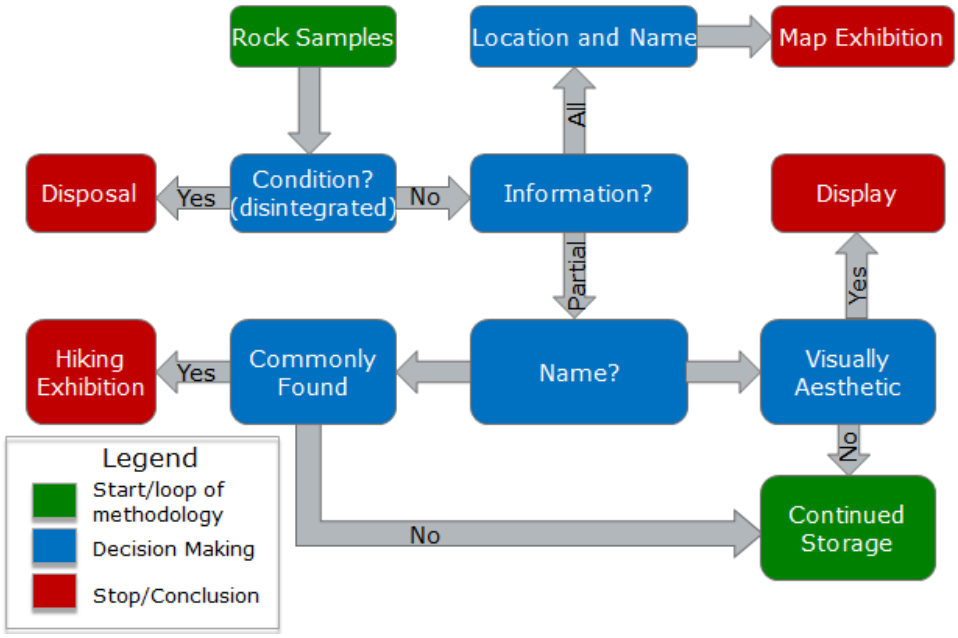
There is a more abstract approach that can lure in audiences to an exhibition. For example, old/broken glassware could be used to make a collage or a chandelier. The glass could be stained to make it more interesting. The broken equipment or dull objects could be cleaned and transformed into an abstract sculpture or a monument.

5.1.2 Rocks and Fossils

The ZHAW Chemistry Institute's collection includes over 800 rock and fossil samples, currently stored in a set of bureaus in an off-campus storage facility. Taking into consideration the historical value and

current condition of the samples, we are able to make the following evaluations and recommendations for overarching suggestions. Figure 8 provides a visualization of our decision process.

Figure 8: Rocks and Fossils Decision Process



5.1.2.1 Museum Exhibitions

One possible option for display would be to create an interactive exhibit from the rocks and fossils. The visitors would have to dig for the samples and then identify them or simply be able to touch them. The benefits of this option are that it is highly engaging and the audience has the best opportunity to learn from the samples. The drawbacks of this option are that with constant touching the rocks and fossils would quickly deteriorate, the exhibit may not be used to its full potential in the foyer space that the ZHAW would use for temporary exhibition, and it would be difficult to find a more permanent location in the ZHAW campus or in another collection.

It is possible to create a glass case display for the rocks and fossils, where the samples cannot be touched. We would recommend the use of the samples with a location of origin associated with them. This would have all of the samples' locations on the same map to display them in relation to each other.

In regards to the samples without information of origin or age, we would recommend a display that includes descriptions or diagrams detailing how that type of rock or fossil is formed. This works well for commonly found rocks. The benefits of this option are that it is a relatively low cost and minimal effort option for generating public interest. This type of display would also fit well in the confines of the foyer space that the ZHAW would use for temporary exhibition. Additionally, it would be relatively easy to move to another, more suitable permanent location. The drawbacks of this option are that it is not very interesting for viewers, as they cannot interact with the exhibit cannot be interacted. Additionally, finding another space within the ZHAW campus or within a collection at a different site as a more permanent display may be difficult.

5.1.2.2 Traveling and Mobile Exhibitions

Another possibility is to create a mobile display in the back of a van or bus. In this option, we would recommend the same types of displays as the glass case option; a map with those samples that have locations associated with them, and information on formation for those samples without that data. This could be done in combination with a more interactive display where the viewers could touch the samples. This would be on a much smaller scale than the full-size interactive exhibit. The benefits of this option are that the samples would be of use garnering interest in audiences that may not have the opportunity to travel to larger museums and collections and thus not have access to this information. Additionally, there is no need for finding a more permanent location for the samples, as their permanent home would be in the mobile exhibit. The drawbacks of this option are that a vehicle would need to be acquired, fueled, and a driver/mobile educator found. Also with the interactive aspect, the rocks and fossils would degrade faster with constant touching and frequent cleaning/preservation would need to be completed.

It is possible to create a mobile learning set comprised of these samples. Here, the samples could be organized into cases or containers that school teachers could borrow and show to their pupils in turn. The advantages of this option are that the information would reach audiences that may otherwise not be able to travel to museums or larger collections, and the only costs entailed would be how to transport the collection to and from the schools. Additionally, a permanent display location does not need to be identified. The drawbacks of this option are the sheer size of the collection and the risk of losing items between locations. The sample collection is too large and too heavy to be easily transported, especially by small amounts of movers.

Another option to use these samples to foster interest in science is to center talks and discussions around them. These could be held at the ZHAW, a café, a bar, or another off-campus location. With scientists or experts guiding a discussion, viewers could look at the samples, ask questions, and actively participate in scientific discussion. The benefits of this option are that it would actively engage viewers in learning about the samples, would be relatively low cost, and would require minimal effort on the part of the ZHAW. The drawbacks of this option are that leaders would need to be found, and the discussions would need to be widely advertised in order for them to be attended. In this type of exhibition, attendance is crucial, as a discussion is not possible with only a single person.

5.1.2.3 Online and Digital Media

It is possible to create a website with pictures of the rocks and fossils and convey information alongside them. The website could be linked from the ZHAW's website or from a sponsor's site as well. The benefits of this option are that it does not require a display space at the ZHAW, the information could reach viewers who may not have the opportunity to travel to a museum or larger collection, and the website could be viewed and perused at the viewers' leisure. The drawback of this option is that something would still need to be done with the samples after the digital exhibit was created.

5.1.2.4 Artistic Design

Another option is to find an alternative use for the rocks and fossils, such as in artwork. Since the vast majority of these samples have rough surfaces, they would not be ideal for painting on, but they could be used in sculptures or a mobile. When the art is displayed, a description of the types of rocks could be included. The benefits of this option are that the samples are being used to garner public interest in science through a unique and engaging medium, and that it would require minimal effort on the part of the ZHAW Chemistry Institute. Additionally, an artistic display would fit well within the confines of the foyer space the ZHAW would use for temporary display. The drawbacks of this option are that it may be met with some dislike as turning the samples into artwork may entail some defacement. Additionally, finding another space within the ZHAW campus or within a collection at a different site as a more permanent display may be difficult.

5.1.2.5 Other Options

It is possible to simply keep the rock and fossil samples in storage. In this case, we would recommend they be stored in a more water- and element-proof container. The benefits of this approach are more time to consider options and minimal cost to the ZHAW as they are currently storing them anyway. The drawbacks of this option are that the rocks and fossils are not being used to create interest in science, and the samples may continue to degrade if not properly maintained.

It is also possible to donate the rocks and fossils to another museum or collection. We have contacted and had discussions with Professor René Providoli from Explore-It and Dr. Heinz Furrer, Curator for the Paleontological Institute and Museum. Professor Providoli indicated that they did not have the resources or space to accommodate the addition of the ZHAW's collection to their own. Dr. Furrer told us that without a location of origin or date associated with the sample, he was not interested in acquiring the ZHAW's collection. It is possible that someone who does want to acquire the collection

could be found with further investigation. The benefits of pursuing this option are that the rocks and fossils would be available to the public with minimal effort and financing on the part of the ZHAW. The drawbacks of this option are that not many curators are interested in these samples because they seem to be lacking outright historical significance.

Another possibility is to dispose of the rock and fossil samples. For this collection, it could mean simply throwing them in the trash or potentially returning them to nature. In the words of Pia Viviani, this would be "a shame… for you can always do something with them". The benefits of pursuing this option are that it requires minimal effort and financing on the part of the ZHAW, in regards to both display and continued stowage. The drawbacks of this option are that the samples would cease to generate public interest in the sciences and that the time and efforts of those who compiled the collection will have gone to waste.

5.1.3 Vials

There are about 700 vials containing various chemical compounds in the ZHAW Collection, which are individually labeled in German and in identically sized vials. Some of the vials contents have been degraded and contaminated by environmental elements. The powders a have somewhat solidified and some are slightly discolored from top to bottom. However, there are many possibilities for these samples in their current state.

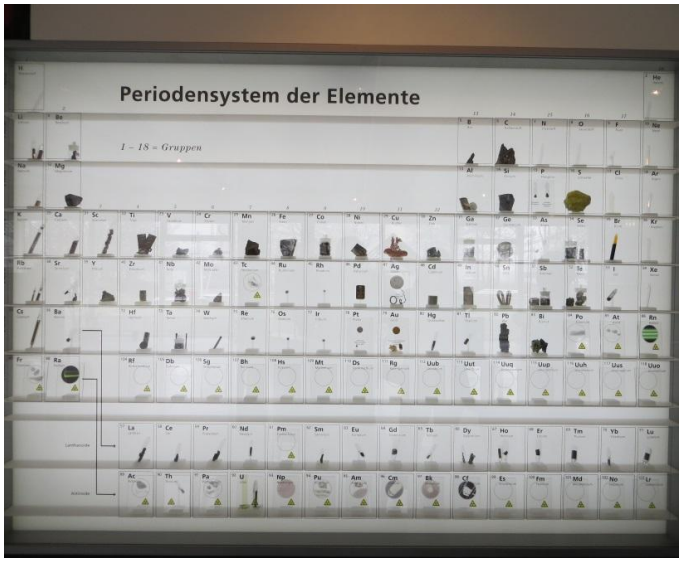
5.1.3.1 Museum Exhibitions

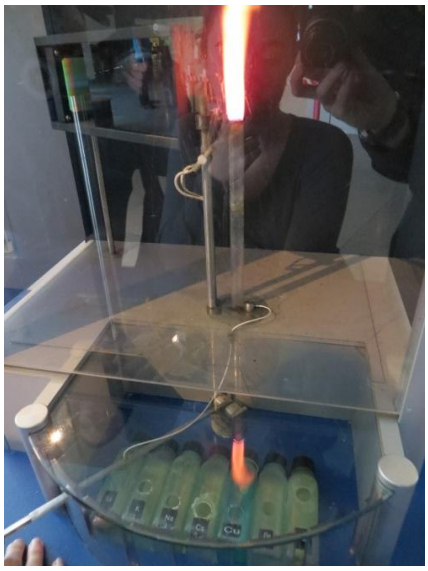
We advise against handling the vials roughly as they are fragile and could break easily. A non-interactive exhibition would be best for the vials in that case. There are many ways to go about this. One of the simplest, yet duller, methods would be to put the vials together in a glass case for everyone to view.

This would not hold the attention of the viewers but would be simple and easy to do. A more complicated version of this would be to organize the vials into a periodic table or an ionization chart (An example can be seen on the left in Figure 9). We would organize each element into a glass display case so that each periodic element would have a visual representation. The picture from the Technorama displays such a table; our group would go beyond their table by including the chemical compounds in an ionization chart or some other organized fashion.

However, the best way to have an interactive exhibit would be to have something similar to the Technorama's Flammenfärbung Exhibition (Seen on right in Figure 9). In this exhibition, the viewers could interact with the display by moving a level that would put a certain element into a flame thereby causing the flame to change color. The best way to make an interactive exhibition for the elements in the ZHAW collection would be to do something similar with newer chemicals, with the vials in a display elsewhere.

Figure 9: Design Inspirations





The elements could also be used for an interactive children's exhibition. We had the idea that balls and rods could be placed in a bin near the exhibit. These would be pieces to a molecule building set. Visitors

could pick them up and build different molecular compounds and learn about the formations and shapes that the molecules take in different types of bonding. To correspond with this interactive exhibit, we would place pictures and simple text on the walls so that the visitors would be instructed on the different mixtures. The benefits of this exhibition would be the higher-level learning and engagement of the children. However, this would take longer to create and would be costly. Exhibitions such as this would not be used to its potential and would also require a chaperone to watch the children and care for the exhibition.

Another display could show an ordinary object from today. For example, a television, iPod, cellular phone, or even clothing/backpacks would be put into a display case with the elements. The reason is simple; the common object will be surrounded by the elements of which it is composed. Coins would have Petri dishes containing the metals found in them, and the other items would have their elements near them as well. The benefits of such an exhibit would be using the actual chemical samples. The story or idea would be very easily relatable too. A drawback is the cost of buying additional everyday materials for the displays.

It would be very easy to put a chart up on the wall that included all of the information about all of the elements and compounds. This would be very simple, but not at all engaging. It would be a "textbook on walls". This type of conveyance would work better in a digitized medium and not in an exhibition.

5.1.3.2 Traveling and Mobile Exhibitions

Small experiments performable in school laboratories could be packed into a suitcase exhibition and sent to schools across Switzerland. However, this would require all new materials and would not utilize the vials that are available to us. Not mentioning advertisement, travel expenses, and the disposal of the vials are also shortcomings. If the vials were incorporated in the mobile exhibit, they are stable in their

current state, but if dropped would spill from their glass vials. The vials would only be successful in a mobile exhibit if they were secured in a display case.

The idea of a café talk on the vials is not feasible. There could be a very scientific discussion on the use of chemicals in modern chemistry and the make-up of specific objects, but this requires a professional in the field of chemistry and does not require the presence of vials.

5.1.3.3 Online and Digital Media

We believe the vials would be best presented on a website. That way there could be a webpage with the indexing spreadsheet that lists each compound's information and data. Videos could also be created to show different laboratory procedures as well as what happens when various compounds are mixed together. Games on the website could allow for the viewer to choose which compounds they wanted to mix and the website would show the reaction and the corresponding chemical equation for the reaction. Again, this would not involve the vials directly and would instead use only their information and things relating to them. A website would be interactive, have a greater audience, easily available any time, easily translated, and cost little money to maintain.

5.1.3.4 Artistic Design

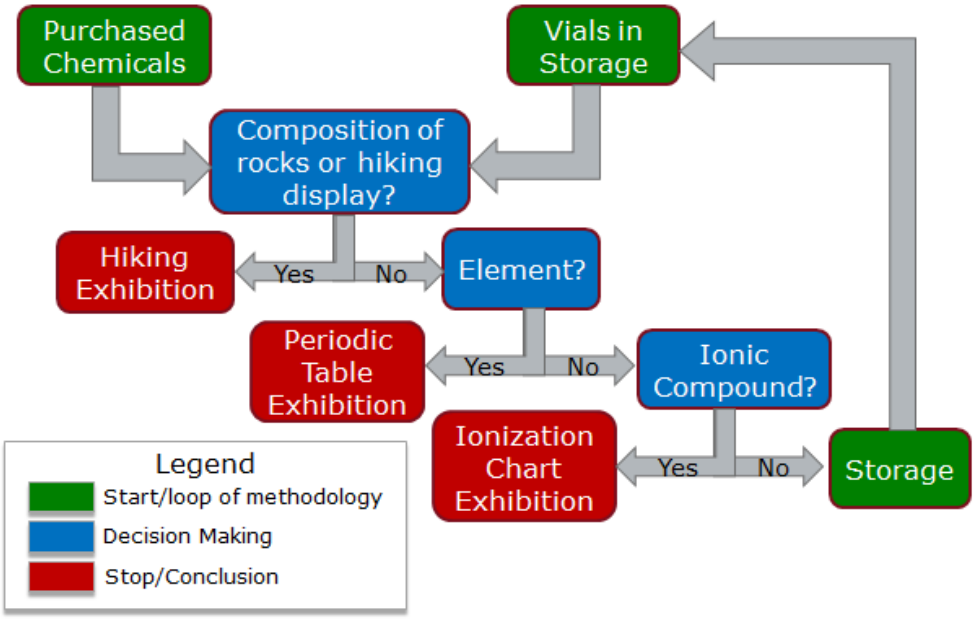
There is little to no art that could be created from vials. They could be hung from the ceiling so that viewers could guess what compound it is based on the bottom of their vial. The vials cannot be broken, or disturbed. Therefore, a sculpture or monument cannot be made from them and is much more suitable for old experiments/artifacts.

5.1.3.5 Other Options

In the event that the vials are not used, they should be disposed of safely. They are not suitable for donation due to the elements contamination and unusable state of being. Although they have secure

housing in a ZHAW cabinet in storage, continuing to store them there is not ideal. Figure 10 shows our methodology for determining the possible usages for the chemical vials.

Figure 10: Chemical Vials Decision Process



5.1.4 Equipment and Experiments

The equipment and experiments, which the ZHAW uncovered in their move from Winterthur to Wädenswil, have been packed in a series of boxes. The boxes have been stored in a corner of a chemistry laboratory, occupying valuable space; this puts them at great risk for disposal. Although these items are unorganized and seemingly useless, it is possible to find multiple ways to relate them together and tell a story of science.

5.1.4.1 Museum Exhibitions

The possibilities for designing a museum exhibit with the experiments and equipment are endless. Each of these items has its own story and history and together they could create a unique exhibition. One positive aspect of implementing a physical display is the possibilities to attract people simply passing

through the area. A physical display allows the collection to be available to those not necessarily looking for a science collection. The majority of the experiments and equipment are old and fragile so the possibilities for interactive exhibits where items are touched and handled are limited. If we are to create an interactive museum exhibit only some of the pieces will be able to be touched or handled. Therefore, if we want to incorporate an interactive component into the exhibit it will likely need to be through the use of senses other than touch. This may call for the implementation of sounds, buttons, and lighting. For instance, perhaps we would have pieces of equipment in a box and when visitors hit a button the corresponding item would light up and visitors would hear a brief explanation of the piece. This would keep the items in good condition but would still give visitors a chance to have some interaction with the exhibit.

A glass case display may be a more appropriate way to exhibit this part of the collection. It would offer viewers the opportunity to study and learn about the various pieces and ensure that the equipment stays in prime condition. However, a simple display may not be as effective in holding visitor's attention. If we choose to design a display we may choose to make it more appealing by implementing the use of different types of cases such as the 360-degree glass displays or a bookcase like display.

A "textbook on walls" type of exhibit is another possibility for this part of the collection. It could simply display pictures of the equipment with explanations for each piece. This may be ideal for small spaces; however, this type of exhibit can be dull and is not likely to draw in and hold the attention of many viewers. Too much text may discourage viewers from even beginning to read the display.

5.1.4.2 Traveling and Mobile Exhibitions

Traveling with the experiments and equipment in a mobile venue would help to reach a greater audience. It would be an ideal way to share the stories of the collection with people that may otherwise

never view the artifacts. However, many of the pieces are large and can easily be damaged or broken. Safely transporting the equipment in a van or bus may be difficult and expensive.

Creating a "suitcase" exhibit could be useful if we want to perform actual experiments with the equipment. This is one of the best ways to share the story of each piece because viewers can see how they are used first hand. If we were to implement this method for display we would be limited to only using the small and less delicate pieces of equipment.

Holding public talks with the equipment present could be an easy way to convey lots of information about a few items in the collection. However, with the size of the collection and the size of the individual pieces this is not likely feasible. This would be an inexpensive option in terms of the cost to display but we would need to find people to hold these talks.

5.1.4.3 Online and Digital Media

A digital display method could be an ideal way to show the entirety of the collection. We would not be limited in terms of space and we could easily convey the large spectrum of different pieces. On the other hand, it may be more interesting for people to physically see the collection opposed to viewing online photographs. A digital display could increase the audience size. Contrarily, only people specifically searching for a similar topic could stumble across the display. Making the website interactive may hold viewers' attentions longer and help them to retain more information on the collection. A guessing game or simulation game could serve this purpose. In order to explore the story that lays in the history of the collection, a movie on the history of the ZHAW may be appropriate. In a film, we could use the artifacts to illustrate the history of the chemistry institute at the university. Also, if the ZHAW is to create a digital display they will still need to find a location to store the collection.

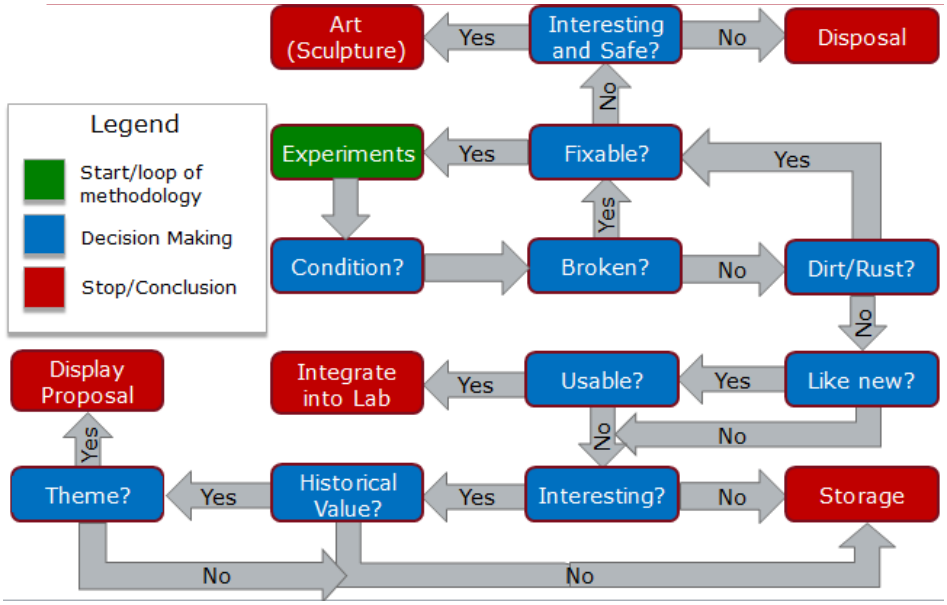
5.1.4.4 Artistic Design

Instead of focusing on the history of each piece individually, we could create an artistic design exemplifying multiple pieces together. For instance, the old glassware could be used to create a chandelier. Another idea is to fill the pieces of glassware with different colored water to make an artistic display. This type of exhibit would appeal to many different audiences and would allow the pieces to speak for themselves. It would allow much of the collection to be on display and could be more interesting than simply placing the pieces in a display case. One disadvantage of turning the pieces into art is that the history of some pieces might be lost. Viewers will see the display as one piece of history rather than the different backgrounds of each piece.

5.1.4.5 Other Options

If none of these options seem feasible, there remains the option to continue storing this part of the collection. Further analysis and design ideas may come at a later date. If this is the case, the ZHAW will still need space to store the artifacts and there is a chance pieces of the collection may become broken or damaged. If the ZHAW does not wish to continue storing the collection it may be possible for us to find a museum or other university where we could donate the collection. The items will still be available to the public; however, the display will not be predominately for the students at the ZHAW. Also, if we determine that these items are not display worthy we may choose to dispose of them. This will prevent the ZHAW from having to store the items. On the other hand, many pieces with a rich history will be lost and no one will have the opportunity to view the collection. Figure 11 offers a visualization of our decision process.

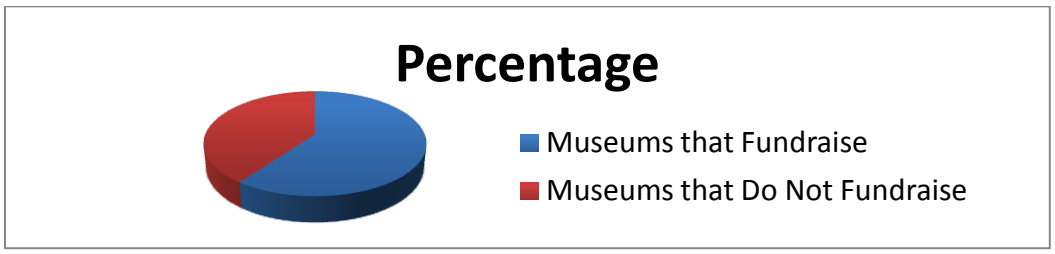
Figure 11: Equipment and Experiment Decision Process



5.2 Fundraising in Swiss Museums

In 2009, 244 museums in Switzerland took part in a study that analyzed how they allocated their funds. In order to construct an exhibition, the ZHAW will need funding; we will use this study, along with similar ones, in order to gain perspective on how to find support funds for an exhibition. Figure 12 illustrates that forty percent of museums surveyed in Europe had some form of fundraising system, which supported their exhibitions and exploits (Betzler 2011).

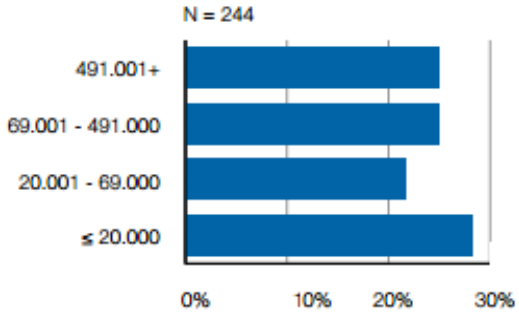
Figure 12: Museums that Fundraise



The sample of 244 museums involved in a study conducted by the ZHAW included museums of all sizes and a wide variety of categories. The regional/local museums and art museums were the two most

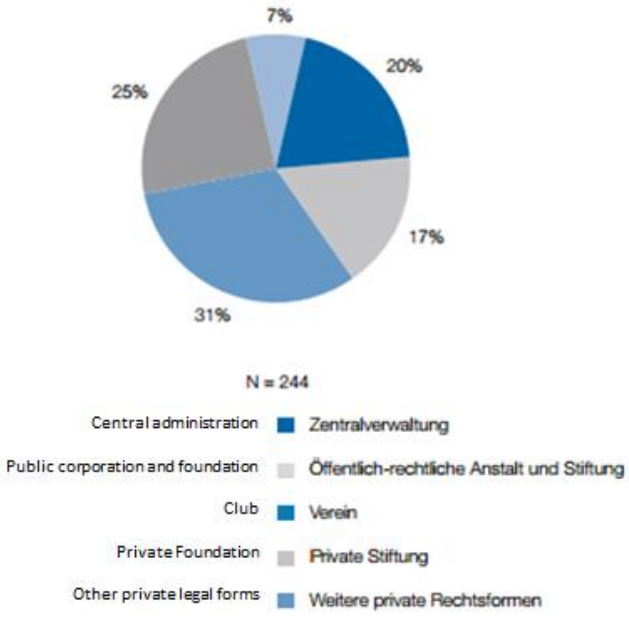
popular categories, comprising 36 percent of the total museums studied. Other categories included ethnic museums (from outside of European Culture), technical museums, natural science museums, thematic museums, and archaeological museums. The average expenses for all of these museums in 2009 are given in Figure 13. These funds did not originate from any single source; each museum had several means of raising the money to support its exploits as can be seen in Figure 14 (Betzler 2011). It is very surprising that the museums themselves (called central administration in the figure) account for only 20 percent of museum revenue.

Figure 13: Museum Revenue (CHF)



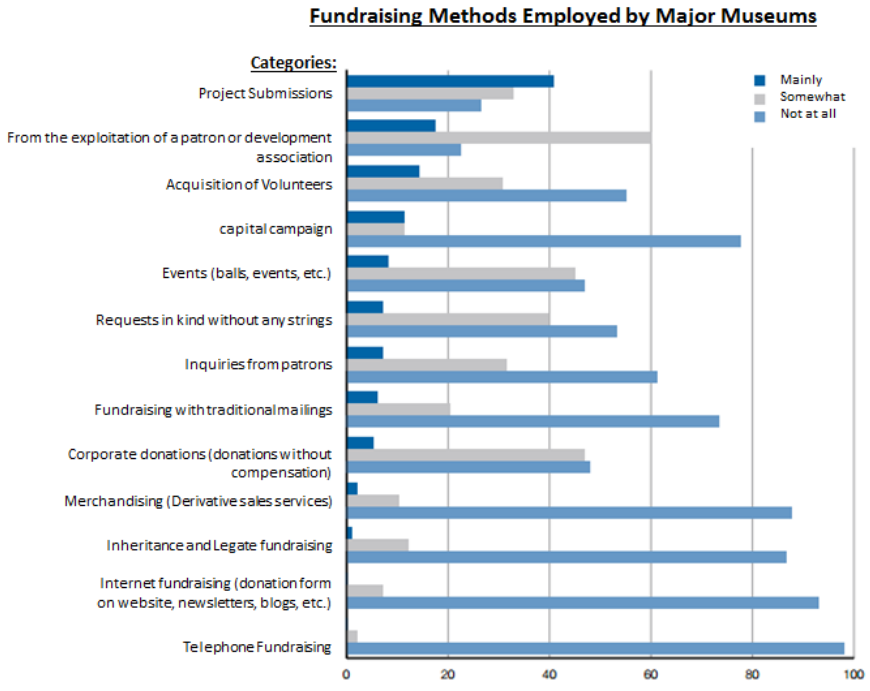
The vertical axis displays the amount of revenue in Swiss Francs, and the horizontal axis displays the percent of that revenue gained through fundraising.

Figure 14: Museum Revenue Origin



Reports on fundraising reveal that the revenue from fundraising and its efficiency are low compared to larger donations from non-profit organizations. There are few major museums with professional fundraising structures. The level of professionalism is considerably low in fundraising because main donors are the lottery funds that are members of the Association and the grant making foundations. Museums typically agree that the subsidies from the federal government, cantons, and communities must be preserved. According to surveyed museums, professional fundraising usually lacks resources but has increased. The most successful forms of fundraising were project submissions, utilization of development associations, and acquisition of volunteers. Ordinarily museums or associations establishing exhibitions employ multiple fundraising methods at once, ensuring greater support. Figure 15 illustrates possible funding methods used by major museums.

Figure 15: Fundraising Methods Employed by Major Museums



There are three main populations in fundraising: the public, the museum, and professional/private third parties. The public is defined as those who would attend the museum but are not directly tied to big

investors of the museum (i.e. private companies or professional investors). Surprisingly, private third parties were the strongest supporters of the idea to fundraise a museum, whereas the actual museum heads were strongly against the idea. The public eye was split very evenly on the subject. However, there are major fundraising risks that lead to increased loss of revenue. For example, telephone fundraising is not an effective means of fundraising. Similarly, internet fundraising or newsletters do not have much effect on revenue because of the costs to distribute newsletters and advertise.

The 244 Swiss museums analyzed in the study conducted by the ZHAW revealed that their fundraising income increased from 2003 to 2009 (Betzler 2011). To our best knowledge, the ZHAW exhibitions will be sponsored by the Chemistry Institute of the university in combination with potential corporate sponsors. Dr. Ecker has set aside 10,000 CHF for implementing our project's suggestions; however, he says this value is easily changeable. Comparatively, the 12 glass display case collection at the ETH cost approximately 60,000 CHF. If this proves to be the case at the ZHAW, fundraising becomes crucial.

The ZHAW is small compared to the 244 museums in the study; small in terms of exhibition space and small in terms to the awareness of the collection. Our biggest fear is that the ZHAW is not widely recognized and that it would not have many visitors for its exhibition. Conversely, if the exhibition is done correctly, it will attract more people to the university. Thus it is imperative to ensure stable and long term funding for the ZHAW exhibition, safeguarding the exhibition and further enhancement.

The methods to raise revenue for museums in Switzerland are project submissions, exploitation of a developing association, volunteers, capital campaign, events, and more. Since our IQP is setting the exhibition process in motion, we advise further projects to continue this trend of volunteers. That way, the exhibition will continually expand with volunteers and developing associations. In order to gain public recognition, holding events is highly recommended. Our final project presentation serves to draw people to the collection, especially those who would otherwise be unaware of its existence. Similarly,

the ZHAW could hold a formal dinner or ball to unveil the exhibition to corporate sponsors, perspective students, and the public.

While approximately 20 percent of Swiss museum capital is earned through charging admission for exhibitions, this is actually less than that earned through merchandising. We recommend some minor merchandise like ZHAW key chains, magnets, or T-shirts to bring in revenue. Until an exhibition consisting of several displays and interactive sections is built, it is not advised to charge visitors to see display cases. We do advise placing a donations box in or near the exhibition. Though this won't bring in too much revenue, an advertisement for a new exhibit could be place above the box with a chart that says "Once a certain amount of Swiss Francs are raised a new exhibit will be added". This kind of fundraising gives donors incentive; without incentive, the museum is lucky to get spare pocket change.

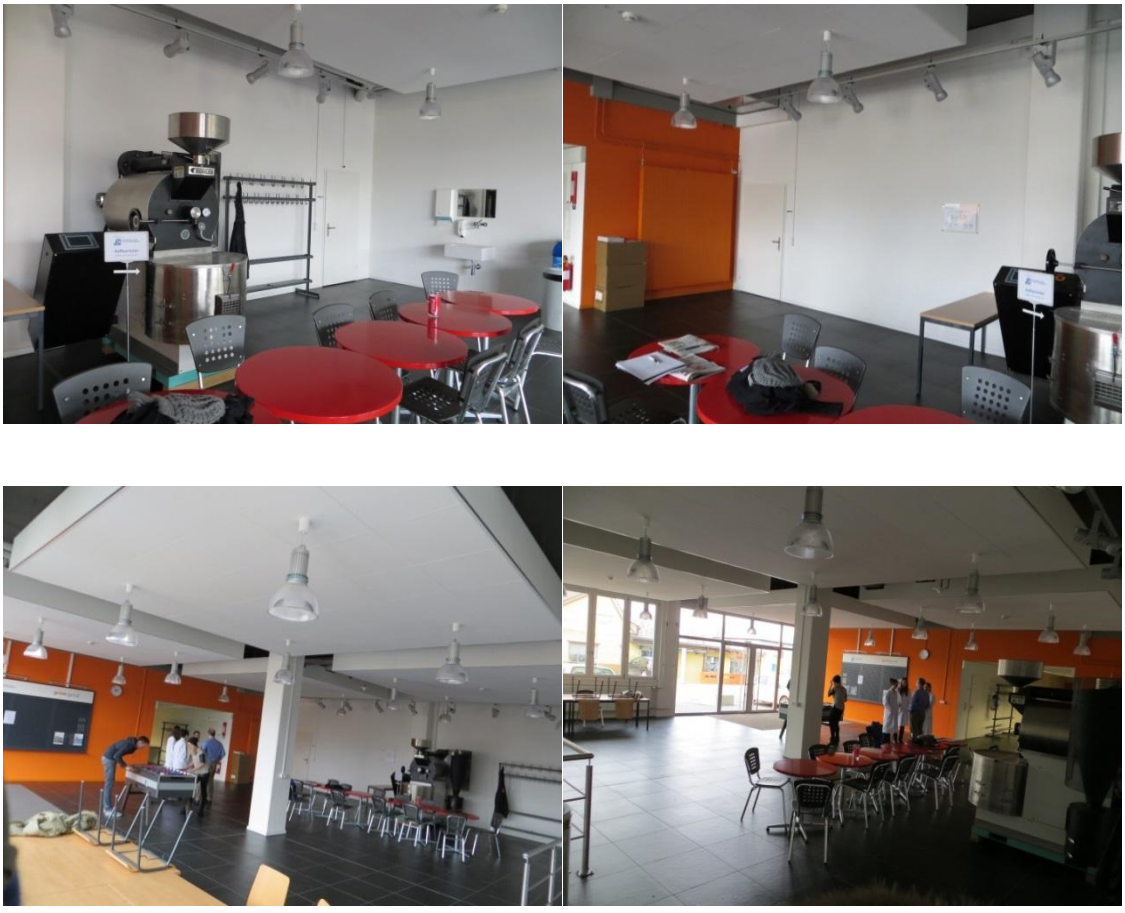
It is important to keep in mind that in 2009, only 40 percent of Swiss museums had fundraising plans implemented. The lack of emphasis is due to the successful sponsorship of private foundations and clubs. Examples of each include: Pfizer will help fund chemical/pharmaceutical exhibitions for advertisement and Christian organizations (or other clubs) donate to religious ceremonies/exhibitions. The two sponsorships consist of 56 percent of Swiss museum capital. We strongly advise the ZHAW officials overseeing the exhibition's progress to secure private foundations. It may be difficult to find a club organization directly related to our project. By adding interactive exhibitions, we hope to draw younger crowds as well as children foundation/club sponsorship. The hiking exhibition could also connect to a club organization for outdoor excursions.

6. Conclusion and Recommendations

6.1 Design Recommendations

Based on the advantages and disadvantages given for each broad conveyance possibility in the previous section, we have narrowed down our recommendations of conveyance methods. Based on the analysis of the items, we worked to create an interest in the natural sciences by conserving and conveying the collection of samples and experiments. This is possible in several phases, which will add layers to the display and build on the exhibition. A possible and most probable venue for the exhibition is in a foyer at the ZHAW where there is ample unused space and blank white walls as shown in Figure 16 below.

Figure 16: ZHAW Display Space



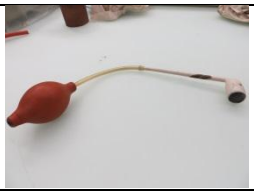
6.1.1 Interactive Bookshelf Exhibition

The experiments were kept in the corner of a chemistry laboratory in boxes and were therefore most at risk of being disposed. The improper housing of these items led to breakage, dust accumulation, and degradation. Our team analyzed these items and selected those that had historic value and were in acceptable condition for possible display. We were able to separate the salvageable items into several categories: electrochemistry, metallurgy, glassware, mechanisms, historic, and light. The experiments, however, are not suitable for frequent travel because of their antique and fragile nature. For the same reason, they would not fare well being handled directly by visitors. It was then determined that the best possible way to convey these items was in some form of stationary display.

Traditional glass displays are not ideal. They do not have the holding power of interactive exhibitions and are often times considered uninteresting. Our group was not content on suggesting such an exhibition, which is why we decided to take our display a step further. The display should incorporate lighting queues that would center on a selected experiment chosen by the observer. This approach would add a level of interaction that would associate names to the devices. The digital control pad would have different language options, age ranges, and audio explaining each item separately, based on the users' selection. This would allow for multilingual learning and would make the exhibition accessible to a wider audience. For instance, age is included so that the information given about each item is targeting the audience present. Children would have the story or the item told to them first hand by the item itself, whereas adults and students would receive a more serious/informative response. The digital device would count which options were selected as to survey the audience and which was most popular. This information would be used to inform future designs to target the most prevalent audience.

The experiments that we intend to include in this exhibition are found in Table 2 and are grouped by common categories.

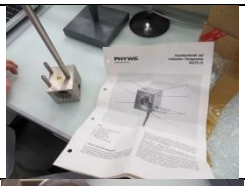
Table 2: Equipment and Experiments Recommended for Use

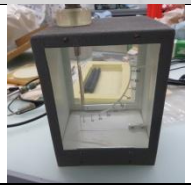
Category	Name	Current Location	Description	Condition	Picture
Bunsen Experiment	Bunsen Burner	Box 5 Box A	The item is used in chemical laboratories to produce an open flame. Item is in need of restoration.	Crusted substance on the item, rusty, corroded, the rubber connector is cracked.	
Bunsen Experiment	Metal Bunsen Burner Stands	Box 51	These stands would hold a beaker, container, or other items above the Bunsen burner	Some rust	
Bunsen Experiment	Tripod holder	Box 5 Box A	Tripod with holder for evaporating dish or crucible (including a Bunsen burner comes)	Some rust	
Wall	Poster	Box 66	Black and white laboratory photo	Some dents	
Wall	Presentation	Box 66	On a black board is a collection of samples of different metals and elements	Slight wear	
Aromacology	Fume/ fogger	Box 51	Glass and metal drum with a three legged stand. For analyzing various gases/fumes	Slight wear	
Aromacology	Pipe	Box 7 Box B	Pipe with a pump bulb attached	The pump bulb is cracking	

Aromacology	Cigars	Box 7 Box B	Cigars in 4 cigar boxes	Old	
Balance	Balance 1	Box 4	Mettler Brand device. Green bottom with an off white top. Scale with capacity of 180g. Place for substance in sliding plastic door.	Shiny	
Balance	Balance 2	Box 4	Overhead display Mettler GM 53, instructions included	Like new, in a box, with instructions	
Balance	Balance 3	Box 4	Leybold-Heraeus balance, black, with instructions	Good condition	
Metallurgy	Hammer	Loose Box A	Hammer like object (mallet/chisel), iron head, wooden handle	Stable and rusty head, dull, wood in good shape	
Metallurgy	Anvil	Loose	A heavy metal anvil	A bit dirty and corroded	
Metallurgy	Mixture F303+Al-powder	Box 14 Box 66	Cans of iron chips for fusing (5 sealed cans)	Slightly worn	
Metallurgy	Mixture F303+Al-powder	Box 14 Box 66	Can of iron chips for fusing (opened)	Mostly used	

Metallurgy	Masses and holder	Box 52 Box A	Pronged stick/holder with Al, Fe, Cu, Hb	Slight wear	
Metallurgy	Masses	Box 52 Box A	Various metallic cylinders, “SN 118”, “PB 207”, “Cu 63.57”, “Al 27”	Slight wear	
Metallurgy	Gold Foil	Box 5 Box B	Ribbon/reel of gold plating	Falling apart and flaking	
Metallurgy	Metal plates	Box 66	Assorted metal plates in a small box and a large box	Slightly worn	
Metallurgy	Gold-substitute	Box 7 Box B	Glass jar with heavily rusted lid and gold leafs labeled “Unechtes Blattgold”	Jar is dirty and the top is rusted	
Metallurgy	Metal-plates	Box 14 Box 66	Two differently weighted metals, one is shiny and the other not	Dirty	
Metallurgy	Galvanikbleche?	Box 59 Box B	4 golden plates	Slightly dirty/burnt	
Metallurgy	Metal Plates	Box 59 Box A	Silver metallic tabs in a hard plastic container	Excellent condition	
Metallurgy	Mini Iron Smelter	Loose	Dark green metal with a square wooden base.	Old and dusty	

Metallurgy	Tongs	Box 3 Box A	Long black tongs	Very rusty	
Historic	Letters, box and vials	Box 51	Small box labeled Ra-Praeparate: three small test tubes corked tops, small electrodes in the test tubes with a pin and a cork. Two letters: one in German dated 1937 and on in French 1939 (Deyrolle)	Good Condition	
Cathodes	Cathode Ray Tubes	Gray Bin Box B	One taller gray base and one smaller black base	Good	
Neon	Neon Sign	Box 33 Loose	CHO neon sign, Ne, Ne+Hg, Ne+Rd	Dusty	
Neon	Bulbs and lighter	Box 33 Box B	Light bulbs and a stand for them to be plugged in: Ar, Ne, Kr, He, Xe, Na; Black stand 6 bulbs	Good condition	
Power	Generator	Loose	Brand name “Gloor Oerlikon” “no. 24266 type []” “250 BA” “ 220-9000V” “50~” “0,028a” “leerlauf 9 watt A vide” “Technikum Winterthur C12 65”. Standard Swiss outlet plug, handles, red light bulb. Big wooden base with a dark green and black box on opposite sides. The black box has a crank “800V and 9000V” painted in yellow next to the crank. White knobs in between the	Plug prongs are corroded, dusty	  

			boxes.		
Power	Car Battery	Box 66	Car battery and manual “Electrona”	Old and corroded	
Power	Adjustable Resistors	On cart Box A	adjustable resistors [1.4A 230 ohms, 2A 115 ohms, 2.8A 61 ohms, 3.4A 40 ohms, 3.4A 40 ohms, 5.5A 15.5ohms, 2A 115 ohms, 3.4A 16 ohms, 4.8A 40 ohms, 6.5A 20 ohms, 6.5A 31 ohms] 11	Various conditions from new and shiny to slightly rusted	
Power	Druckkammer CO2 Verfluessigung	Gray bin Box B	Mini reactor with liquid inside and instructions	Like new	
Sound/ Electrostatic experiments	Speaker-Electrostatic Experiments	Box 5 Box A	“Lautspreches” box containing an old fashion speaker from England, “Celestion Type B25MO Spec 2486” speaker with metal ring	Good condition	
Glassware	Bulb Flask	Box 5 Box B	Round glass flask with rubber stopper and cork stand.	Slightly smudged	
Glassware	Absorber	Box 3 Box B	Apparatus with rocks and different compartments	Good condition	
Glassware	Distillation	Box 59 Box B	Wooden stand, with intricate glass tubing which connects three bulbs	Contagion in bulb sections, wood is dirty	

Electrolchem	Electrostatic experiment	Box 3 Box B	Glass container with corked top containing metal cage and two glass L-shaped tubes and two nozzles	Clean	
Electrochem	Reactor for electrolysis reaction with cooler	Box 18 Box B	Metal Clamp holding a three bulb and a heating/cooling tube	Dirty	
Electrochem	Water Electrolysis	Box 59 Box B	Small glass cylinder with a cork top, contains suspended bottle with glass tube coming out the top. Two metal plates are inside, electrodes on top	dirty	
Electrochem	Pyrolyseapperat	Box 59 Box B	Glass bulb with three necks, one with a stopper with positive and negative plug-ins, connected to a metal coil within the bulb	Little dirty	
Electrochem	Cork holders	Box 51	Cork holders, 2 for above Pyrolyseapperat	One is burnt, the other is new	
Electro magnetism	Stromwaage (oerstedt)	Gray Bin Box B	Gray box that detects magnetism	Good	

These items were selected based upon several criteria. We first analyzed the condition of the experiment to see if it was broken, rusty, or deteriorate and if it was reparable. The experiments which were unfixable were disposed of or were considered for art sculpture ideas. When things were in usable condition, we integrated them into the chemistry laboratory. When we encountered items that were not for modern laboratories but were interesting, we set them aside. The items that were part of this

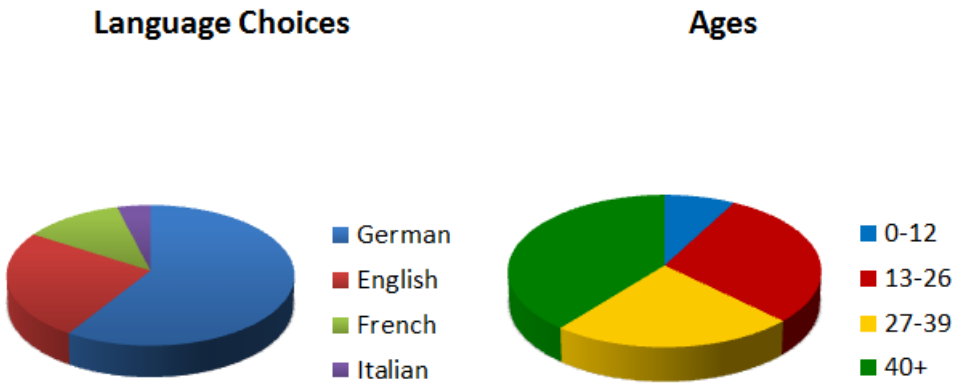
grouping were analyzed further for their historical value and sorted by common themes in combination with other experiments. The artifacts that progressed to this point were included in our suggestions for possible exhibitions, while the others were placed back in their respected storage areas.

The overarching idea for this exhibition is to turn the experiments into an interactive display case. The ultimate goal is to have an interactive screen that allows the viewer to select language, age, and what items they wish to learn about specifically. In response to the viewer's commands, the individual experiments would be lit up and the display would give written information on screen along with audio (both in the language selected). We asked the age and other demographic information of the viewer so that the information given could be directed at the present audience. Children would receive a friendly response with less information, pictures rather than words, and the information would be given from the first person perspective of the experiments. Adolescents would receive slightly more serious response, and adults would receive more information and historical context.

To better describe the mechanics of this exhibition we will use the Bunsen burner theme as an example. For visitors under the age of 12, the display will show an animated Bunsen burner and the stands that would describe themselves in first person. The burner could say something similar to: "Back in my day I was really hot stuff. Some people thought I was just a flame, but I was so much more than that. People just needed to see past that. I helped scientists in their lab conduct experiments…." The children's version would have more humor and friendlier discussion whereas the adult version would contain information about when the burner was created, what specifically it was used for, and the mechanics of how to adjust the size and temperature of the flame. Our goal is to ensure the presented information differs across the age groups so that viewers would have the opportunity to acquire new knowledge from each selection. In order to assess the visitor population, the display would be programmed to record which selections were made. For example, there would be a poll on what languages were

selected, what ages were most prevalent and which artifacts were most popular. Figure 17 offers an estimate on the ages and language preferences of the ZHAW visitors.

Figure 17: Language Preference and Age of Potential Visitors



Before this exhibition suggestion is implemented, certain experiments should be restored and most require some form of cleaning. The actual cleaning and restoration is at the ZHAW's discretion; however, we have written such a section on restoration and cleaning techniques for their reference. An approximate cost of this exhibition is best summarized in Table 3.

Table 3: Interactive Bookshelf Exhibition Approximate Cost (See Appendix D-5 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	200 USD	600 USD
Shelving/casing	800 USD	6,500 USD
Lighting	25 USD	300 USD
Interactive Display (touch screen)	1,600 USD	3,800 USD
Voice actors/translators	0 USD	2,000 USD
Maintenance	50 USD	200 USD
Aesthetics	40 USD	200 USD
Labor	0 USD	3,450 USD
Total:	**2,715 USD**	**17,050 USD**

The greatest attribute of this exhibition is that it is adaptable for the present audience. Additionally, it provides data from the audience to improve the design of the display. This design would attract more viewers, gain greater interest, and have the largest impact across age and language categories. We feel

that the High Cost Approximation is not necessary and the project could be completed for less than this estimate. If all of the luxuries in the High Cost are preferred, we recommend finding a sponsor to fund the display.

6.1.2 Rocks and Fossils Map

In the case of the rock and fossil samples, we do not recommend donating them because they lack outright historical significance for another host. We contacted multiple museums and collectors in Switzerland, and none of them were interested in acquiring the ZHAW rock and fossil collection. Because the samples have neither dates of origin nor collection associated with them, and most lack locations of origin, they have very little historical significance. Our experts indicated that this would make it difficult to find an organization that would want the collection.

Additionally, we do not recommend either the disposal or continued storage of the collection. Although little is known about the samples' origins, they can still be used to convey geological information and garner interest in petrology. We also do not recommend the use of the samples in an interactive way, as constant touching would quicken the degradation of the collection and increases the risk of breaking the fossils. This eliminates the possibility of using the "Suitcase Exhibit" or the "Interactive Museum Exhibit" conveyance methods. We do not recommend the use of a mobile display because purchasing a vehicle is expensive, and securing display cases within the vehicle would be difficult.

With the limitations of the collection in mind, we recommend the implementation of a display exhibit at the ZHAW. We feel the best use of the collection would be to display the rocks and fossils that have a location associated with them on a map. This would educate audiences on the different types of rocks found in different regions and how they were formed. Used in this way, the fossils could provide historical insight for the audience on how these regions once were. The samples we recommend for inclusion on the map are found in Table 4.

Table 4: Rock and Fossil Samples for Inclusion in Map

Amphiolit (Gotthard)	Ampholit mit Granat (Gotthard)	Amphybolit (Schweden)	Baryt (Eifel)
Basalt (V. Vesuv)	Bimsstein (Vesuv)	Brauneisenstein (Rauvis)	Brauneisenstein (Spanien)
Brauneisenstein (Staffel)	Chloritschiefer (Gotthard)	Chrom (Themitverfahren)	Cölestin mit Schwefel (Sizilien)
Eisenglanz (Elba)	Eisenglimmer (Bergün)	Feuerstein (Silex)	Flusspat (Säntis)
Gabbro (Bayern)	Gabbro (Marmels)	Gabbro (Schlesien)	Gips Marienglas (Bex)
Glimmerschiefer (Gotthard)	Gneis (Gotthard)	Gneis (Maggiatal)	Gneiss (Tessin)
Gneisgranit (Gotthard)	Gold (Siebenbürgen)	Granit (Calanda)	Granit (Gotthard)
Graphit (Ceylon)	Graphit (Innertkirchen)	Hämatit (Blutstein)	Hämatit (St.Croix)
Hämatit (Stavffel)	Hornstein roter (Eisenkiesel)	Kalait (Türkis)	Keieselschiefer (Probierstein)
Kieselkalk (Seeliesberg)	Klapperstein (Tramelan)	Kobaltblüte auf Ferrit (Marokko)	Kobaltblüte (Marokko)
Kochsalz (Marokko)	Kreide weisse (Rügen)	Kupferkies (Rammelsberg)	Magnetit (Tirol)
Marmor (Wallis)	Marmor blauer (Belgien)	Marmor grüner (Genova)	Marmor l. Qualität (Carrara)
Marmor schwarzer (Ragaz)	Marmor weisser (Piastaccio)	Nagelfluh (Hörnli)	Nagelfluh (Rigi)
Porphyr (Rehinpreussen)	Pyrit in Bündnerschiefer (Chur)	Quarzporphyr (Schwarzwald)	Rote Minette (Luxemburg)
Roteisenstein (Gonzen)	Sandstein (Schweden)	Schmirgel (Naxos)	Schwefel (Girgenti)
Schwefel (Sizilien)	Steinsalz (Bex)	Titaneisen (Norwegen)	Torf (Hausersee)
Türkis (Persien)	Wolframit (Erzgebirge)		

We recommend using a map of Europe, as most of the samples that have locations associated with them are in Europe. Very few are from outside Europe, and it would be more beneficial to have a larger map of Europe and exclude the others than to scale it down to fit in only a few more samples. The map should not be the size of the display shelf; a space should be left around the map so that descriptions of the samples can be placed there without obstructing the view of the map.

We recommend the use of a counter-height class display case, that way the map and samples can be easily viewed from both above and the side. A table display case measuring 920mm high by 1000mm wide by 600mm deep from DisplaySenseEurope costs about $1,200. This is quite a reasonable price, especially considering that the ETH paid approximately $5,500 for each of their upright display cases. Additionally, the aluminum frame would match well with the décor of the space in the ZHAW foyer. However, a single display case may not attract enough attention on its own, so we recommend it be displayed in the space with another exhibition.

As for the rocks that do not have a location associated with them, we recommend they remain in storage for use for future IQP's. However, we recommend that they be stored in a different manner. Currently, the samples may be exposed to extreme temperatures and moisture. While this may not seem important, as these samples are rocks and would normally be exposed to harsh conditions, some of the crystalline samples have already degraded, so this clearly is an issue. The samples should be cleaned and stored in a sealable unit. It would also be beneficial to reorganize the drawers/sorting system during this transfer. It is clear that at some point, similar samples were stored in the same drawer together, but over time this system dissipated. It would be useful to reorganize the drawer groupings to make the samples easier to find.

6.1.3 Sandbox Exhibition

Another display option for the rocks and fossils is a "Sandbox Exhibition". In this exhibit, the samples would be buried in sand in a large, shallow, open topped box. Here, visitors could dig through the sand with shovels or brushes to find the samples. Once the visitor found a sample, they could identify it on a nearby chart and learn about the sample.

In this exhibition, we recommend the use of any of the fossils; they can even be interchanged for variety. A wooden or plastic box, with dimensions of approximately 1m by 1m by 0.3m, but filled to a height of about 0.15m with sand, would be ideal to engage younger visitors. Individual informational cards with an image and description of each sample should be placed around the box. In doing so, multiple levels of engagement and learning are available, and it facilitates old and young audiences to work and learn together. However, it would be a good idea to keep a staff member in the room with the exhibit at all times, to ensure that none of the samples are stolen.

This exhibit would be relatively inexpensive compared to exhibits that require glass cases. A small sandbox can be purchased for $75, and sand to fill it would cost $50. However, a wooden box might

easily be constructed by hand for less expense but would require more labor and effort. The informational cards could be printed and laminated for low cost as well. The only high expense here would be to pay the staff member to make sure the samples are not stolen. Based on the anticipated age of normal visitors to the ZHAW, they would most likely not appreciate this exhibit to its fullest potential, so a new location would need to be found, potentially at a nearby school or interactive museum. Table 5 provides cost approximations for this exhibition.

Table 5: Sandbox Display Approximate Cost (See Appendix D-1 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	0 USD	290 USD
Table/stand	20 USD	200 USD
Lighting	0 USD	215 USD
Sandbox	50 USD	125 USD
Aesthetics (map, cards, etc.)	20 USD	60 USD
Labor	0 USD	350 USD
Total:	**90 USD**	**1,240 USD**

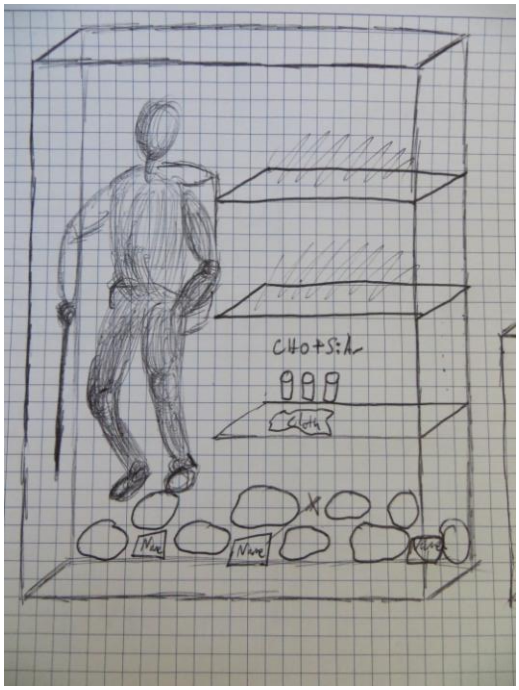
6.1.4 Showcasing Hiking

After careful analysis, our group deemed that the rock samples could provide a significant layer of information to another collection. We researched multiple natural history museums in Switzerland, the United States, and Germany, all of which had sections with rock samples. The main difference between our samples and theirs was that most of the rocks on display had information about their location and date of discovery as well as their age (estimated formation). The ZHAW collection lacks most of this information. A select few have information regarding their location of discovery, but no other information is available. Even after emailing the previous proprietor of the samples, Felix Eppensteiner, he confirmed that all of the rock samples had names associated with them and that not much else was known. This is why our group decided that the best course of action was to pair the rocks together with the vials. In doing so the two different items would aid each other significantly in show and information.

Using the rocks and the vials, a museum exhibition showcasing hiking could be produced. This exhibition would be simple, concrete and is meant for low interaction with its viewers. This style encompasses object displays, display casing, and has very limited hands on sections. The information being conveyed will be simple enough for people to understand no matter their background knowledge. The exhibition would be in a glass display case and would include the vials, rocks, some hiking gear and a map. The rocks would be at the base of the display with a world map behind them showing where each originated from. We would select the rocks with this information available to us. We would also research which rocks are commonly found in hiking areas, but do not have a labeled location and include them in the display. For the rocks that are aesthetically pleasing, we would put the chemical vials beside them so that the viewers can see what minerals make up each rock/crystal/fossil. There would be rough percentage information and the two would go hand in hand.

In the same display above the rocks there would be a mannequin dressed like a hiker, complete with boots, hiking pole, Gortex jacket, backpack, and other gear (See Figure 18). Each piece of the hiker's equipment would be broken down into its most basic elements; that is, the chemicals associated with each would be put nearby. The chemical compound/chemical equation would also be given. This would tell the viewers about products they encounter daily and the chemical composition of each. The display could discuss how waterproofing sprays works on boots and clothing. The vials would then be placed accordingly to show the chemical components of the hiker's equipment and the rocks, especially some of the crystal-like rocks that are more aesthetically pleasing. The information being conveyed to viewers includes the location of where various rock samples can be found, the chemical composition of the rocks, as well as other information about them (i.e. age since formation, practical uses). Other information includes the chemical composition of the hiker's equipment.

Figure 18: Sketch of Hiking Exhibition



The cost of this display would have to cover the display casing, the lighting in the display, the mannequins and the hiking equipment. This type of exhibition does not require supervision or maintenance; so long as the glass is kept clean. The costs would come from the cases, the lighting, and the mannequin (their equipment). A decent display case would cost $650 - $6,000, but most are between $1,000-2,000. A plastic Mannequin with wig can be purchased for $129.00. Potentially, a company could donate the hiking gear as a form of sponsorship for the exhibit and advertising for the company. Otherwise we would have to purchase the clothing/equipment for the Mannequins. For a total cost estimate, see Table 6.

Table 6: Hiking Exhibition Approximate Cost (See Appendix D-2 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	0 USD	80 USD
Shelving/casing	450 USD	1,000 USD
Lighting	25 USD	100 USD
Mannequin	280 USD	360 USD
Hiking gear	600 USD	1,500 USD
Sandbox	90 USD	1,240 USD
Aesthetics (map, cards, etc.)	20 USD	60 USD
Labor	0 USD	560 USD
Total:	**1,465 USD**	**4,900 USD**

This exhibition can be easily placed in numerous locations. It could be located anywhere from the bottom of a trail in a cabin for visitors to a museum in one of Switzerland's cities. In regional areas farther from the bigger cities, it would draw in the crowds of people who enjoy hiking. The hiking theme is one that is easily relatable for most people in Switzerland and the country's tourists.

6.1.5 Children's Chemistry Exhibition

Our analysis of the vials led us to the conclusion that they were not stable enough to travel regularly (glass vials could be dropped or cracked), should not be handled by people who have not had chemical training (some of the elements are toxic and react dangerously with other elements), and were unusable in their current state (the chemicals have been contaminated by environmental elements such as moisture). Moreover, the best use for the vials is in a display form.

One option is to arrange the vials to form a periodic table. There would be a glass wall display that viewers could walk around with different shelves or compartment for each element. That way the letter associated with each periodic element could be placed on the glass behind the vial and the vials themselves would be used in a display. For all of the vials that are not in the periodic table, which includes compounds, mixtures, etc., they could be arranged in some form of logical increments such as an ion chart. This would deliver a visual representation of each element and compound to viewers.

Such an exhibition would be informative, but not at all engaging. This is why we recommend an interactive exhibition.

There is a way to make this exhibition highly interactive and keep the ideas and concepts concrete and simple. In order to make the exhibition friendly to younger audiences we would have a molecule building table in the middle of the room. This would consist of different length rods and different size/color spheres. These would represent the different types of bonds and elements that form molecules and compounds. We would put familiar molecule pictures up on the wall for the viewers to try and make using the molecules on the table. This would make for a great interactive organic chemistry lesson or a great review of organic chemistry and the various formations of molecules. Molecule models and other related objects could be hung from the ceiling to make the most of a space with a high ceiling. The displays would give viewers a new perspective on what the elements look like. The ionization chart with the elements would be both informative and deliver a visual representation to the visitors.

The costs for this exhibition would be for the materials in the display. For example, the display case would be most expensive. The other items would be less expensive, but the molecule model set would be less expensive, as would the molecules that would hang from the ceiling. The pricing would vary greatly depending on the display case (See Table 7).

Table 7: Children's Chemistry Exhibition Approximate Cost (See Appendix D-3 for Cost References)

Item:	Low Cost:	High Cost:
New Chemical Samples	0 USD	2,000 USD
Shelving/casing	100 USD	500 USD
Lighting	35 USD	250 USD
Molecule sets	50 USD	240 USD
Aesthetics (map, cards, etc.)	20 USD	60 USD
Labor	0 USD	450 USD
Total:	**205 USD**	**3,500 USD**

Finding a place for this exhibition would be difficult because there needs to be a place that is open enough to hang molecules from the ceiling and have a big display case as well as a table with the molecule sets. A person to monitor the area would also be advised if there were younger audiences or a lot of people. Therefore, this exhibition would most likely work best in a larger museum or a museum with interactive exhibitions.

6.1.6 Interactive Chemistry Website

We believe that the chemical vials would be most successfully displayed on a webpage. That way there could be a webpage with the indexing spreadsheet that lists each compound's information and data. Videos could also be created to show different laboratory procedures as well as what happens when various compounds are mixed together. Games on the website could allow for the viewer to choose which compounds they wanted to mix and the website would show the reaction and the corresponding chemical equation for the reaction. Again, this would not involve the vials directly and would instead use only their information and things relating to them. A website would be interactive, have a greater audience, easily available any time, easily translated, and cost little money to maintain. A cost approximation for the interactive chemistry website is outlined in Table 8.

Table 8: Interactive Chemistry Website Approximate Cost (See Appendix D-4 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	0 USD	80 USD
Photography	250 USD	800 USD
Website Creation	8,500 USD	15,500 USD
Labor	0 USD	560 USD
Total:	**8,750 USD**	**16,940 USD**

6.2 Implementation of the Main Exhibition

We developed a multiple phased plan, outlined in Figure 19, for implementation of the bookshelf, hiking, children's chemistry, and other suggested exhibitions to keep the construction manageable for the ZHAW. Through our evaluations of the feasibility of construction, the jeopardy and condition of the items, the historical value, the potential interaction level, and the intended audience, we decided a four-phase plan would be best. It is highly recommended that these exhibitions are constructed in phases to prevent an overwhelming project. If the space provided for exhibition is not large enough to support all of these ideas at once, the pieces that would not otherwise fit can easily be removed or used in rotation. This serves as a rudimentary guide or outline that does not need strict adherence. Figure 20 provides a visualization of the exhibition after the completion of all phases.

Figure 19: Multi-Phase Plan

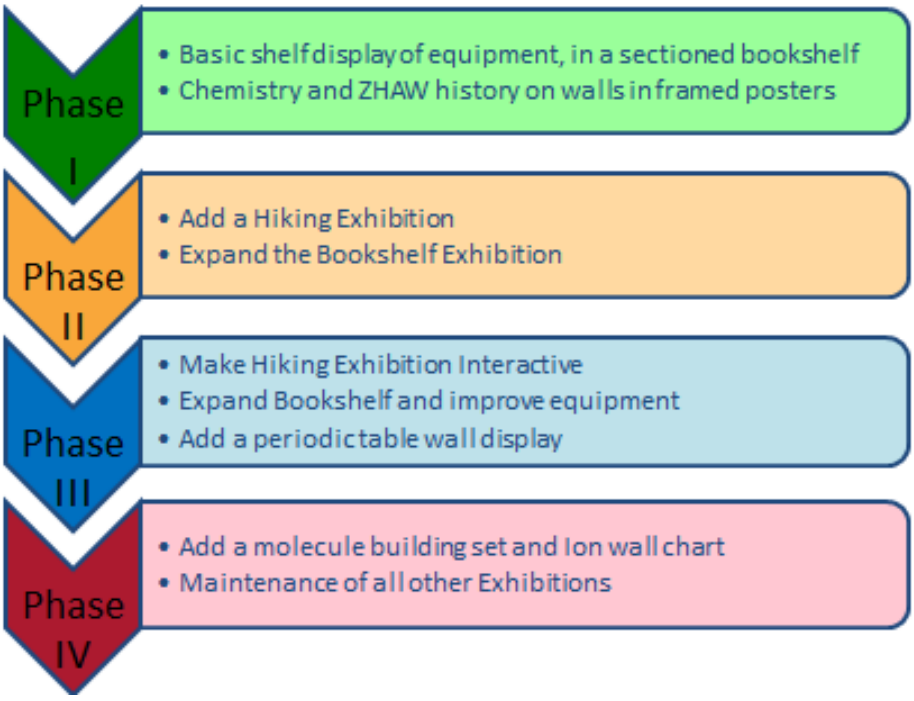


Figure 20: Sketch of Final Exhibition

6.2.1 Phase I

The purpose of this phase is to establish the basis on which the entire exhibition can build upon. It is most feasible to utilize basic displays and historical context at the onset. Educating the visitors about the acquisition of samples and experiments would be one of our primary focuses. The historical information would focus on two main topics: the Winterthur Technikum and the Wädenswil Facility. A brief summary of these historical facts is found in previous sections of this paper. This information would be placed on the walls of the exhibition room, so not to invade space designated for floor displays. The information would be put into a framed poster that could easily be taken down or moved.

The bookshelf display will start off very simply. The categories recommended for implementation in phase one are: the Bunsen experiments, cathode ray tubes, balances, aromacology experiments, metallurgy, chemical display board, historical letters, and lighting. We chose these items because they were most interesting, were in the best condition, and were easily grouped. Items that could not be displayed in this phase should be kept in storage until more display space becomes available and the

artifacts are properly cleaned. At this time, cards would identify the items in the display. The cards will name the experiments and provide information about their historical significance and uses.

The approximate cost for the implementation of phase one is summarized in Table 9.

Table 9: Exhibition Implementation Phase I Approximate Cost (See Appendix D-6 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	200 USD	600 USD
Shelving/casing	850 USD	6,000 USD
Lighting	25 USD	100 USD
Cards	20 USD	60 USD
Framed Posters	60 USD	120 USD
Aesthetics	20 USD	100 USD
Labor	0 USD	1,400 USD
Total:	**1,175 USD**	**8,380 USD**

6.2.2 Phase II

Phase II expands upon the displays of phase one and adds a new exhibition. The bookshelf exhibition would be enlarged to display more items. It would also gain a digital element, which would increase interactivity. This digital display could also be used to gather information about the audience interaction and enjoyment, so appropriate adjustments can be made. The purpose of this phase is to engage viewers with the existing displays, introduce new material, and increase visitation.

The bookshelf would have a greater collection of experiments and a digital interactive display for viewers. This interactive display would permit visitors to select an exhibited item, which would then be lit and on the display, information would be given about its historical context and uses. The display would allow viewers to select the language (German, English, French, and Italian) in which the information would be given. The result should be a more interactive display that increases holding power of the viewers. The touchpad display should survey which options are most readily selected. This is so that uninterested items can be rotated and the exhibition can be updated according to the gathered feedback.

The greatest change in this phase is the addition of the hiker exhibit display case, which incorporates the vials and the rocks. The hiker exhibit would have a mannequin fully dressed as a hiker, rocks with the maps, and vials describing the chemical composition of both. This part of the exhibition should be interesting and relatable. The approximate cost for the implementation of phase two is summarized in Table 10:

Table 10: Exhibition Implementation Phase II Approximate Cost (See Appendix D-7 for Cost References)

Item:	Low Cost:	High Cost:
Shelving/casing	500 USD	2,000 USD
Lighting	50 USD	250 USD
Mannequins	280 USD	360 USD
Hiking gear	600 USD	1,500 USD
Aesthetics (map, cards, etc.)	40 USD	200 USD
Interactive display (touchpad)	1,000 USD	1,800 USD
Maintenance	0 USD	100 USD
Labor	0 USD	1,000 USD
Total:	**2,470 USD**	**7,210 USD**

6.2.3 Phase III

Phase III updates the bookshelf and hiking exhibits as well as adds a chemistry section to the exhibition. The updates are meant to increase the interactivity of the visitors with the material and make the information readily accessible to a broader audience. Accessibility would be increased with the addition of audio queues for the bookshelf. The audio would deliver the written information for the visitor in the language selected. However, in order to further increase accessibility, we advise separate digital responses for different age groups; thereby, crossing not only languages barriers, but age barriers as well. We would accomplish this by adding an option to the touchpad for age group (see the bookshelf plan above for further details on this exhibit).

To create an interactive component for the hiking exhibit, we would add a sandbox with buried rocks and fossils. Our research has indicated that immersion is the best form of learning. By digging for rocks and identifying the rocks, the individuals partaking will have a greater interest in the exhibition.

Interactivity such as this would increase the length of time visitors spend viewing the exhibition and increase knowledge retention.

The new section of the exhibition would be a periodic table placed on a wall, or in the center of the room with glass cubicles for each element. This would utilize vials, but would also require the acquisition of new chemicals and examples of elements where necessary. The approximate cost for the implementation of phase III is summarized in Table 11.

Table 11: Exhibition Implementation Phase III Approximate Cost (See Appendix D-8 for Cost References)

Item:	Low Cost:	High Cost:
Periodic Table Chemicals	100 USD	2,500 USD
Sandbox	90 USD	1,240 USD
Lighting	100 USD	300 USD
Programming, audio, speakers	600 USD	2,000 USD
Aesthetics	50 USD	200 USD
Maintenance	0 USD	100 USD
Labor	0 USD	1,400 USD
Total:	**940 USD**	**7,740 USD**

6.2.4 Phase IV

The purpose of Phase IV is primarily to maintain and update the current exhibitions. The items in the bookshelf should be rotated according to popularity and the hiking exhibit should be maintained. The chemistry section should now include a new wall or display to include an ionization chart (see chemistry plan above for further details).

To increase interactivity, we suggest a children's play area in the chemistry section. We use the term "children's" lightly. The idea is to have a table in near the periodic table and chemistry charts with information about organic molecules, types or molecule formation, as well as molecular interactions. It would consist of balls and rods that make up the bonds and the molecules. The age range for this section would encompass older age groups, who are studying chemistry as well as younger audiences who want to play. This would lead to interaction across the age differences. The approximate cost for Phase IV is summarized in Table 12.

Table 12: Exhibition Implementation Phase IV Approximate Cost (See Appendix D-9 for Cost References)

Item:	Low Cost:	High Cost:
Maintenance	0 USD	100 USD
Shelving/casing	100 USD	500 USD
Lighting	50 USD	300 USD
Molecule (rod/balls)	50 USD	240 USD
Aesthetics (map, cards, etc.)	20 USD	60 USD
Labor	0 USD	500 USD
Total:	**220 USD**	**1,700 USD**

6.3 Website Implementation

The following is a several phase plan for the implementation of the online portions of this exhibition. It is highly recommended that these exhibitions are added in parts; this prevents an overwhelming project. The website consists of online exhibitions as well as advertising, and can be updated easily at any time. This serves as a rudimentary guide or outline that does not need strict adherence. Since the pricing is similar throughout each phase, we include an approximate cost for the entire project in Table 13.

Table 13: Website Implementation Approximate Cost (See Appendix D-10 for Cost References)

Item:	Low Cost:	High Cost:
Experiment Restoration	0 USD	80 USD
Photography	250 USD	800 USD
Website Creation	2,500 USD	8,500 USD
Labor	0 USD	560 USD
Total:	**2,750 USD**	**9,940 USD**

6.3.1 Phase I

The purpose of this phase is to attract an audience to the physical display at the ZHAW. This should be done by creating a webpage for the exhibition, including pictures and information about the displays. History about the ZHAW and the significance of the collection can also be included, so as to facilitate

interest. Ideally, a large audience will learn about the exhibition and be interested enough to visit the ZHAW.

6.3.2 Phase II

In order to add an interactive component and expand the viewer base, we recommend adding links to learning websites and online experiment simulation. With the expansion of the online exhibition, the physical display also gains further exposure to a greater audience. Adding an interactive component will increase learning potential and stimulate interest in science.

Another option is for the ZHAW to create their own videos of simulated experiments or interactive web-based activities. This is more expensive and time consuming than simply offering links and pictures, but it shows a dedication to subject matter, which may be attractive to prospective visitors.

6.3.3 Phase III

This phase is ongoing; here we recommend the website be updated regularly. It is of the utmost importance to include pictures and information about the updated physical display. This again shows commitment to the exhibition and to the viewers, encouraging online viewers to become physical visitors. Phase III requires the least amount of funding; the webmaster needs only to be paid for their time updating, and little other work is necessary.

6.4 Future Work

Although we utilize a large portion of the ZHAW collection, there are still unused items. For these, we recommend that they remain in storage. They still have some historical and scientific value, and we recommend that future IQP's or other project groups incorporate them into other exhibitions.

Additionally, future IQP's might be able to analyze the feedback from the surveys and develop ways to improve and tailor the exhibitions to the visitors' responses.

6.5 Conclusion

Over the course of this IQP, we defined and refined clear, achievable deadlines and goals in order to complete our objectives. Through the use of timelines, agendas, and minutes, we were able to stay on schedule and accomplish our tasks. In the time of seven weeks, we cataloged, inventoried, and analyzed over 2,000 items, developed ideas to display the most presentable of these items, and created a several phase plan so that the ZHAW can know how to complete the implementation. In order to solve our interdisciplinary problem of garnering public interest in the natural sciences, we conducted interviews and extensive research, both online and in the field. Once we gathered the information, we analyzed it and developed a plan that best fits the needs and goals of our project sponsor. Through ample communication, we maintained effective working relationships within our project team, with our project advisors as well as with our project sponsors. We learned the importance of adapting our design ideas based on varying criteria obtained throughout the process. We cultivated skills in adaption, goal selection, communication, and research. These skills have helped us become more aware of how our decisions affect and are affected by other perspectives separated by time, space, and culture. We became more aware of personal, societal, cultural, and professional ethical standards, and thus improved our ability to work individually as well as in groups. By the end of this process, we identified a more finite vision of our task; to encourage visitation to the ZHAW and to instill an interest in the natural sciences in those visitors.

7. Appendices

Appendix A: Cataloging

Appendix A-1: Equipment/Experiment

Box #	Object Description	Amount	Condition	Picture #
behind cart	poster of "organic laborsynthsesn automatisch mit LabMax", a little yellowed but if we revamped it, it looks like it could be good	1	little yellow and dented	152,153
Blue Bin	A large glass test tube complete with base wrapped in cotton and black wooden stand. Double glass wall, element inside is isolated. "Dewar Device". Square base	1	dusty, cotton is degraded (may need replacing)	8,9
Blue Bin	"Ausgang" and "Eingang" on opposite sides of top face. "Technikum Winterthur C" on a name plate. Gray metal, ground, N, and Ph outlets and a Swiss outlet. On the front face, Ph, N, Ground outlets as well as another plug covered by a leather flap labeled Netz 220 V. Labels on black plastic on top include "CMC" "JL2" "10" "A" "500V ~" "[Gate Max picture]" "F100A"	1	Old, no dust, not broken	10,11,12,13
Blue Bin	Another "Dewar Device" Glass test tube sealed on bottom. Has cork on the top. Black wooded base (round). Cotton between the two.	1	Glass looks new and wood is slightly worn	14,15
Blue Bin	"Leybold Koeln" the base is labeled in marker 10-220 V ~ . 9 screw clamps. Glass tube with small glass beads and a "ping pong ball". Metal coil below and +/- plugs. Metal Stand.	1	Gross, worn and corroded metal	16,17,18,19
Blue Bin	Black Cord with typically European grounded outlet. Volex brand name. The second is a standard Swiss grounded outlet	2	Euro cord is new, the Swiss one is corroded	20,21,23
Box 14	cardboard box	1	good	254
Box 14	broken apparatus with two U-shaped glass tubes and charcoal	1	broken	258
Box 14	glass container with bottom pouring valve and three entry points on top	1	little dirty	259
Box 14	clay pots, two with tops	5	good	260
Box 14	unidentified packages - we think they are meant to be ignited and explode	5	antique	261
Box 14	glass tank with two metal clips and two metal sheets clipped to sides	1 set	glass is dirty and metal is corroded	262
Box 14	short glass beaker with pouring spout and steel wool	1	good	263
Box 14	triangular flame stand pieces	4	3 good, 1 burnt	264
Box 14	metal rod with five metal clamps	1	dirty and rusted	265
Box 14	100 ml glass beaker	1	clean	266
Box 14	metal wire holding a metal plate with hole in center	1	clean	267
Box 14	small metal strips in plastic cup	14 metal strips	clean	268
Box 14	rubber stoppers	2	good	269
Box 14	ceramic ring	1	good	270
Box 14	plastic bottles, one is yellowed	3	used	275-6
Box 14	glass tube with charcoal rocks held in by pieces of cotton, stopper on one end	1	used, old	277
Box 14	ceramic dishes	4	good	278
Box 14	glass saucers, and cups, (all small)	7 items	good	279
Box 14	mortar and pestle, ceramic	1	good	280
Box 14	glass apparatus with four spouts and clip holding pieces together	1 set	good	281
Box 14	rubber tubing with glass tubes, two of which have valves, and all have stoppers	5	glass good, rubber used	282
Box 14	rubber rim lining/sealers	4	good	283
Box 14	glass container with bottom pouring spout and opening at the top	1	good	284
Box 14	test tubes (assorted)	10	good	285
Box 14	J shaped glass piping, and one with valve, all have stoppers	3	good	286
Box 14	green tea cup (civilian)	1	good	287
Box 14	brown glass bottle with Mg "Blitzlicht pulver"	1	used	288
Box 14	metallic cups	4	corroded	289
Box 14	metal strips "Bleine CK Hoden", wrapped in cloth	2	used	290
Box 14	small brown jars of cyclohexane with white plastic top	2	good	292
Box 14	triangular flame stand pieces, ceramic tile and three small magnetic pieces	1	good	293
Box 14	Glass cylinder tube with one open end, thick glass	6	good/clean	294
Box 18	cardboard box	1	good	430
Box 18	one triple necked bulb	2	good	431
Box 18	double necked bulbs, varying sizes	5	good	432
Box 18	assorted glass tubing	3 pieces	good	433
Box 18	glass tubes with valves and substrate condensation tubes	4	good	434
Box 18	tubes with valves (graduated)	2	good	435

Box 18	test tube with side valve spout	2	good	436
Box 18	U-shaped glass tubing with spouts on side of top	2	good	437
Box 18	glass flask with glass cork with top for spout and opening 200 mL	1	good	438
Box 18	glass beakers 400 mL, 250 mL x2	3	good	439
Box 18	short glass beaker	1	dirty/wavy glass	440
Box 18	glass graduated cylinders, 25 ccm	2	dirty	441
Box 18	glass cylinder with pouring spout	1	chipped and cracked	442
Box 18	glass flask with pouring spouts and open tops	2	dirty	443
Box 18	glass flasks with labels and corked tops	3	slightly dirty	444
Box 18	small glass jugs, with tops (glass or plastics)	4	dusty	445
Box 18	glass bulb tube with valve and rubber stopper	2	stopper is cracked and old, glass is clean	446-7
Box 18	bulb flasks with glass tops	2	good	448
Box 18	rubber stoppers with glass L-tubing	2	good	450
Box 18	glass test tube with another test tube inside it with another test tube inside of it and valves on top	1 set	good	451
Box 18	blue glass tile and a red glass tile	2	good	452
Box 18	bulb glass flask	1	good	453
Box 18	large glass funnel, small glass funnel	2	good	454
Box 18	rounded glass piece	1	good	455
Box 18	assorted glass tubing, ceramic pipe included	1 set	good	456
Box 18	glass S-tubes	6	good	457
Box 18	glass tops	6	good	458
Box 18	glass flasks/beakers 25 mL	3	good	459
Box 18	two brown glass jars, 4 clear, with brown plastic tops	6	good	460
Box 18	metal clamp	1	rusty/corroded	461
Box 18	ceramic cup	1	good	462
Box 18	glass rectangular prism	1	slightly chipped	463
Box 18	glass petri dish	1	clean	464
Box 18	assorted glass test tubes	14	clean	465
Box 26	cardboard box	1	good	360
Box 26	Gray metal box with handle. Very heavy with a light bulb on top. Double prong poker connected to positive and negative ground, 2 spare 60 watt bulbs	1set	good	361-2
Box 26	Glass bulbs with valves and a long glass tube connected to a rubber tube.	2	glass is dirty, but good rubber	363
Box 26	rubber stopper with an array of glass tubing	2	dirty	364
Box 26	large glass beakers	2	dusty	365
Box 26	various sized glass cylinders with thick rims and thick base	3	dirty	366
Box 26	glass jugs, one has blue glass and the other is clear, thick rim	2	dusty	367
Box 26	Glass boxes with open top no cover. The glass is wavy, i.e. older glass	4	dirty	368
Box 3	Cardboard box	1	slightly word but good	M255
Box 3	Metal stand silver	1	good, old	M256
Box 3	big petri dish, glass, 45 cm wide	1	good	M257
Box 3	expandable ruler, broken on one end	1	worn, broken on one end	M259
Box 3	bent glass tubes	2	new	M261-M262
Box 3	a manometer, "Luwa", silver	1	good	M264
Box 3	Two big glass thermometers	2	good condition	M266-M267
Box 3	four large test tubes with cylindrical bulb on bottom and thin hollow "hook" tube from top, side; one broken, one small, two large (one with stopper)	4	one broken, rest dirty	M269
Box 3	Cotton covered Isolation tank, two nozzle with one corked glass end and one rubber end with glass tubing	1	old	M270-M271
Box 3	Different weighted metal balls, wooden base with a metal slide and two plastic catching places.	1	dusty but good	M273-M274
Box 3	large metal test tube with 4 control valves and blue knobs	1	Crystallized substance near bottom	M275
Box 3	glass collection contraption, glass bulb, rubber hose with a measuring tube	1	dirty with cloudy glass	M277
Box 3	Large glass test tube with inner tube and outer tube and exit spouts on both.	1	dirty	M278
Box 3	narrow glass tube, 80 cm	1	clean	M279
Box 3	"Od-Benzolpipette" corked on both sides with smaller glass tubes going through the corks	1	old/dirty	M280-M281
Box 3	tubing, rubber, with glass end and burnt cork	1	burnt cork	M282
Box 3	cork base/flask holder	1	good	M283
Box 3	black paper	1	good	M284
Box 3	Glass flasks labeled "Kaliumferrocyanid" yellowed bottom and rubber stopper. Ammoniumrhodanid labeled (glass stopper)	2	used	M285-M287
Box 3	glass flasks with 2x 25 mL, 1x 100 mL, 200mL and 250 mL	5	new	M260
Box 3	graduated test tubes	5	slightly cloudy	M263
Box 3	two big glass test tube with bulbous bottom, 70 cm in length	2	good condition	M268

Box 32	cardboard box	1	good	M305
Box 32	two large glass tubes with several in/out spouts, complicated tops and lots of little glass cylindrical pieces. "Saurer Absorptionsturm" and "Alkalisher Absrptionsturm (gefuellt m. NaOH verd.)	2	tops don't close and fall off, leaks glass pieces	M306-8
Box 32	Circular bulb flasks with rubber stopper and L-shaped glass tubes at the top	2	good	M309-10
Box 32	container with corked outlet and two inlets on top, cylindrical	1	dusty	M311
Box 32	U-shaped test tubes with corked tops; one has all black element and the other has white and both have cotton, connected by clamp and rubber connector	1 set	dirty, clamp corroded	M312
Box 32	glass tube with stoppers on each end with a smaller tube interior with network of connecting Y-tubes protruding from the top	1	dirty	M313
Box 32	Apparatus with inner glass tube and outer tube with two spouts and cork on top	1	dirty	M314
Box 32	One short one long, bent, glass pipes with rubber stopper.	2	fair	M315
Box 32	glass valves with knob to open/close	2	good	M316
Box 32	two wooden stands, one with metal rod	2	good	M317
Box 32	Glass stoppers, smaller on fits inside the bigger one, (hollow tubed)	3	good	M318
Box 32	Small Glass valve with rubber stopper	1	dirty	M319
Box 32	plastic cup with metal hooks inside	2 cup, 6 hooks	yellow cup and hooks used	M320
Box 32	assorted rubber tubing with glass connectors	2 orange, 1 yellow	used, old	M321
Box 32	Styrofoam water molecules, complete with magnets inside	10	colorful	M322
Box 32	Styrofoam silver molecule with magnets	1	good	M323
Box 32	Styrofoam P formation	1	good	M324
Box 33	cardboard box	1	good	M325
Box 33	Philips light bulb stand with wooden base, white ceramic knob and Swiss outlet plug	1	old	M331-3
Box 33	black cloth	1	good, frayed edges	M338
Box 33	in a shoe box red, silver, and burgundy balls	1 set	good	M339
Box 33	Green balls in plastic trays	8 balls	good	M340
Box 4	cardboard box	1	good	200
Box 4	Metteer brand device. Green bottom with an off white top. Scale with capacity of 180g. Place for substance in sliding plastic door.	1	antique	201-204
Box 4	overhead display Mettler GM 53, instructions included	1	good	205-6
Box 4	Leybold-Heraeus balance, black, with instructions	1	dusty	207-9
Box 5	Glass bulb with long glass extension and removable glass top stopper. Rubber seal at the end of the extension	1	clean glass with cracking rubber	64,65
Box 5	glass jar, with removable lid, empty	1	good	M205
Box 5	Different sized glass flasks with removable glass bulbs on top, with an unknown yellow substance in the bulbs. Some interior glass tubing and spouts	2	one of the glass spouts is broken, and crack stopper	M207-M209
Box 5	Ceramic jars, 2 without tops, one with. Each has a crystalline yellow substance inside	3	nasty on inside, outsides look worn	M213-M214
Box 5	Two mortars and a pestle, Mortars contain yellow crystalline substance	2 mortars, 1 pestle	good, but dirty	M223-M224
Box 5	U-shaped glass tube with black rod cotton and metal coil. Complete with cork top.	1	good condition, like new	M225
Box 5	metal holder, malleable	1	dirty	M226
Box 5	U-shaped glass tube with two black sticks, two corks, metal wire and two positive plugs	1	like new	M227-M228
Box 5	two metal plates, one with positive and one with negative wires and connectors	1 set	metal is corroded	M229
Box 5	SCHOT MAINZ glass test tube with rubber stopper with two L-shaped glass tubes coming through	2	clean and new, corks are slightly cracked	M230
Box 5	test tube and thermometer held in a cork base	1	good condition, but test tube has melted bottom	M231
Box 5	clear plastic cup with cap(yellowed), contains lots of small clear glass balls	1 cup full	the plastic cup is ready to fall apart	M232
Box 5	glass tubing with L-shape bend on one end and a J shaped bend on the other	1	good condition	M233
Box 5	in plastic bag labeled "Glassy-Carbon-Elektrode f. NaCl-Eleckrolyse", black	1	good	M235-M236
Box 5	"Zuendraetze f. Knallgar, Bezugradoerse ion" collection of little light bulbs, 3.6 V, .8 amps, 3R14.	26	decent	M238-M239
Box 5	Ceramic cylinder white with yellow inside	1	used	M240
Box 5	cork with metallic L-shaped rod	1	rusted and old	M241
Box 5	rubber stoppers	3	old, slightly cracked	M242
Box 5	glass tubes empty	2	dusty dirty	M244-M245
Box 5	glass test tubes	3	clean	M246
Box 5	Glass tubes with rubber hoses and stoppers (assorted)	5	dirty, old, worn	M247
Box 5	50 mL graduated cylinder with 3 mini test tubes inside	1 set	clean	M248

Box 5	ceramic top	1	clean	M249
Box 5	rusty metal rod/stirrer	1	rusty	M250
Box 5	Metal U-hooks	2 hooks	good	M251
Box 5	Black plastic cylinder with metallic inside (missing piece?)	1		M252
Box 5	black cardboard with black paper and feather inside	1 set	ok	M253-M254
Box 5	cardboard box	1	slightly worn, good condition	154
Box 5	large white ceramic bowl, with pouring spout	1	good	M204
Box 5	glass tubes filed with blue rocks	2	clean, well kept, good cotton holding in rocks	M215-M216
Box 5	Large rubber stopper complete with two L-shaped glass tubes, one with rubber hose extension and metal clamp. On the other end we have what looks like a shower head (ceramic 127C-00, HALDENWANGEN BERLIN)	1	dirty	M234
Box 5	a glass bulb with two different points of entry/exit	1	good	M237
Box 50	cardboard box	1	used	181
Box 50	black wooden stand with "Marmor Suspensionen: Gorss und fein" two unlabeled cylinders are resting freely on the stand, they are both corked	1 set	wood is old, chipped and rotting, the cylinders are clouded with liquid inside	182
Box 50	short glass beaker, one large one small, no labels	3	good, one broken	183
Box 50	Glass graduated cylinders. 4 100 ml, and one 25 ml	5	good, slightly dirty	184
Box 50	glass funnel	1	dirty	185
Box 50	glass circular domed piece with hole in center	1	good	186
Box 50	saucers, ceramic,	8 small, 1 large	good	187
Box 50	small ceramic cups	7	good	188
Box 50	flask beakers, assorted sizes	5	good	189
Box 50	cooling apparatus	1	good	190
Box 50	glass tube with valve and top plug	2	good	191-2
Box 50	Extraction apparatus	1	good	193
Box 50	glass distillation Y-piece	1	good	194
Box 50	thermometer holder	1	good	195
Box 50	three double spout bulbs	3	good	196
Box 50	broken assorted beaker sizes	4	broken	197
Box 50	assorted beakers	16	old glass no good for lab	198
Box 50	1 800 ml beaker, 3 600 ml beakers, 3 400 ml beakers, 3 250 ml beaker, 4 150 ml beakers, 9 100 ml beakers, 2 50 ml beaker, 1 25 ml beaker	26	good	199
Box 50	600 ml glass beaker	1	good	240
Box 50	glass short beaker with pour spout	1	yellowed	248
Box 50	Glass bulb flask	1	dusty	255
Box 50	metallic molecule set	1	rusty	256
Box 50	rubber coaster	1	good	257
Box 50	big glass flask with a spout near top	1	good	271
Box 51	cardboard box	1	good	155
Box 51	Glass and metal drum with a three legged stand. With rubber hoses inside. Leybold brand.	1	dusty	156-8
Box 51	Black metal lid with padding underneath	1	Old	159
Box 51	glass jar no lid	1	very dirty/dusty smudged	160
Box 51	Warning sign reads "Vorsicht! Geraet steht unter spannung"	1	yellowed paper, smudged	161
Box 51	Small box labeled Ra-Praeparate: three small test tubes corked tops, small electrodes in the test tubes with a pin and a cork. Two letters: one in German in 1937, and the French letter is 1939 (envelopes for each. "Deyrolle"	1 set	old	162-4
Box 51	balls: one smaller red, two bigger red, and 5 blue	5 blue, 3 red	dusty	165
Box 51	metal stands for Bunsen burners	3	rusty	166
Box 51	Brown glass bottle with Ag-Ldg? Not sealed	1	good	167
Box 51	test tube holder, metal,	1	corroded	168
Box 51	metal hooks attached to springs	4	old, but good	169
Box 51	Large test tube with smaller nested test tube, each is corked, tom test tube has a spout also corked and a wire coming out of the top.	1	very dirty glass	170
Box 51	squirt bottle for methanol	1	old	171
Box 51	Strips of paper in plastic sheets.	11	old and slightly yellow	172-3
Box 51	small test tube with cork pin and string	1	good	174
Box 51	non-glass test tube?, "Nr. 579, 16x100 ml" stiff and brittle, of unknown material	1	stable	175-6
Box 51	Rings of stretchy rubber. "O-Ringe f. Osmose, App. Mit Zuckerlsg., C 403" and "58x3" and another bag with similar label	2	good	177-8
Box 51	large tall petri dish, glass	1	very clean	179
Box 51	cork holders	2	one is burnt, other is good	180
Box 52	Box 52 cardboard, in good condition		Good	52
Box 52	Sealed glass jar on a triangular glass bottom and cylindrical middle. Unidentifiable objects inside with an unknown liquid inside. It is hermetically sealed.	1	can't see through well	53,54

Box 52	Caramel colored (wax?) in a metal saucer/ round plate.	1	Burnt bottom and sides	55,56
Box 52	Metal rod with wires coming out one end and a serious of metallic coils and a clamp on one end. The wires are for +/-. There is a paper tag which reads " Max 12V = (1.3 ohms 9.6A)	1	Coils are rusty as is rod	57,58
Box 52	glass tube open at both ends stuck in a stopper with a metal backing with measurements in centimeters	1	Stopper is stained and cracking, backing is discolored	59,60,61
Box 52	Pyrex beaker, glass, labeled for 800mL.	1	Like New	62,63
Box 52	Brown glass bottle containing 2:1 ratio of water:ammoniak. Screw top, not sealed.	1	Label faded, glass is in good shape	66,67
Box 52	L-Shaped glass tube with rubber stopper	1	stopper is cracking, glass is clean	68
Box 52	Metal Strips 3cm by 10cm	6	clean	69
Box 52	positive and negative clips which stand alone	2	red is very corroded, and black looks new	70
Box 52	2 Pyrex dishes, cylindrical, 15cm in diameter and 8cm in height	2	like new, clean glass	71,72
Box 52	rubber connection sealers	2	cracked and broken	73
Box 52	Small metal grate, three squares by eight squares, end 2 squares are at an angle to the 3x4 square base	1	used	74
Box 52	"Wasserwert bei 400 ml Wasser 1840 J/Celsius" metal cylindrical container with hermetically sealed glass interior and plastic bottom base	1	outside metal is corroded	75,76,77
Box 52	Glass beaker with glass test tube inside padded with cotton.	1	cotton is discolored, glass is dusty	78,79
Box 52	graduated cylinder, plastic, 500 mL capacity, with rubber stopper contains 4 25 mL Pyrex beakers	1	plastic is yellowed, stopper is good, glass beakers are clean	80,81,82
Box 52	Plastic cylinder with a plastic screw base, cork top, blue colored plastic.	1	used, not really gross but eh	83,84
Box 52	Glass flask with rubber stopper, "Bural Puli 1000" label.	1	Glass is like new, stopper is old	85,86
Box 52	"Bural Puli 1000" glass beaker	1	like new	87,88
Box 52	250 mL glass beaker, "SCHOTTUGEN MAINZ"	1	like new	89,90
Box 52	Fiolax "SCHOTT MAINZ", broken glass test tube	1	clean, but broken	91,92,93
Box 52	Gray clay cylinder open on both ends, malleable, retains shape after being deformed.	1	little dirty	94
Box 52	"SCHOTT MAINZ" 400mL glass beaker	1	clean like new	95,96
Box 52	glass tubing with two bends, rubber connector	1	glass is like new, stopper is cracked	97
Box 52	Ceramic cylinder open on one end, white	1	clean, not broken, but slightly chipped	98
Box 52	"BORAL PULA" 600ml Glass beaker	1	clean	99,100,101
Box 52	"SCHOTT MAINZ" 800mL glass beaker	1	clean	102,103
Box 52	"SCHOTT MAINZ" 400mL glass beaker	1	Dirty	104,105
Box 52	"SCHOTT MAINZ" 600mL glass beaker	1	used	106,107
Box 52	white ceramic dishes of various sizes with pouring spout	4	slightly dirty	108
Box 52	Plastic Methylenblau + Zucker empty bottle with suction tube	1	dirty/used/discolored	109,110
Box 52	Quarzglas (Q auf Glas ligenitzt), glass tubes of various lengths with two rubber stoppers	5 tubes 2 stoppers	clean, one stopper is dirty	111,112
Box 52	glass tube, 40 cm long	1	dirty	113
Box 52	Glass jars with brown tops, two empty and one filled with "Grauguss 25, GG 25, (gefraest), and 1.2.84/Ko."	3	used	114
Box 52	glass bulb flasks with cork stoppers, filed with crystallized substance	2	has crystalline substance inside, good corks	115,116
Box 52	4 prong test tube holders, silver metal	4	slight corrosion	117
Box 52	rubber house with glass T-intersection and a rubber stopper	1	dirty glass and rubber, the stopper is old and slightly cracking near glass	118
Box 52	test tube prongs, metal	1	corroded and rusty	119
Box 52	tweezers, metal	1	dirty	120
Box 52	Blue plastic bottle with white cap "Blau 27407170", "dispersion + nikrobrownische Bewegeng", screw top is stuck	1	old used	121,122
Box 52	Clear plastic container with blue substance inside which is solidified on the bottom and has stained the interior.	1	used	123
Box 52	tiny glass cylindrical pieces, purpose unknown	4	clean	127
Box 52	ceramic tile, "Laufen Suisse", offwhite in color	1	dusty	128
Box 59	cardboard box	1	good	369
Box 59	Electrodes in glass tubing.	1	in a box in very good condition	370
Box 59	Elektroden, four plugs-ins and a dial. Legrand brand name. Gray box	1	good	371
Box 59	Bottle of bimsstein. Large and white, used to contain one kg of the substance, now has about 1/3 full.	1	fair	372
Box 59	small blue/green box with kill switch and + and - plug in	1	good	374
Box 59	large glass pipettes containing a thin metal strip (coiled)	5	good/dusty	376
Box 59	large glass tubes with valves at the bottom with a thinner neck, traces on crystalline substances remain (one labeled torfmull)	2	good except for substance	377
Box 59	glass tube with a bulb in the middle (bulb contains metallic netting of which some has been burnt)	1	good	379-380

Box 59	capsule of unidentified substance	3	old	381
Box 59	stepping glass tubing (stair formation), with wires and melted candles on each "step"	1	dirty and covered in melted wax	383
Box 59	Glass cylinder	1	dirty, gross bottom	384
Box 59	bag containing Cu-Bleche metal plating	10 plates	shiny, but scratched	385
Box 59	Bag containing (Eisenblech z. Demo von Galvanielemnten"	10 plates	dirty	386
Box 59	long glass tube with an X-shaped end	1	clean	387
Box 59	wire (gray) connecting a button to a metal rod with stopper and threaded end	1	fair	388
Box 59	graduated cylinders glass 100mL	2	dusty	389
Box 59	Glass flask (bulbous) 250 mL capacity.	1	scratched and dusty	390
Box 59	glass tube with a slight bent end and thin section in the middle	3	clean	391
Box 59	s-shaped glass tubes	2	dusty	392
Box 59	glass bulb with valve and rubber stopper	1	very clouded glass and very dirty	393
Box 59	glass tubing, Y-shape	2	fair	394
Box 59	brown glass bottles, (LiCl purum warrerfier) this one is empty, (terpentinoel) this bottle contains liquid	2	older, fair	395
Box 59	small glass beaker containing two glass test tubes, covered by a newspaper like sheath (brom in m-Xylol)	1	old	396
Box 59	foam with tiny glass test tubes and metal scrapers	3 tubes, 2 metal scrapers	fair	397
Box 59	silver colored metallic strips	7	good	398
Box 59	bag containing "Cu-Bleche, schon oxidiert" two blackened metallic strips	2	dirty	400
Box 59	glass petri dishes	3	good	401
Box 59	Ear plugs, in a green cardboard box.	1	older, but good	402
Box 59	plastic bag with "Murtes z. thema Lochfrarrkorrotion" two silver strips with blue dots	1	fair	403
Box 59	metallic rods with notches in the middle	5	rusty	404-5
Box 59	short glass beaker with pouring spout	1	dirty	406
Box 59	plastic bag containing malleable metal strips of differing metals	5 strips	dirty	407
Box 59	small test tube with white bottom and hole in side	1	good	408
Box 59	metallic plate attached to a wire with plug in and test tube (glass) without spout on the bottom	1	good	409
Box 59	glass panes wrapped in newspaper	7	newspaper is yellow and old, but the glass is good	410
Box 59	metal clips with plug ins.	4	corroded	411
Box 59	metal samples in rubber stoppers, rough metal	4 stopper, 2 metal strips	corroded	412
Box 59	charcoal rods	3	fair	413
Box 59	glass tube with stopper	1	stopper is stained, glass dirty	414
Box 59	metallic strip, rough	1	dirty	415
Box 59	white hard plastic wheel with a hole in the center	1	dirty, scratched	416
Box 59	green plastic tray	1	dusty	417
Box 59	"Kupferblech halbhart Cu-DLP" bag with copper strip	1	good	418
Box 59	glass Y-shape junction with rubber tubing and L-shaped glass tubes	1	rubber has hardened	419
Box 59	metal rods, one has wax on it, others are shaped to hold test tubes	3	rusty	420
Box 59	metal strip	1	corroded/burnt	421
Box 59	"Quarzroehrchen z. Herstellung v. Li d. Scmelzflusselektr." plastic both with short glass tubes inside	5 tubes	good	422
Box 59	L-shaped metal pick, tube (hollow) with one pointed end	1	rusty/corroded	423
Box 59	graduated tube (glass pipette) 2 mL	1	fair	424
Box 59	glass tube with valve attached to two clamps	1	rusty	425
Box 59	bag containing three metal coils	3 coils	dirty	426
Box 59	two large index cards with chemical formulas written on both sides	2 cards	yellowed	427
Box 59	T-junction glass tubing with three rubber tubes and another glass j-junction	1	fair	428
Box 59	Red electrode connector? Two metal ends and a coil in the middle (resistor)	1	fair	429
Box 66	cardboard box	1	good	M288
Box 66	black and white picture of a lab	1	fair	M289
Box 66	car battery and manual "Electrona"	1	old	M290-M291
Box 66	on a black board is a collection of samples of different metals and elements	1	worn	M292
Box 66	Thin aluminum foil	1 roll	good	M293
Box 66	stone wheel	1	fair	M294
Box 66	Opaque rock sample in test tube with corked top	1	little dirty	M295
Box 66	"Chromalann" cool looking purple and green sample	1	very dirty/dusty	M296-M297
Box 66	Assorted metal plates (Caitlin thinks they are cool and wants to organize them later) in a small box and a large box	2	boxes are worn	M298-M299
Box 66	loose metallic (silver shiny) plates and manual	lots	good	M300-M302

Box 66	metal wells, three different sizes of four wells each	3	good	M303
Box 66	long metal strip	2	good	M304
Box 66	cans of iron chips for fusing (sealed)	5	older, used	272
Box 66	can of iron chips for fusing (opened)	1	used	273-274
Box 66	metallic plates, two different weights	lots	dirty	291
Box 7	cardboard box	1	good	210
Box 7	corked test tube	1	good	211
Box 7	cooling apparatus, for distillation	1	good	212
Box 7	glass distillation piece, drips condensation	1	good	213
Box 7	glass tube 90 degree turns on both ends	1	good	214
Box 7	large flask beakers, two large with corks, on medium, and one small	4	antique	215
Box 7	500 ml bulbous flask	1	good	216
Box 7	flask beaker with large opening, glass	1	good	217
Box 7	large glass cylinder 60 cm tall and 10 cm wide	1	good	218
Box 7	ceramic saucer and cup	2	good	219
Box 7	metal bowls with pour spout	6	slightly rusted	220
Box 7	glass cylinder open on both ends with a cork on one end with a glass L-piece through it	1	cork is cracked, good glass	221
Box 7	conical glass containers, with pouring spout	2	good	222
Box 7	narrow glass cylinder closed on one end with thick rim and base	1	slightly yellowed	223
Box 7	two glass cylindrical glass bottles with glass caps that have glass tubes that go in opposite directions	2	slightly yellowed	224
Box 7	orange rubber hoses with glass T-connectors	4	used	225
Box 7	reel of blue fabric	1	dirty stained slight fray	226
Box 7	assorted test tubes with stoppers	6	some clouded and dusty	227
Box 7	T-junction with valve (glass) with rubber connectors	2	rubber is cracked	228
Box 7	glass tubing shaped like an L on one end and a J on the other with rubber connectors	2	rubber is cracked	229
Box 7	9 glass L-shaped pieces with stoppers	9	good	230
Box 7	glass tubes with stoppers	8	good, some stoppers cracked	231
Box 7	cardboard conical funnel	1	some smudges	232-3
Box 7	block of wood with 13 nails on the top	1	slightly rotted	234
Box 7	wooden dowel, rectangular wooden stick and a wooden circular tray	1 set	fair	236
Box 7	Ceramic cylinder open on one end, white	2	fair	237
Box 7	u-shaped glass pipe with three stoppers	1	slightly dirty	238
Box 7	brown glass bottle labels "120g ChCl3"	1	antique	239
Box 7	two glass saucers with hole in center	2	good	241
Box 7	tiny glass funnel	1	good	242
Box 7	metal holder (copper)	1	corroded	245
Box 7	two glass tubes with J and L ends with rubber connectors	2	rubber is cracked, glass is good	246
Box 7	bag containing and experiment with 3 corks, one metal weight, one large hook, wires and fishing line, instructions	1 set	used	247
Box 7	corks and stoppers	2 of each	good	249
Box 7	metal coils	3	burnt	251
Box 7	tiny ceramic trays	2	good	252
Box 7	metal wires	2	rusted	253
Box 7	metal hooks	4	used	250
Box A	Hammer like object (mallet/chisel too). Iron head, wooden handle.	1	old, rusty head, dull, wood is in good shape	32
Box A	Al,Fe,Cu,Hb weights held on a pronged stick/holder	1	used, old	124
Box A	various metallic cylinders, "SN 118", "PB 207", "Cu 63.57", "Al 27", "Zn 65"	5	used	125,126
Box A	metal stand with triangular support	1	rusted	M206
Box A	Bunsen burner, with hardened broken rubber connector	1	crusted substance, rusty, corroded, connection is cracked	M217-M218
Box A	"Lautspreches" box containing an old fashion speaker from England, "Celestion Type B35MO Spec 2486" speaker with metal ring	1	Old but good	M219-M222
Box A	black beaker tongs	1	very rusty	M258
Box A	silver metallic tabs, hard plastic container	many tabs	good	399
Box B	Round glass flask with rubber stopper and cork stand. "Brom" label from Technikum Winterthur	1	slightly smudged	M210-M212
Box B	a ribbon/reel of gold plating	1	old, falling apart	M243
Box B	apparatus with rocks and different compartments	1	good condition	M265
Box B	glass container with corked top containing metal cage and two glass L-shaped tubes and two nozzles	1	CLEAN	M272
Box B	Light bulbs and a stand for them to be plugged in, Ar, Ne, Kr, He, Xe, Na; black stand	6 bulbs, 1 stand	good	M334-337
Box B	glass jar with heavily rusted lid and gold leafs labeled "Unechtes Blattgold"	1	very dirty jar, rusted top	235
Box B	pipe with a pump bulb attached	1	pump bulb is cracking	243
Box B	cigars in cigar boxes, Swiss made	4 boxes	old	244
Box B	gray box that detects magnetism	1	antique	310

Box B	mini reactor with liquid inside and instructions	1	good	350
Box B	Cathode ray tubes, one taller gray base and one smaller black base	2	good	358-9
Box B	Small glass cylinder with a cork top, contains suspended bottle with glass tube coming out the top. Two metal plates are inside , electrodes on top	1	dirty	373
Box B	glass bulb with three necks, one with a stopper with positive and negative plug-ins, connected to a metal coil within the bulb	1	fair	375
Box B	Wooden stand, with intricate glass tubing which connects three bulbs and two (entry/exit) tubes	1	contains substance within, wood is dirty	378
Box B	golden plates,	4	slightly dirty/burnt	382
Box B	Metal clamp holding a three necked bulb and a heating/cooling tube	1	dirty	449
Gray bin	Funkenl volt 6 amps 2; wooden base with black metallic cylinder	1	dusty	305+1
Gray bin	glass bulb with two openings on top	1	good	306
Gray bin	copper storage container with a bulbous bottom with metallic stand	1	corroded and very dirty	307-8
Gray bin	bulb and vial held together by wax	3	bulb discolored	309
Gray bin	metallic funnel with filter clamp and stopper	1	good condition, stopper has cracks	311
Gray bin	light bulb stand, current test kit	1	good	312
Gray bin	plastic bottle containing NAClO4	1	good	313
Gray bin	brown bottle 10g Jod in and 100 ml Toluol, removable top	1	old, dusty	314
Gray bin	beakers	2	older, not good for use	315
Gray bin	broken test tubes	2	broken	316
Gray bin	needle and syringe	1	syringe is busted, needle is good	317
Gray bin	ceramic dishes, white with blue interior	4	clean	318
Gray bin	mortar and pestle, ceramic	1	clean	319
Gray bin	Glass syringe 100ml	2	clean	320
Gray bin	little light bulbs (two prong)	3 boxes	good	321
Gray bin	filtration paper, circular	2 boxes	good	322-3
Gray bin	metal handle, yellow and gray	1	chipped paint	324
Gray bin	lens in an old box	1	old box, sturdy, clean lens	325
Gray bin	metal ring insert with wide brim	1	shiny clean	326
Gray bin	metallic plates/strips/samples	3	dirty/rusted	327
Gray bin	spoon, yellowed plastic	1	yellowed	328
Gray bin	"Ersatz fuer Funkeninduktor (R.Eggli)" metallic battery clips	1	good	329
Gray bin	nylon fishing wire in a bag	1	good	330
Gray bin	T-junction with valve (glass) with rubber connectors	1	good	331
Gray bin	pipet glass	1	used	332
Gray bin	large short beaker with pour spout	1	very dusty	333
Gray bin	small beakers, 25 ml	3	dusty	334
Gray bin	mini test tubes with mini corks	6	yellowed	335
Gray bin	glass cylinder open on one end with thick brim	2	good	336
Gray bin	animal hide, one rabbit, one brown	2	clean	337
Gray bin	metal rod, glass rod	2	good	338
Gray bin	metal clamp with adjustable pieces	1	slight rust	339
Gray bin	metallic samples on stands	2	good	340-341
Gray bin	tiny labeled Leybold bottle and cork (knuckle sized)	1	good	342
Gray bin	circular piece of glass, square piece of glass and square metallic piece	3	good	343
Gray bin	yellow cloth	1	frayed, stained	344
Gray bin	"wood's der Metale" metal bins	2	dirty slight	345
Gray bin	two metal plates held together	1	fair	346
Gray bin	surface switch for photo element, green cover, purple lens, dr. b lange. Bryant electric company	1	fair, box is old	347
Gray bin	plastic cylinder and a metal rod and wire for positive and negative in a box	4	used	348
Gray bin	wires positive, 2 negatives, 1 ground	4	good	349
Gray bin	glass tubes open at both ends (narrow)	16	good	351
Gray bin	glass test tube with metal attachment and wires with plugs. In the tube is a string and a metal wire with protruding metal at bottom	1	fair	352
Gray Bin	Light bulb with flip switch, long wire (black)	1	fair	353
Gray bin	charcoal rods	2	good	354
Gray bin	Labels for different "Stoffe".	5	yellowed paper	355
Gray bin	really old German filter paper, in cool envelope	1 set	old	356-7
Gray bin	plain gray bin full of stuff	1	good	304
Gray bin red dot	used, plastic grey bin	1	used	295
Gray bin red dot	MKZ 100 glass vial no lid	98	good	296
Gray bin red dot	MKZ 100 glass vial with lid	67	good	297
Gray bin red dot	Glass cylindrical vials with glass lids and wide bottoms	4	good	298

Gray bin red dot	blanks labels for the "Technikum Winterthur" "abteilung Chemie"	lots	good	299
Gray bin red dot	screws flat head, 3,5x15	6	good	300
Gray bin red dot	note card "Fuer Kleine Etiketta"	1	old and worn	301
Gray bin red dot	Clips and fastener one metal and one plastic	2	new	302
Gray bin red dot	lids and inserts for lids	22	good	303
Loose	On the back it says "Technikum Winterthur C H 24" On the Front the brand label reads "Leyrold". Glass tube with rope/metal coil inside and two separate plugs. Has a wooden backing.	1	Dusty, worn plugs, Glass is good	1,2,3
Loose	Black Wooden Frame with a glass tubing with two bulbs high and low. One is labeled "Ammoniak" and the other is "Luft". There is a paper on the side of the tube that measures "h/l" for "ammoniak" it has marks for 0 and 60 and for "luft" it has marks for 0 and 660	2	Achim said they were ugly	4,5,6,7
Loose	Brand name "GLOOR OERLIKON" "no. 24266 Type []" "250 BA" "220-9000V" "50~" "0,028a" "leerlauf 9 watt A vide" "Technikum Winterthur C12 65". Standard Swiss plug, Handles, red light bulb. Big wooden base with a dark green and black box on opposite sides. The black box has a crank "800V and 9000V" painted in yellow next to the crank. White knobs in between the boxes	1	Plug prongs corroded, dusty`	33-39
Loose	It is a metal anvil.	1	dirty and corroded	40,41
Loose	Black metal pole stand. "MUELLER & KREMDEL ZURICH"	1	corroded and dusty	42,43
Loose	Black metal Pole stand with a corked glass beaker with a soft plastic tube. Two clamps hold a glass tube and a white ceramic cylinder that has a stopper around the glass tube. This apparatus is taped to a manometer, with a meter stick beside it	1	dusty, corroded, not pretty	44-47
Loose	Mini Iron Smelter, Dark green metal with a square wooden base.	1	old and dusty	48-51
Loose	CHO neon sign, Ne, Ne+Hg, Ne+Rd	1	dusty	M326-30
middle cart shelf	additional pieces for the apparatus above. "Lorraine Paris" labeled rod (6), halogen bulb, 3 different glass lenses, metal block that attaches to apparatus track, empty clamp, clamp with a stand, lens on a metal square, hollow metal cylinders, large magnifying glass(all fit on track)	1	dusty but good	147-151
On cart	Double walled glass cylinder, with suspended metal cylinder	1	metal is corroded, glass is clean	135,136
On cart	loose gray painted metal cylinder with domed top, battery (12V), positive and negative plugs, "METALLARBEITERSCHULER WINTERTHUR", long apparatus, the battery is suspended on a track and feeds to a glass lens with an adjustable opening (on lens "SPINDLER & HOYER"), next on the track is a large metal cage with knobs (burnt inside), then empty clamp, then another lens, glass triangular prisms ends the track	1	cool	137-146
On cart	metal track, probably going with the experiment on shelf	1	good	M276
On cart/Box A	adjustable resistors [1.4A 230 ohms, 2A 115 ohms, 2.8A 61 ohms, 3.4A 40 ohms, 3.4A 40 ohms, 5.5A 15.5ohms, 2A 115 ohms, 3.4A 16 ohms, 4.8A 40 ohms, 6.5A 20 ohms, 6.5A 31 ohms]	11	various conditions from new and shiny to slightly rusted	129-134
White Bin	Glass beaker, Z G20, 800 below label, "SCHOTT u.GEN. JENA ER GLAS" circular label.	1	Broken	24,25,26
White Bin	Very heavy device. Three protruding metal tubes with plugs on the top of a metal basin (oblong in shape). Wooden base. PCB-Analyse, Oelprobe Transformator. "Technikorm Winterthur C 12-64" label. "220/5000-7000" "Volt" "50" "300" "watt" "1,36/0,04" "amp" "leerlauf" "Watt A Vid" "type WONst03" "no. 106.236" Tank is leaking.	1	dusty and old	27,28,29,30,31

Appendix A-2: Rocks/Fossils

Appendix A-2.1:Rocks/Fossils Inventory Chart

A star indicates that this rock or fossil was not present in the original set of catalog cards but was in a drawer, so it is an addition to the inventory catalog.

Name	Drawer #	Description	
(Unknown)	102	large rock	
Aaregranit	94		
Achat	55		
Achat	55		
Achat	55		
Achat (Brasilien)	55		
Achat Ausscheidungen in einem Rohr	55		
Achat künstl.gefärbt	55		
Achat Pigmentfarbe	82		
Achatdruse	55		
Achatgeröll (Brasilien)	55		
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Adular mit Cloritüberzug	67		
Adular mit Cloritüberzug	113		
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Ammoniten-Petrefakten diverse	102		
Ammonites Polypocas	105		
Amphibolit	68		
Amphibolitschiefer	113		
Amphiolit (Gotthard)	99		
Amphiolit (Gotthard)	99		
Amphiolit mit Granat	99		
Ampholit mit Granat (Gotthard)	95		
Amphybolit (Schweden)	83		
Anarakit	61	Cu Ni Verb. Fundort:Anarak, Iran	
Andalusit Chiastolit	103		
Andesit	93		
Anglesit	64		
Anhydrit	63		
Anhydrit	63		
Anthrazit	80		
Anthrazit-Geschiebe	110		
Antimon	49		
Antimon	65		
Antimon künstlich	49		
Antimonglanz	60		
Antimonit	60		
Antimonit mit Quarz	57		
Aragonit	79		
Aragonit auf vulk. Gestein	79		
Aragonit Kalkspat Paramorphose	82		
Aresneisen	60		
Argentit auf Calcit	60		
Arsenkies	60		
Asbest, Chlorit, Adular, Quarz	69		
Asphalt	80		
Atakamit	73		
Atakamit	73		
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Augit	106		
Auripigment	60		
Auripigment Charakterfarbe	82		
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Austernshale versteinert	92		
Austernshale versteinert	92		

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Azurit	73		
Azurit	104		
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Baryt	63		
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Basalt	85		
Basalt	85		
Basalt	85		
Basalt	85		
Basalt	93		
Basalt	93		
Basalt (V. Vesuv)	85		
Basalt verschlackt	85		
Basaltbombe	86		
Basaltbombe	100		
Basaltschlacke	86		
Basaltschlacke	86		
Basaltschlacke	88		
Basalttuff	57		
Basalttuff	86		
Basalttuff	100		
Baumabdruck in Schieferkohle	101		
Baumabdruck in Schieferkohle	112		
Bavenogranit	94		
Belemniten	92		
Belemniten	92		
Belemniten	98		
Bergkork	68		
Bergkristall	52		
Bergkristall Gkasglanz	82		
Bergkristall mit Chloritüberzug	52		
Bergkristall plattenförmig	52		
Bergkristall Querschnittplatte	52		
Bergkristalle	52		
Bergkristalle	52		
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Bernstein	113		
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Beton	90		
Beton	90		
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Biotit	95		
Bleierz mit Silber und Gold	62		
Bleiglanz	61		
Bleiglanz	61		
Bleiglanz	62		
Bleiglanz	62		
Bleiglanz	62		
Bleiglanz	106		
Bleiglanz (Rocky-Mountains Canada)	61		
Bleiglanz in Quarzgang	62		
Bleiglanz Kupferkies	61		
Bleiglanz u. Kupferkies	60		
Bleiglanz und Schwerspat	62		
Bleisandstein	60		
Bleisulfid Calciumflourid, Eleiphosphat Bleichlorid	62		
Blitzspuren	89		
Bohnerz	59		
Bohnerz	59		
Bohnerz	59		

Bohnerz	59		
Bohnerz Form kugelig	82		
Bollingersandstein	91		
Boluston	89		
Brauneisenstein	59		
Brauneisenstein (Rauvis)	59		
Brauneisenstein (Spanien)	60		
Brauneisenstein (Staffel)	59		
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Braunit	57		
Braunit	111		
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Calzit	74		
Calzit	75		
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Calzit dicht	75		
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Calzit Stalaktite	103		
Calzit Stalaktitisch	103		
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Carborundum	80		
Carborundum	80		
Carborundum	80		
Carborundum	80		
Carborundum Künstlion	111		
Carnallit mit Steinsalz und Kieserit	51		just cloudy water
Carnallit mit Steinsalz und Kieserit	51		just cloudy water
Chabasit	66		
Chamosil Eisenerz	58		
Chloritschiefer	110		
Chloritschiefer	113		
Chloritschiefer (Gotthard)	95		
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Chrysokoll und Brauneisenstein	73		
Citrin	52		
Cölestin	64		
Cölestin auf Keupersand	64		
Cölestin mit Schwefel	64		
Cölestin mit Schwefel (Sizilien)	64		
Dentriten	92		
Desmin	72		
Diabas Gabbro	83		
Diabas-Porphyr	96		
Diabastuff	100		
Diaspor	113		
Diorit	83		
Diorit	93		
Disthen	70		
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Disthen Cyanit	69		
Dolomit	76		
Dolomit	79		
Dolomit und Talk	79		
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Eisenoxid Fe2O3 aq Strichfarbe braun	82		
Eisenoxid Fe2O3 Strichfarbe rot	82		
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Eisenschiefer	100		
Eisenspat	79		
Eisenspat FeCO3	58		
Eisenspat FeCO3	59		
Eklogit	87		
Elektrographit	Zwischen Kasten		
Epidot	70		
Erbsenstein	76		
Erchinodermenbrekzie	76		
Erchinodermenbrekzie	98		
Erchinodermenbrekzie	113		
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Fahlerz in Quarzgang	84		
Farnblatt	102		
Farnblatt	102		
Farnblatt	102		
Fasergrips	63		
Fe(OH)3 nach FeS2 Pseudomorphose Eisenspat	82		
Feldspat mit Orthoklas krist.	105		
Feldspat Orthoklas	105		
Feldspat Sanidin	68		
Felsit-Porphyr	83		
Ferrochromstaub	111		
Ferro-Silicium	58		
Festungsachat	55		
Feuerstein	54		
Feuerstein	106		
Feuerstein (Silex)	54		
Feuerstein erratisch	54		
Fisch in Glarnerschiefer	101		
Flintsteine aus Zementmühle	98		
Fluorit	50		
Fluorit	50		
Fluorit mit Markasit	103		
Flusspat	50		
Flusspat	50		
Flusspat (Säntis)	50		
Flusspat blau	50		
Flusspat grüner	50		
Flusspat mit Pyritüberzug	50		
Flusspat Pigmentfarbe	82		*
Flusspat Pigmentfarbe	84		
Fucciden	112		
Furohensteine	89		
Gabbro	83		
Gabbro (Bayern)	83		
Gabbro (Marmels)	83		
Gabbro (Schlesien)	83		
Gabbro Hyperstenfels	83		
Gabbro-Smaragtit	83		
Geschiebe	93		
Geyserit (Island)	56		
Gips	63		
Gips	63		
Gips	63		
Gips	63		
Gips	104		
Gips	108		
Gips	108		
Gips dicht	63		
Gips kristallin blätterig	82		
Gips kristallin faserig	82		

Gips Marienglas (Bex)	63		
Gips mit Permutterglanz	82		
Gips rein	111		
Gips rot körnig (Schinznach)	63		
Gipskristall	63		
Glanzkobalt	61		
Glanzkobalt	104		
Glarnerschiefer	87		
Glaskopf brauner	113		
Glasopal Hyalith	56		
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Gletscherkritze	89		
Glimmer dunkel	69		
Glimmer kristallin blättrig	82		
Glimmer kristallin blättrig	82		*
Glimmer Perlmutterglanz	82		
Glimmer spaltbar blättrig	82		
Glimmerquarz Pyrit und Gold	48		
Glimmerschiefer	87		
Glimmerschiefer	96		
Glimmerschiefer	100		
Glimmerschiefer	106		
Glimmerschiefer (Gotthard)	95		
Glimmerschiefer (Gotthard)	99		
Glimmerschiefer (Gotthard)	99		
Glimmerschiefer mit Granat	70		
Gneis (Gotthard)	95		
Gneis (Maggiatal)	88		
Gneis gefälteter	88		
Gneisgranit (Gotthard)	95		
Gneiss	95		
Gneiss (Tessin)	95		
Gneiss mit Granaten	88		
Gold	49		
Gold (Siebenbürgen)	49		
Gold auf Quarz	49		
Gonzenerz mit Pyrit	58		
Granat	70		
Granat Kristall	82		
Granat roter	70		
Granatfels	70		
Granatglimmerschiefer	88		
Granatglimmerschiefer	100		
Granit	94		
Granit	94		
Granit (Calanda)	99		
Granit (Gotthard)	99		
Granit (Gotthard)	99		
Granit (Gotthard)	99		
Granit feinkörnig	110		
Granit mit Lamporphyrader	94		
Granit roter	94		
Granitgneiss	95		
Granitporphyr	93		
Graphit (Ceylon)	48		
Graphit (Innertkirchen)	48		
Graphit gross ca 40 kg	Zwischen-kasten		
Graphitgewebe	48		*
Grauspiessglanz	60		
Grauspiessglanz	104		
Grauspiessglanz dicht	60		
Grauwacke	91		
Griffelschiefer	87		
Grobkalk	98		
Grobkalk	103		
Gruenerflussphat	50		
Grünbleierz	65		
Grünbleierz Pyromorphit	62		
Grünerde	71		
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Halbopal mit Calzedon	56		
Hämatit	58		
Hämatit (Blutstein)	58		
Hämatit (St.Croix)	58		
Hämatit (Stavffel)	58		
Hämatit mit Mangan und Calcium	58		
Härteskala	???	Eine vollständige Härteskala befindet sich in der Apparatensammlung bei den nachgebildeten Edelsteinen.	
Härteskala Nr. 1 Talk	87		
Härteskala Nr. 2 Gips	81		
Härteskala Nr. 3 Kalkspat	81		
Härteskala Nr. 4 Flusspat	81		
Härteskala Nr. 5 Apatit	81		
Härteskala Nr. 6 Orthoklas	81		
Härteskala Nr. 7 Quarz	81		
Härteskala Nr. 8 Topas	81	leer fehlt	
Härteskala Nr. 9 Korund	81		
Hartpech	105		
Haupt-Oolith	106		
Hausmannit mit Calzit u. Feldspat	105		
Helvetanschiefer	113		
Herzmuschel versteinert	92		
Heulandit	72		
Holz verkieselt	54		
Holz verkieselt	54		
Holzstein	54		
Hornblende Amphibol	67		
Hornblende Amphibol	68		
Hornfels	87		
Hornfels	88		
Hornsilberüberzug	50		
Hornstein roter (Eisenkiesel)	54		
Ichthiosauruswirbel	92		
Jadeit Aufit (China)	68		
Janira-Kreide	77		
Jaspis	56		
Jaspis Kristallin dicht	82		*
Jaspis Kristallin dicht	84		
Kainit K2SO4.MgSO4.KCl.6H2O	51		dissolving
Kainit K2SO4.MgSO4.KCl.6H2O	51		very much dissolved
Kalait (Türkis)	104	Al2(OH)3PO4.H2) Spuren Cu Fundort: Alimirsai Mine bei Nischapur Iran	
Kaliglimmer	69		
Kaliglimmer	69		
Kaliglimmer	69		
Kalk mit Fe gefärbt	56		
Kalk Rollstein schön gezeichnet	110		
Kalkablagerung	77		
Kalkbreccie	90		
Kalkschiefer	103		
Kalkspat	74		
Kalkspat	74		
Kalkspat	74		
Kalkspat	74		
Kalkspat	74		
Kalkspat	74		
Kalkspat grobkörnig	75		
Kalkspat Kristall	82		
Kalkspat mit Bleiglanz	74		
Kalkspat Skalenöder	103		
Kalkspat und Quarz	74		
Kalkspatader in Kalkstein	75		
Kalkspatader in Mergelschiefer	75		
Kalkstein	75		
Kalkstein	103		
Kalkstein	108		
Kalkstein gelb	76		
Kalkstein grau	75		

Kalkstein grauer	103		
Kalkstein Kristallin dicht	82		
Kalkstein kristallin körnig	82		
Kalkstein Spaltbarkeit Rhomböder	82		
Kalkstein Struktur dicht	82		
Kalkstein u. Gips Pseudomorphose	82		
Kalktuff	76		
Kalktuff	77		
Kalktuff	77		
Kalktuff	77		
Kalktuff	103		
Kalktuff	105		
Kaolin	71		
Kaolin	106		
Kaolin	113		
Keieselschiefer (Probierstein)	54		
Keupersandstein	91		
Kieselkalk	76		
Kieselkalk (Seeliesberg)	75		
Klapperstein (Tramelan)	59		
Kobaltblüte (Marokko)	104		
Kobaltblüte auf Ferrit (Marokko)	104		
Kochsalz (Marokko)	50		
Kohlentonschiefer	105		
Koks	80		
Konglomeratgeröll	90		
Korallen rot	101		
Korallenkalk	77		
Kreide weisse (Rügen)	76		
Kristall auf Quarzit	52		
Kugelscheelit Quarz, Glimmer	65		
Kupfer derb	49		
Kupfer derb	49		
Kupfer Gediegen	49		*
Kupfer gediegen Zwillingsaggregat.	73		
Kupferglanz	61		
Kupferglanz, Kupferkies	73		
Kupferkies	73		
Kupferkies (Rammelsberg)	60		
Kupfervanadat	73		
Labrador	66		
Lapilli	60		
Lava	104		
Lava mit Schwefel und Gipskrist.	86		
Lehm	89		
Leucit	66		
Leucitbasalt	85		
Limburgit roter Basalt	108		
Limonit	98		
Liparit	84		
Litorinellenkalk	91		
Litorinellenkalk mit Haifischzahn	91		
Löllingit	61		
Magnesiaglimmer Biotit	69		
Magnesit	79		
Magneteisenstein	58		
Magnetit	58		
Magnetit (Tirol)	58		
Magnetit Kiruna	58		
Magnetkies	61		
Malachit	73		
Malachit	73		
Malachit aus Salomons Kupfermine	73		
Malachit Charakterfarbe	82		
Malachit mit Goldtrpfen	49		
Malaisensandstein blau	91		
Malaisensandstein rotbraun	110		
Malaphyr-Mandelstein	110		
Manganeisenerz	113		
Manganspat (Peru)	61		
Manganspat rot	79		

Markasit	61		
Markasit	108		
Marmor	78		
Marmor	78		
Marmor	96		
Marmor	96		
Marmor	96		
Marmor	96		
Marmor	96		
Marmor	96		
Marmor (Wallis)	75		
Marmor blauer (Belgien)	78		
Marmor blauer fleuri	78		
Marmor grüner (Genova)	78		
Marmor l. Qualität (Carrara)	78		
Marmor Malachit und Bleriglanz	78		
Marmor mit Malachit u.Azurit	75		
Marmor mit Pyrit	75		
Marmor schwarzer	78		
Marmor schwarzer (Ragaz)	75		
Marmor weisser	75		
Marmor weisser (Piastaccio)	78		
Massenkalk	76		
Massinkalk	98		
Melaphyr	84		
Melaphyr Mandelstein	110		
Mergel	89		
Mergel	90		
Mergel grauer	89		
Mergel mit Planorbis	89		
Mergelschiefer	89		
Mergelschiefer sandig	84		
Meteoreisen	58		
Meteoriten (Polen)	58		
Milchopal	103		
Molybdaenglanz	60		
Moosachat	55		
Moränenlehm	89		
Morion	52		
Morion	52		
Muschekalk	102		
Muschel versteinert (Wa.priv.)	92		
Muschel versteinert (Wa.priv.)	101		
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Muscheln Petrefakten Ammoniten	107		
Muscheln und Versteinerungen	109		
Muscheln versteinert	101		
Muschelsandstein	91		
Muscovitglimmer	69		
Muscovitglimmer	69		
Muscovitglimmer	103		
Nagelfluh	93		
Nagelfluh (Hörnli)	90		
Nagelfluh (Rigi)	90		
Nagelfluh kleinkörnig	93		
Natica	92		
Natriumchloridkristalle auf Gips	51		
Natriumchloridkristalle auf Kalkstein	51		no label
Natrolith gelb	79		
Nephelinbasalt	85		
Nephelin-Dolerit	85		
Nephelinphonolyth	110		
Nephritasbest von Strahlstein	69		
Noseanphonolit	84		
Nummulitenkalk	76		
Nummulitenkalk	104		
Obsidian	85		
Ofenbruch mit Zinnkörnern	98		
Ofenstein	105		
Ofenstein Speckstein	71		
Olivin	70		

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Opal	103		
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Orthoklas	66		
Orthoklas	67		
Orthoklas kristallin	66		
Orthoklas Mondstein	66		
Orthoklas Spaltstück	66		
Orthoklas Zwillinge	66		
Orthoklas, Kupferkies Hornblende	66		
PbS, CaF2, Pb(PO4)2, PbCl2	62		
Perlit	84		
Petrefakten Ammoniten Muscheln	107		
Petrefakten-Ammoniten diverse	102		
Pfannenstein	50		
Philippsit	72		
Phonolit	84		
Phonolith in Natrolith	85		
Phonolithtuff	86		
Phonolithtuff	86		
Phonolithtuff mit Kalksteineinschluss	86		
Phonolithtuff Volviclava	88		
Phonolithtuff zersetzt	86		
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Phosphorit (Algerien)	65		
Phosphorit (Südlantina)	65		
Phosphorit (Ungarn)	65		
Porphyr	108		
Porphyr	111		
Porphyr (Rehinpreussen)	83		
Porphyr roter	100		
Porphyr roter	100		
Porzellanerde	71		
Psilomelan	57		
Psylomelan Stalakitit	108		
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Pyrit	61		
Pyrit	61		
Pyrit auf Bündnerschiefer	62		
Pyrit auf Kohle	80		
Pyrit in Bündnerschiefer (Chur)	62		
Pyrit in Granit	108		
Pyrit mit Kupferkies	73		
Pyritknollen	58		
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Quarz	53		
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Quarz auf körnig	82		
Quarz bruch koernig	82		
Quarz körnig kristallin	53		
Quarz kristall	82		
Quarz Kristall von gemeinem Quarz	53		
Quarz mit gold	49		*
Quarz Pigmentfarbe	82		
Quarzfels	53		
Quarzfels kirstallin körnig	82		
Quarzit	53		
Quarzit roter	53		
Quarzit Struktur kleinkörnig	82		
Quarzporphyr (Schwarzwald)	83		
Quarzschiefer	110		
Quarzschiefer	113		
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Rapakivigranit	94		
Rauchquarz	52		
Rauchwacke	77		

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Realgar Charakterfarbe	82		
Realgar, Bleiglanz und Pyrit auf Quarz	60		
Retortengraphit	48		
Rhynchonella	92		
Rogenstein	76		
Röhrentuff	77		
Rosaquarz	52		
Rosa-Quarz (Madagaskar)	52		
Rotbleierz	65		
Rote Minette (Luxemburg)	59		
Roteisenstein	58		
Roteisenstein	58		
Roteisenstein	58		
Roteisenstein	59		
Roteisenstein	79		
Roteisenstein (Gonzen)	58		
Rotkupfererz (Peru)	73		
Rotnickelerz	60		
Rotnickelkies	62		
Rotzinkerz	57		
Rubin Diamantglanz	82		
Rutil	57		
Rutil	57		
Sand	90		
Sandstein	110		
Sandstein (Schweden)	91		
Sandstein nach Calzit Pseudomorphose	82		
Sandstein rot	91		
Sanidinit	66		
Säule in Fluorit	104		
Savoniere	104		
Scheelit (zinnwald)	65		
Scherbenkobalt	60		
Schiefer roter	87		
Schieferkohle Anthrazit	105		
Schilfsandstein	91		
Schlacke aus Salomons Kupfermine	73		
Schlacke von Roheisen	98		
Schlacke von Vesuv	98		
Schmelzschlacke Zinnfrei	108		
Schmirgel (Naxos)	57		
Schnecke versteinert	101		
Schnecke versteinert	101		
Schoenit K2SO4. MgSO4. H2O	51		
Schoenit K2SO4. MgSO4. H2O	51		
Schotter verkitteter	90		
Schwefel	48		
Schwefel	49		
Schwefel (Girgenti)	49		
Schwefel (Hakone Lake Japan)	49		
Schwefel (Sizilien)	48		
Schwefel (Sizilien)	49		
Schwefel auf Bimsstein	49		
Schwefel auf CaSO4 und CaCO3	49		
Schwefel auf Gips	49		
Schwefel auf Steinsalz	48		
Schwefel Charakterfarbe	82		
Schwefel Fettglanz	82		
Schwefel Sizilien	49		
Schwefel und Cölestin	48		
Schwefel und Cölestin	48		
Seelilienblüte versteinert	92		
Seelilienblüte versteinert	92		
Seelilienblüte versteinert	92		
Seelilienstengel versteinert	92		*
Seepferdchen (Wa. Priv.)	92		
Seesand z. Teil verkittet	53		
Seestern (Wa. Priv.)	92		
Seestern (Wa. Priv.)	92		
Sericit	69		

Sericitschiefer	87		
Sericitschiefer	88		
Sermfit-breccie	90		
Serpentin	63		
Serpentin	71		
Serpentin	71		
Serpentin	104		
Serpentinasbest	68		
Siderit	104		
Silber ästig zackig	49		
Silber auf calcit	49		
Silber auf calcit	49		
Silber in Schwerspat	49		
Sodalith	66		
Speckstein Dolomit Verdrängungspseudomorphose	82		
Sphalerit Galena Tetrahedrit (Peru)	61		
Sprudelstein	108		
Spruulstein	98		
Stalaktit	76		
Stangenschwefel	48		
Stassfurtit	113		
Staurolith und Disthen	70		
Stein mit Blitzspuren	65		
Stein von der gelben Wand am Tödi	98		
Steinkohle	80		
Steinkohle	80		
Steinkohle	80		
Steinsalz	50		
Steinsalz (Bex)	50		
Steinsalz Blau	50		
Steinsalz Gestein aus Bex	50		
Stiehlglieder	92		
Strahlsandsteinschiefer	87		
Strahlstein	68		
Strahlstein	106		
Strontianit	79		
Syenit	94		
Syenit	94		
Syenit	96		
Syenit-Porphyr	100		
Sylvin KCl	51		
Sylvin KCl	51		
Sylvinit	50		
Talk	71		
Talk 2.Qualität	71		
Talk Fettglanz	82		
Talkquarzit	113		
Tantalit	65		
Taveyannazstein vulk.Tuff	59		
Terebratula	92		
Terebratula	92		
Terrkoks	98		
Tiefensteiner Granit	90		
Tigerauge (Achat)	55		
Tintenfischflossen	101		
Titaneisen (Norwegen)	59		
Titanit braun	65		
Ton roter	89		
Tonschiefer	87		
Tonschiefer	110		
Topas (Mexico)	70		
Topasfels	70		
Topfstein	87		
Torf	80		
Torf	108		
Torf	113		
Torf (Hausersee)	80		
Trachyt	84		
Trachyt	84		
Trachyt-Porphyr	110		

Trass mit Einschlüssen	59		
Trass mit Einschlüssen	59		
Trass Phonolithtuff	86		
Tropfstein	77		
Tuff vulk. Alt	88		
Tuffstein	104		
Tuffstein	104		
Tuffstein vulk.	86		
Türkis (Persien)	104		
Turmalin (Brasilien)	70		
Uranerz	65		
Vanadinit	106		
Versteinerungen und Muscheln	109		
Verucano	90		
Verucano roter schieferiger	87		
Vesuvian	66		
Vesuvlava	86		
Wad (Manganschaum)	57		
Wasserglas	68		
Wasserglas	68		
Windkanter	89		
Wismut	49		
Wismutglanz und Wismut	60		
Wolframit	57		
Wolframit	106		
Wolframit	106		
Wolframit (Erzgebirge)	65		
Wolframit mit Quarz	62		
Wurmspuren	89		
Zechstein	111		
Zementmergel	91		
Zeolithglimmer	69		
Zinkblende	105		
Zinkblende mit Quarz	60		
Zinkblende Quarz Kupferkies (Peru)	73		
Zinkgalmei	79		
Zinkgalmei	79		
Zinkschalenblende (Peru)	61		
Zinnober (Jdria)	62		
Zinnstein	57		
Zinnstein	57		
Zirkon	104		

Appendix A-2.2: Pictures of Rocks/Fossils

Storage Drawers for Rocks/Fossils

Example of Drawer Contents - Fossil

Example of Drawer Contents - Rocks

Appendix A-3: Vials

Appendix A-3.1: Pictures of Vials in Storage

Appendix A-3.2: Vials Inventory Chart

Acidum Wolframicum Puriss.
Ag-Lsg
Al-Pulver
Aluminium
Aluminiumblech
Aluminiumfluorid
Aluminiumnitrid
Aluminiumpulver
Aluminiumsiliconfluorid
Aluminum-kristall
Ammoniumnitrat
Ammoniumsulfat
Anthrazit
Antimon
Antimonpulver
Antimonzinnober
Asbest kardiert
Bariumnitrit
Bariumoxyd
Bariumperoxyd
Basische Schlacke
Bleifolien
Bleipulver
Bor krist
Borsaeure
Borsaeure Schuppen
CaCO3
Cadiumoxyd
Cadiumsulfat
Cadmium
Cadmiumiodid
Caesium
Caesium Sulfat
Caesiumalaum
Caesiumnitrat
Calciumchlorid siccun
Ce(SO4)2
Ceylongraphit
Ceylongraphit (chips)
Chilesalpeter
Cl2 fluessig (in box)
CoCl2-Loesung
Copper Wire
Cu-Bad
Cu-Bleche
Dinatriumsulfid
Eriochromcyanin
Gold Kristall Methyl
Graphitgewebe
Graues Zinn(zinnpest)
H2O+Fuchsin Z.Mech.Energy
H2SeO3
Hexamethyl-1.4.8.11- Tetraazacyclotetradeca
4,11- dien cobalt (II)
Iod
Iodiertes Kochsalz
Iodtrichlorid
Ironpentacarbonal Eisenpentacarbonal
Kationentauscher Stark Sauer
KClO3 Ger.
Kobalt
Kobalt (II) Nitrat
Kobalt(III)oxyd
Kobaltblau
Kobaltchloridloesung Gesaettigt
Kobalt-Silicium
Kobaltviolett
Kolloidaler schwefel
Kolloide kohlenstoffloesung
Kolloides Eisen
Kupfer(I)bromid
Kupferammoniumchlorid
Kupferchlorat
Kupfernitrat
Lithium
Lithiumcarbonat
Loetzinn
Luminol
Metazinnsaeure
Mischbettentsalzer aus Anioen- und kationentauscher
MnSO4 Gesaettigt
Molybdän(V)chlorid
Molybdäntrioxyd
Na2WO4
NaBrO3(0,4M)
NaPO3-Loesung
Natrium in Wasserstoffatmosphaere
Natriumbikarbonat
Natriumbisulfat
Natriumdithionat
Natriumhydrosulfit
Natriummetasilikat
Natriumperoxid
Natronkalk
Nickel Wire
Oxanalbronce (L)
Oxanalgold (L)
Oxanalgold (RL)
Phosphorsäure aus Knochenasche
Pinksalz
Pyroantimonsaeure
Raffinade-Aluminum
Schwefelkristalle
Silberbromid
Silberchlorid

Silbernitrat
Silberoxyd
Silbersulfid
SO2 fluessig (in box)
Spaene mit NaOH
Stangenschwefel monoklin
Stark Saurer Kationentauscher
Steinkohle
Stickstoff-Dioxyd
Talkum
Tellur
Tellurium
Tierkohle
Titanschwefelsaeure
Trans dichloro bis (Aethylendimin) cobalt (III) chlorid
Trans-bis (glycynato) kupfer (II)
Trans-Dinitrotetrammincobalt (III) chlorid
Triphenylzinnchlorid
Tris(acetylacetonato)cobalt(III)
Versilberungs(I)
Versilberungs(II)
Wolframfaeden fuer Gluehlampen
Wolframgluehlampenspirale
Wolframsäure
Zinn(II)nitrat
Zinn(II)oxyd
Zinn(II)sulfid
Zinn(II)Tellurid
Zinnoxyd
Zinnsaeure Geglueht
Zinntetraphenylzinn
Borm
Bortrichlorid
Calciumhydrid
Calciumhydrid
Chromoylclorid
Dischwefeldichlorid
Distickstofftetroxyd
Iod
Kolloide Goldloesung
Kolloide Silberloesung
NH3
Nickeltetracarbonal
Oxalatobis(ethylendiamin)cobalt(III)bromidhydrat
Phosphorsäure
Schlacke
Schwefelsaeurekontaktmasse
Schwefeltrioxyd
Stickstoffdioxyd
Stickstofftrioxyd
Eisen-katelysator
Indium
Schwefel

Schwefel Techn. Raffinert Gepulvert
Schwefelblumen
Zinn
Zinnober
Kobaltchlorid
Kochsalz
Silber
Aluminiumacetat
Aluminiumcarbid
Aluminiumchlorid
Aluminiumhydrat
Aluminiumhydroxid
Aluminiumnitrat
Aluminiumoxid
Aluminiumphosphid
Aluminiumsulfat
Amadonsgrün
Ammoniumacetat
Ammonium-Aluminium Alaun
Ammoniumbicarbonat
Ammoniumbichromat
Ammoniumchlorid
Ammoniumchromalaun
Ammoniumchromat
Ammoniumhydrogenphosphat
Ammoniumpentasulfid
Ammoniumperchlorat
Ammoniumpersulfat
Ammoniumplumbichlorid
Ammoniumrhodanid
Ammoniumthiowolframat
Antimon(III)oxid
Antimon(V)sulfid
Arsen(II)sulfid
Arsen(III)oxid
Arsen(III)sulfid
Arsen(V)sulfid
arsenige Säure
Auripigment
Barium
Bariumcarbonat
Bariumchlorat
Bariumchlorid
Bariumchromat
Bariumdithionat
Bariumhydroxid
Bariummanganat
Bariumnitrat
Bariumpyrophosphat
Bariumsulfat
Bariumsulfid
Bariumthiocarbonat
Bauxit
Bergblau
Berggrün

Berliner Blau
Berylium
Beryll
Berylliumchlorid
Berylliumhydrat
Blattgold
Blaugel
Blei(II)iodid
Bleiacetat
Bleichlorid
Bleichromat
Bleidioxid
Bleihydroxid
Bleinitrat
Bleisulfat
Bleisulfid
Bleizucker roh
Bordeaubrühe Kukaka
Brechweinstein
Breslauer Braun
Brom
Cadmiumchlorid
Cadmiumhydroxid
Cadmiumsulfid
Calciumcarbid
Calciumcarbonat
Calciumchlorid * 2 H2O
Calciumchlorid * 6 H2O
Calciumfluorid
Calciumhydrid
Calciumhydroxid
Calciumnitrat
Calciumoxyd
Calciumphosphat
Calciumphosphid
Calciumsulfat
Calciumsulfid
Calciumsulfit
Calciumwolframat
Carbonatobis(ethylendiamin)cobalt(III)chlorid
Carbonatotetraammincobalt(III)nitrat
Cerioxid
Cernitrat
Cerochlorid
Cerphosphat
Chlorkalk
Chloro-bis-(dimethylglyoxinato)pyridin-cobalt(III)
Chloropentammincobalt(III)chlorid
Chloropentamminocobalt(III)trichlorid
Chrom(II)acetat
Chromacetat
Chromalaun
Chromchlorid
Chromgelb
Chromhydroxid

Chromnitrid
Chrompyrophosphat
Chromrot
Chromsulfat
Chromtrioxid
cis-bis(1,2 ethylendiamin-dichloro-cobalt(III)chlorid
Cobalt(III)sepularat
Coleothar
Deuteriumoxid
Diammoniumtetrarhodanooxovanadat(IV)
Dibortrisulfid
Dichlorobis(ethylendiamin)cobalt(III)chlorid
Dichromtrioxid
Dicyclopentadienyldichlortitan
Di-hydroxo-bis[bis-diethylendiamin]cobalt(III)chlorid
Dikaliumhydrogenphosphat
Dikaliumpentasulfid
Dikaliumtetrachromat
Dikaliumtetrathiocyanatocobaltat(II)
Dischwefeldichlorid
Dithiocyanatotetrakis(pyridin)cobalt(II)
Diwismuttrioxid
Druckerschwärze
Duraluminium
Eisen(II)carbonat
Eisen(II)hydroxid
Eisen(II)oxalat
Eisen(II)phosphat
Eisen(III)bromat
Eisen(III)bromid
Eisen(III)oxid
Eisen(III)-trispentandionat
Eisenammoniumalaun
Eisenammoniumsulfat
Eisenoxid
Elektrospäne
Europium
Ferrocen
Ferro-Chrom (65% Cr)
Ferro-Mangan
Ferro-Molybdän
Ferro-Vanadin
Ferro-Wolfram
Frankfurter Schwarz
Gallium
Germanium
Gips
Glanzruss
Grauspiessglanz
Guano
Guignetsgrün
Hammerschlag
Hexaammincobalt(III)chlorid
Hexaamminocobalt(III)nitrat

Hexaamminonickel(II)bromid
Hexamethyl-1,4,8,11 Tetraamminocyclotetradecadien (4,11) perchlorat
Hexamethyl-1.4.8.11-tertaamminocyclotetra-decadien (4.11) Kupfer(II)perchlorat
Holzkohle
Hydrazinsulfat
Hydroxylamin-hydrochlorid
Iodoform
Iodsalz
Iodsäure
Iodsäureanhydrid
Iridium
Kaliumbicarbonat
Kaliumbichromat
Kaliumbisulfat
Kaliumbromat
Kaliumbromid
Kaliumcarbonat
Kaliumchlorid
Kaliumchlorochromat
Kaliumchromat
Kaliumcobalt(III)hexacyanid
Kaliumcyanat
Kaliumcyanid
Kaliumdibromoiodat
Kaliumdihydrogenphosphat
Kaliumeisensulfid
Kaliumferrat
Kaliumferricyanid
Kaliumhydroxid
Kaliumiodat
Kaliumiodid
Kaliummanganat
Kaliummanganicyanid
Kaliummetaantimonat
Kaliumnitrat
Kaliumnitrit
Kaliumpercarbonat
Kaliumperchlorat
Kaliumperiodat
Kaliumpermanganat
Kaliumperoxychromat
Kaliumperphosphat
Kaliumpersulfat
Kaliumpyrophosphat
Kaliumpyrosulfit
Kaliumsulfat
Kaliumtetrachloroplatin(II)at
Kaliumtriiodblei
Kaliumtrioxalatochrom
Kalkspat
Kalkstickstoff
Kaolin
Kesselstein
Kienruss
Kieselgur
Kieselsäureanhydrid
Kohlenstoff
Kreide
Kryolith
Kupfer(I)chlorid
Kupfer(I)oxid
Kupfer(II)oxid
Kupferacetat
Kupferammoniumsulfat
Kupferchromat
Kupferhydroxid
Kupferkaliumsulfat
Kupferoxid
Lanthannitrat
Legierung nach Devarda
Letternmetall
Lithiumchlorid
Lithiumoxalat
Lithopone
Magnesiumammoniumphosphat
Magnesiumchlorid
Magnesiumhydroxid
Magnesiumnitrid
Magnesiumsilicid
Magnesiumsulfat
Malachit
Mangan(II)carbonat
Mangan(II)chlorid
Mangan(II)oxid
Mangan(II)-sulfat
Mangan(II)sulfid
Mangandioxid
Mangano-Wolfram
Manganperoxid
Mangansilicat
Marmor
Mauersalpeter
Meersalz
Messing
Metaantimonsäure
Metaphosphorsäure
Molybdän(II)sulfid
Molybdän(III)chlorid
Molybdänoxid
Molybdänsäure
Nachtgrün
Natrium
Natriumaluminat
Natriumaluminiumwolframat
Natriumamid
Natriumantimonat
Natriumarsenat
Natriumarsenit

Natriumbisulfit
Natriumbromid
Natriumchlorat
Natriumchlorid
Natriumchromat
Natriumcobalthexanitrit
Natriumcyanamid
Natriumcyanid
Natriumdichromat
Natriumfluorid
Natriumhexanitritocobaltat(III)
Natriumhypophosphit
Natriumhyposulfit
Natriumnitrat
Natriumnitrit
Natriumperborat
Natriumperoxoborat
Natriumpersulfat
Natriumphosphat
Natriumphosphit
Natriumpyrophosphat
Natriumstannat
Natriumtetrametaphosphat
Natriumtetrathionat
Natriumthioarsenat
Natriumthiosulfat
Natriumtrithionat
Natriumwolframat
Neodymnitrat
Nicalin
Nickel
Nickel(II)carbonat
Nickel(II)hydroxid
Nickel(II)nitrat
Nickel(II)oxid
Nickel(II)sulfat
Nickelammoniumsulfat
Nickelocen
Nickeloxalat
Niob
Niobchlorid
Nitropentamminocobalt(III)chlorid
Nitroprussidnatrium
Norgesalpeter
Oleum
Osmium
Palladium
Pariser Blau
Phosphor
Phosphorbronze
Phosphorige Säure
Phosphorit
Phosphorpentabromid
Phosphorpentasulfid
Phosphorpentoxid
Phosphorsalz
Phosphorsäure
Phosphorsesquisulfid
Phosphorstickstoff
Phosphortrichlorid
Phosphortrioxid
Platin
Platinchlorid
Platinkaliumchlorid
Platinoxid
Platinsand
Portlandzement
Quarzmehl
Quecksilber(I)nitrat
Quecksilber(I)oxid
Quecksilber(II)bromid
Quecksilber(II)chlorid
Quecksilber(II)iodid
Quecksilber(II)nitrat
Quecksilber(II)oxid
Quecksilber(II)sulfat
Quecksilber(II)sulfid
Quecksilber(III)chlorid
Quecksilberchromat
Realgar
Rhenium
Rhodium
Rinmansgrün
Roscocobaltoxid
Rost
Rubidium
Rubidium-Alaun
Ruthenium
Salmiakstein
Sassolin
Scheele's Grün
Schippsale's Salz
Schrot
Schwefeldisulfid
Schwefeleisen
Schwefelleber
Schwefelsäure
schweflige Säure
Schweinefurtergrün
selenige Säure
Siliciumchloroform
Siliciumtetrachlorid
Smolteblau
Soda
Strontium
Strontiumcarbonat
Strontiumchlorid
Strontiumhydroxid
Strontiumnitrat
Strontiumoxid

Strontiumsulfat
Strontiumtitanit
Talkum
Tantalchlorid
Tantalsäure
TetraamminKupfer(II)sulfat
Tetraphosphordekasulfid
Thalium
Thaliumnitrat
Thaliumsulfat
Thenard's Blau
Thomasmehl
Thomasphosphatmehl
Tinkal Borverbindung
Titan(IV)sulfid
Titanoxid
Titanschwamm
Titansulfid
Titanweiss
Tribleitetraoxid
Trieisentetraoxid
Trikaliumtris(oxalato)chromat (III)
Trimangantetraoxid
Tris(acetylacetonato)cobalt(III)
Tris(ethylendiamin)cobalt(III)chlorid
Turpethummineral
Überosmiumsäure
unterphosphorige Säure
Vanadinchlorid
Vanadium
Vanadiumpentoxid
Verkupferungsmittel
Victorias grün
Wasserglas
Wolfram(II)sulfid
Wolfram(III)sulfid
Wolframhexachlorid
Wolframoxychlorid
Wolframsäure
Wood'sches Metall
Yttriumnitrat
Zement
Zinkcarbonat
Zinkchlorid
Zinkchromat
Zinkgrün
Zinkhydroxocarbonat
Zink-Kaliumcyanid
Zinkoxid
Zinksulfat
Zinksulfid
Zinn(II)chlorid
Chlor
Ammoniummolybdat
Asbest

Blei
Bleicarbonat
Bleioxyd
Bor
Bornitrid
Bronce
Calcit
Calciumhydrogenphosphat
Cer
Eisen(II)sulfat
Eisen(III)chlorid
Elektroferrol
Ferro-Titan
Kaliumaluminiumsulfat
Kaliumchlorat
Kaliumferrocyanid
Kaliummanganocyanid
Kalkstein
Knochen
Kupfer(II)chlorid
Kupfercarbonat
Kupfersulfat
Kupfersulfid
Magnesiumcarbonat
Natriumcarbonat
Natriumdihydrogenphosphat
Natriumhydroxid
Natriummetaphosphat
Natriumsilicat
Natriumsulfat
Natriumsulfit
Natriumtetraborat
Nickel(II)chlorid
Niob-Tantal
Phosphorkupfer
Quarzsand
Quecksilberchlorid
Schwefel
Tetraschwefeltetranitrid
Wolfram
Arsen
Bleiweiss
Calcium
Ferro-Silicium
Mangan
Molybdän
Selen
Silicium
Siliciumcarbid
Titan
Gallium-Arsen
Magnesium
Chrom
Eisen
Tantal

Zirkon	Disalicyl-1,2-diiminoethancobalt(II)
Zink	Graphit
Wismut	Kaliumhexacyanoferrat
Kupfer	Kaliumsilicofluorid
Ammoniummolybdän	Natriumhydrogenphosphat
Bimstein	Quarz
Calciumchlorid	Schwefeldioxid
Calciumdihydrogenphosphat	Silicagel
Dinitrotetrammincobalt(III)chlorid	Tris(o-phenantrolin)nickel(II)perchlorattrihydrat

Appendix B: Interview Notes and Transcriptions

Appendix B-1: Basic Interview Questions for Collection Affiliates

- Can you tell us about how you do your job?
    - How are the exhibits chosen?
    - What goes into designing an exhibit?
        - Aesthetics?
        - For specific age groups?
    - How do you execute the construction of the exhibit?
        - What goes into the design process?
- Where do the interests of various age groups fall?
    - How do you best target each of these?
- What goes into the decision process?
- Is there any subtle cues that make viewers happier/more interactive (e.g. colors, sounds, etc)?
- How do you incorporate the background of an artifact with the artifact itself?
    - A plaque?
    - Little comment cards?
    - A video?
    - Auditory/spoken information?

Appendix B-2: Barbara Brauckmann

Barbara Brauckmann
Departement Chemie und Angewandte Biowissenschafte
ETH
Zurich, Switzerland

Meeting 1:

- Project Introduction
- Show Barbara collection
- Agreed to help us identify unknown equipment pieces

Meeting 2:

- Guided tour of ETH exhibits
- Start quickly
    - Artifacts at ETH almost were thrown out
    - Determine which objects are most likely to be disposed
- Look for sponsorship
    - Took 5 years for faculty to create exhibit by themselves
- Process description in terms of:
    - Designing
    - Spending money
    - Implementing physical display

Appendix B-3: Andrea Durham

Andrea Durham
Director of Exhibit Development and Conservation
Boston Museum of Science
Boston, Massachusetts

- Advice
    - Do not rush into building
    - Ensure proper planning
    - Set goals
    - Have ideas before starting to build

Appendix B-4: Laura Hanlan

Laura Hanlan
Research & Instruction Librarian
WPI
Worcester, Massachusetts

- Download Endnote Installers
- Demonstration on how to use Endnote
    - Add sources
- Introduction to SharePoint
- Finding sources
    - Using databases
    - Using Google scholar
    - Using ERIC
- Demonstrated search methods for exhibit design
- Literature Review
    - Look at different angles of science exhibit and form discussion among sources
    - Essentially background report
    - Organize and highlight important sources
    - Asses "learning" settings
    - Aim for 20-25 "good" sources

Appendix B-5: Sebastian Hug, Claudia Rüegger, and Sabina Tresch

Sebastian Hüg
Project Leader of Higher Education and Partnerships
swissnex
Boston, Massachusetts

- Personal Background
  - Been at swissnex for 18 months
- swissnex Background
  - Public-private partnership
  - 10 person team
  - Business/entrepreneur orientated
  - Help students to find jobs
- Arriving in Switzerland
  - Zurich airport tips
  - www.sbb.ch
  - Expect lots of different cultures
  - Utilize train system
  - Avoid using taxis
- Laws
  - No turn on red
  - Do not cross streets without sign or crosswalk
  - No showers 10pm-7am ("Night Rest")
  - Stores are all closed on Sundays
  - Recycling is very important
- Important Numbers
  - Police: 117
  - Ambulance: 144
- Culture
  - Use Swiss Franc
  - 7 members on an exec branch
  - Sports: biking, skiing, soccer, wrestling
- Project Recommendations
  - Visit ETH chemistry exhibit
  - Use HBZ (main library of Zurich)
  - Visit Basel Pharmaceutical Museum
  - Contact Pia Viviani

Appendix B-6:Vera Narodnitzkaia

Wednesday, April 10

Vera's first reaction to our project was to say several pieces of advice

- Do not copy or attempt to compete with the Winterthur Technikum, because the ZHAW is too small and the exhibition would fair
- The type of person, who could help us generate a visual representation and estimate prices for the entire exhibit, would be an experienced and trained professional who would have to be paid hourly
- She also said that with the amount of time given it would be very difficult to find someone willing to work that quickly

Appendix B-7: Sandro Lochau

Friday, April 12

- Same age as us
- Willing to help
- Paid 20 CHF by the university
- Said he would have the design to us within 24 hours

Appendix B-8: Betsy Loring

Betsy Loring
Manager of Exhibits and Collections
EcoTarium
Worcester, Massachusetts

There are two types of exhibits:
    - Those centered around the visitor experience(engage)
    - Those centered around history, art, or culture; EcoTarium is a combination of these two types
- Recommended Readings
    - Museum 2.0by Nina Simon (WPI alumni)
    - Consumer Reports of museums
    - Local projects that incorporate history
    - Projects advised by Dominic Golding
    - User Friendly by Jeff Kennedy
    - Exhibit Tricks by Paul Orselli
    - Dark Humor by Edward Gory
- Exhibit Recommendations
    - Use emotional story
    - Use the most powerful objects
    - Engage in real phenomena
    - Target multiple generations
    - Build prototypes
    - Include detailed instructions for detailed exhibitions
    - Avoid "textbook on walls"
    - Giant molecules for visuals
    - Test prototypes in real world
    - Incorporate a video
- Target Audience
    - Young Kids
        - Don't need instruction
        - Just want to play
        - Lots of visuals
    - Middle Aged Kids
        - Might read some text
        - Still want to interact with exhibit
    - Adults
        - Read text
        - Follow instructions
- Questions for us to focus on
    - What do we have?
    - What is our theme?
    - What are our goals?
    - Where is our interest?
    - What is our main target audience?

Appendix B-9: Ed Rodley

Ed Rodley
Exhibit Developer
Boston Museum of Science
Boston, Massachusetts

- Areas to focus
    - Target audience
    - Determine clear goals
        - What message are we sending
    - Start looking for a sponsor
    - Bridge cultural difference between Switzerland and US
- Display Advice
    - Avoid incorporating too much content
    - Carefully choose what pieces to include
        - Likely that visitors will only see exhibit once
    - BE EXPLICIT
    - Model molecules
    - Periodic Table with elements?
    - Flip labels
    - Keep simple
- Recommendations
    - Visit pharmaceutical museum in Basel
    - Draw and Deliver
        - Disappointment is most deadly
    - Power of tangible experience
    - Aura of all senses
    - Stay conceptual
        - What do we want audience to take away
        - Pictures or it did not happen

Appendix B-10: Vidya Santosh

Vidya K. Santosh
Graphic Designer
Museum of Natural History
New York, New York

- Personal Background
    - Involved with placement of collection
    - Focuses on arranging displays
    - Works as part of a team
        - Split up jobs based on strengths
    - Average time from brainstorm to completion: 2 years
- Functionality vs. beauty
    - Create and hold interest in content
    - What is the story and to whom?
    - Visual hierarchy: Break down of info
    - Tiers of info
- Project Advice
    - Incorporate 3 categories
        - Editorial
        - Visual
        - Physical Space (3D)
    - Focus on content
        - What does audience really need to know?
        - Adults are engaged by knowledge
        - Children are engaged by analogy
    - Arrange chemicals in periodic table
        - Put in middle of room so people can walk around space
        - Show beauty of vials
    - Challenge self to 2 or 3 ideas
    - Decision process based on:
        - Budget
        - Viability
    - What you show and say must support each other
    - Use sound selectively
    - Only implement a video if we incorporate ZHAW history
    - Thought we should focus on equipment
        - How they work
        - Let beauty show

Appendix B-11: Marc Siddall

Marc Sidall
Curator and Professor of Invertebrates
American Museum of Natural History
New York, New York

- Latest exhibition regarded science technologies
    - Viewers can walk through working laboratory
    - See actual research
- Our collection differed greatly from that at the museum
- Put us in contact with Vidya Santosh

Appendix B-12: Pia Viviani

Pia Viviani
Deputy Head
Science-et-Cité Management
Bern, Switzerland

- Personal Background
  - Biotechnologist from ETH
  - Earned PhD
  - Worked showing gene technology to children
- Science Cafe
  - Discussions with real scientists in bar/cafe setting
  - Moderator ensures discussion stays in common man's tongue
- Aspects to explore
  - Natural History Museum of Zurich
  - Natural History Museum of Bern
  - Uni Bern
    - "Citizen science": experiments with public
    - Web based "platform" full of information
  - ExploreIt
  - Interpharma
- Exhibition Forms
  - Exhibition Train
    - Simple discussions
    - Train reaches larger audience
  - Science Suitcases
    - Schools order suitcase to do experiments
  - Science Cafe
    - Discussions with real scientists in bar/cafe setting
    - Moderator ensures discussion stays in common man's tongue
  - Periodic Table
    - Put vials near modern day object
    - Elemental quiz
- Advice
  - Find a way for objects to tell their own story
  - Find a Swiss story teller (gave us a potential contact)
  - SHOW and TELL

Appendix C: Museum Visit Notes

Appendix C-1: Deutsches Museum

Deutsches Museum
Munich, Germany

- 50 different exhibitions areas displaying science/technology
- Exhibit Ideas
    - Rocks on a map showing origin of samples
    - Test tubes with colored water
    - Cut outs to reveal inner workings
    - 360 degree glass cases
    - Colored carpeting surrounding displays
- Exhibit ideas could be employed in our designs

Appendix C-2: Ecotarium

EcoTarium
Worcester, Massachusetts

- Types of Display
    - Live animals
    - Taxidermy
    - Interactive
    - Textbook on walls
- Exhibits tell a story with displays
- Interactive- Greater holding power
- Textbook on walls- Boring, Did not hold interest

Appendix C-3: ETH Zürich

Eidgenössische Technische Hochschule (ETH) Chemistry Display
Zurich, Switzerland

- Similar story to ZHAW
  - Artifacts uncovered during an institute move
  - Items originally were to be disposed of
  - Conserved items for exhibition
- Exhibit Design
  - Glass display cases
  - About 12 cases
- Thoughts about exhibit
  - Lack engagement with visitors
  - Similarities between collections
  - Feasible method for display at ZHAW

Appendix C-4: Hartford Science Museum

Hartford Science Museum
Hartford, Connecticut

- Goals
  - Increase interactivity
  - Immerse visitors in science phenomena
  - Appeal to many audiences
  - Family Friendly
- Want to try to produce a similar type of exhibit
- Similar to out collection in terms of
  - Science
  - Specific subject matter
  - Intellectual level

Appendix C-5: Pharmazie Historisches Museum Basel

Historical Pharmacy Museum
Basel Switzerland

- Pros
  - Most relevant to our project
  - Similar glassware and antique equipment
  - Impressed by extent of collection
  - Engaging exhibits of old apothecaries
  - Recipe exhibits for various medications
  - Story of pharmacy technology
- Cons
  - Could have better conveyance methods
  - Some exhibits were dull
  - Did not like simple glass case exhibits

Appendix C-6: Technorama

Technorama
Winterthur, Switzerland

- Pros
  - Interactive
  - Alternative language cards
  - Wall comics to add humor
  - Periodic table exhibition/rest of chemistry section
    - Interactive
    - Fun
    - Aesthetically pleasing
  - Demonstrations
  - Rocks under microscope
- Cons
  - Dark lighting
  - First impressions
  - Gases in periodic table looked like empty tubes

Appendix D: Cost References

Appendix D-1: Sandbox Cost References

http://www.adventuretoys.co.uk/prodpage.asp?ProdID=2610

http://www.bunnings.com.au/products_product_sand-dried-10kg_P760565.aspx?filter=categoryname--Sand

http://www.rockhounds.com/rockshop/john_betts/clean1.html

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Appendix D-2: Hiking Exhibition Cost References

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Appendix D-3: Interactive Chemistry Exhibition Cost References

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Appendix D-4: Interactive Chemistry Website Cost References

http://www.steves-digicams.com/knowledge-center/how-tos/becoming-a-professional-photographer/shooting-photography-for-a-website.html

http://tameaburdphotography.wordpress.com

http://www.2planawebsite.com/basics/website-costs.html

http://www.webpagefx.com/How-much-should-web-site-cost.html

Appendix D-5: Bookshelf Cost References

http://www.displays2go.com/Category.aspx?ID=27229

http://www.gelighting.com/LightingWeb/emea/

http://www.ikea.com/us/en/catalog/categories/departments/decoration/10789/

http://www.bestbuy.com/site/Speakers/Bookshelf-Speakers/abcat0205001.c?id=abcat0205001

Appendix D-6: Main Exhibition Phase I Cost References

http://www.displays2go.com/Category.aspx?ID=27229

http://www.gelighting.com/LightingWeb/emea/

http://www.ikea.com/us/en/catalog/categories/departments/decoration/10789/

Appendix D-7: Main Exhibition Phase II Cost References

http://www.overstock.com/Electronics/Dell-Latitude-D630-2.0GHz-2GB-80GB-14-Laptop-Refurbished/7894963/product.html

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Appendix D-8: Main Exhibition Phase III Cost References

http://www.bestbuy.com/site/Speakers/Bookshelf-Speakers/abcat0205001.c?id=abcat0205001

Appendix D-9: Main Exhibition Phase IV Cost References

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http://www.amazon.com/Sourcing-Solutions-Cubby-Storage-Required/dp/B002FK8LIG/ref=lp_3733381_1_22?ie=UTF8&qid=1365672314&sr=1-22

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Appendix D-10: Website Implementation Cost References

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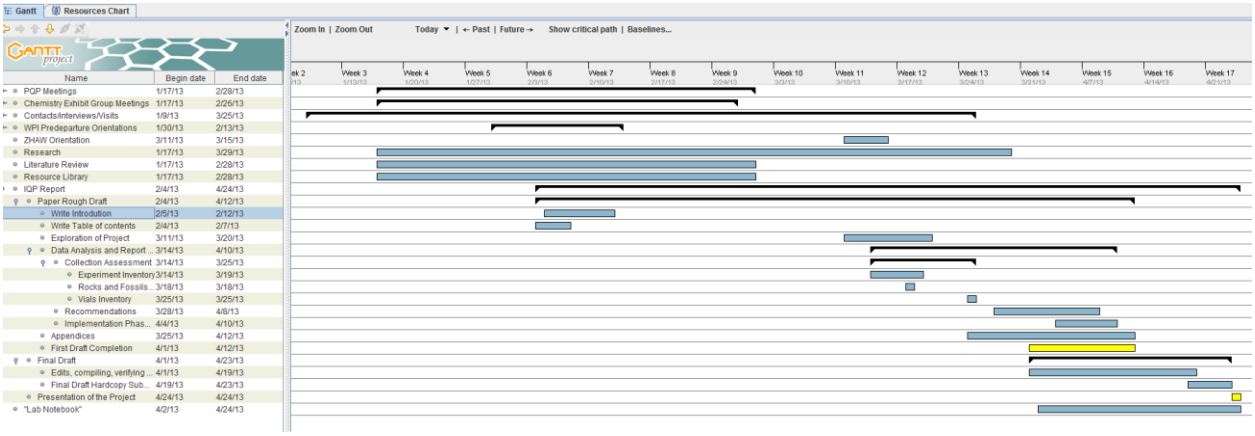
Appendix E: Gantt Chart



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