Trent Wyman: **Senior Project Comprehensive Documentation**

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Executive Summary

Add ***em*** ***Atom*** is a physical science resource consisting of Flash-based animations & user interactions, designed to help students learn the basic concepts of atomic chemistry in ways that are fun and visually engaging. As a learning companion, this project is specifically designed to compliment textbook and science course learning, while at the same time contrasting the mundane and often boring exposure that many young students feel when learning such concepts through a strictly text medium.

This application works to teach students about the fundamental properties of atomic elements; the basic structure and classification system of the Periodic Table of Elements; and the simple bonding involved behind chemical compounds and their structures. ***Add*** ***em*** ***Atom*** shows students how elements and compounds are formed on a microscopic level, through animations and user activities that involve visual art models consisting of basic shapes and simple motion graphics to visually represent such microscopic scenarios. User activities involve building basic atomic elements and simple compound structures by "dragging" & "connecting" together different components of artwork, to visually create their own atomic models.

Project Concept Note

Introduction:

The goal of ***Add*[em] *Atom*** is to create an interactive learning environment that simplifies the concepts of atomic chemistry in a way that entertains and inspires younger students, who may feel challenged when learning this type of subject matter.

Essentially, this is a physics resource as well as a tutorial to assist science students (Middle School & High School) in learning basic concepts behind atomic science and atomic chemistry. Through direct interaction and immersion within a graphically provided Periodic Table of the Elements, students will click through and explore the various elements shown.

While exploring the elements arranged on the Periodic Table, users should quickly learn to identify simple elements by their key physical properties (Atomic Mass, Electron-Configuration, Period Group, etc.) based upon the information they learn from the sub-section that provides animated demonstrations (mini-tutorials), that illustrate atomic concepts and processes.

The scientific and technical information within this project will be conveyed through a combination of various media & multi-sensory methods:

- **Still-Images:** illustrations, photos, & text-data;
- **Motion Graphics:** animated artwork, text / typography;
- **Audio:** sensory feedback of sound effects alerting right or wrong choices during user interactions.

As basic concepts of atomic structure are provided and shown, users can optionally move on to performing their own constructive activities where they can apply their knowledge into interactive, game-like scenarios.

The "Activities" section of the ***Add*** *em* ***Atom*** will involve specific, interactions and user choices that depend upon successful, task-based, follow-through, completions in order to visually construct accurate atomic models. Users will construct atomic elements models by directly interacting with the shapes, forms, and content provided on the screen in the form of graphics and artwork.

> **Example:**
> A user has studied the Hydrogen atom within the 'Elements' section, then may choose to go into the 'Activities' section and attempt to construct their own Hydrogen model according to that element's particular properties as defined by the Periodic Table.

Each element's activity will include a graphic representation of that element's specific electron configuration as a visual hint to assist users in cases when they are uncertain and may not wish to return to the Periodic Table in order to complete that element model. Other hints will also be available that offer more specific information regarding other ways that a user may determine the correct choice, without directly giving them the answer. The provided "Hints" will merely give users different methods and ways to think about and find proper solutions for the problem at hand.

In addition to constructing element models, students will also construct chemical compound models in a similar manner as the element activities.

Example:

If a user decides to construct a model representing the chemical compound of Water, they must know that this process involves a combination of two particular element types, Hydrogen and Oxygen. Specifically, a model representing water will require two Hydrogen atoms bonded to a single Oxygen atom. Chemical formulas will be provided to aid the students as they seek to connect the appropriate atoms together in order to achieve the desired chemical bond.

Communication & Learning Objectives:

The communication and learning objectives outlined for ***Add*^em *Atom*** involve the following goals (if achieved, will validate the overall success of this project):

- **Assist students in learning basic concepts of Atomic Science**
  (Basic Elements and Simple Compounds)
- **Engage users throughout the learning process; to entertain and teach**
  (Learning made fun)
- **Inspire appreciation, interest, and comprehension of atomic science**
  (Encourage students to learn more)
- **Simplify the subject's scientific complexity**
  (Convey complex ideas through a medium understood by most student audiences)
- **Remove the subject's intimidation-factor**
  (Present higher-level concepts in a visual medium that's easy & fun to interact with)

Target Audiences:

The two main user groups for which this project has been designed/developed are:

Primary users:

Science students ranging from middle school (7th & 8th grades), to junior high school students (9th – 11th grades)

Secondary users:

Physical science teachers and others who are generally interested atomic chemistry, particle physics, and / or science in general, for their work, fun, or recreation

Sources of Inspiration:

Inspiration for this project and its subject matter derived from the following sources (people, works, academic materials, etc.). These are all inspiring due to the various clever approaches taken regarding methods in which ideas and concepts are conveyed:

Carl Sagan:

Scientist and documentary host of the PBS mini series "***Cosmos***" and author of: "***Billions and Billions***", "***The Dragons of Eden***", "***Cosmos***" (the book), and many other related works on subjects of science.

Brian Greene:

Scientist and documentary host of the BBC mini series "***The Elegant Universe***" and author of the book entitled "***The Elegant Universe***"

Fritjof Capra:

Author of the book entitled "***The Tao of Physics***"

Mr. Wizard's World:

A favorite TV show from when I was a kid (inspired my appreciation for science)

Sources of Competition:

Currently, there appears to be a limited number of specific competitors that directly relate to this topic in ways similar to which ***Add*[em] *Atom*** will be presented (animated techniques, online interactions, technical medium, hosting environment, etc.).

Internet Tutorials:

There are many Periodic Tables available on the Internet. However, I not yet found one that takes user interaction to the depth or level that I plan, nor do many of these sites cater to non-knowledgeable users.

Periodicals:

There are not many periodicals available on the common newsstand, which relate to this particular field of science (atomic chemistry). However, there are a few magazines that do focus on subjects that are closely related to this field, such as: "***Scientific American***" and "***Astronomy***".

School Textbooks:

The bulk of this sort of scientific material is generally reserved for academic and school textbooks in subjects such as chemistry, physics, biology, and other relative branches of study.

For details and information regarding specific competitors and benchmarks, refer to the "Competitive Analysis" section within this documentation book. Provided within are detailed findings which derived from analyzing the overall usability and delivery of content within a few selected competitive sources. These sources have been given different success and severity ratings based on how well they meet their users' requirements and overall project goals.

Required Skills for Project Development:

The development and successful delivery of ***Add*[em] *Atom*** will require the following skills:

- **Research**: various forms of scientific materials for ideas, inspiration, and content gathering
- **Information Architecture**: organization of content and subject matter such as creating sitemaps, process flows, etc.
- **Illustration**: to conceptualize and develop ideas for interactive artwork and visual designs for user interfaces
- **Vector Art**: to convert illustrated artwork and concepts into a digital production environment (Adobe Illustrator)
- **Raster Art**: to convert vector-based artwork for web delivery, in addition to adding effects & filters (Adobe PhotoShop) to the „flat-looking‰ vector graphics in order to produce images that have more „depth‰ or more 3-dimensional appearances
- **Animation**: to convey physical processes, show sequencing of events, add non-linear perspectives and interactivity through action-scripting and motion graphics
- **Multimedia Composites**: compose all content (animated & still images, static & dynamic text, and sounds) into singular and hybrid technological formats interchanged between Flash animations and the dynamic XHTML
- **Java Scripting**: for behavioral and controlled delivery of dynamic content through user interaction with the XHTML output
- **Cascading Style Sheets**: for visually formatting the layout and appearance of the web delivered content
- **XHTML**: output static and dynamic content through any standard web-based browser
- **Usability Testing**: for quality assurance that the project is meeting its goals in regards to the needs of both primary and secondary user groups

Project Deliverables

Deliverables Introduction:

Progress in this project will be marked according to specific deliverables that will be required in order to successfully develop the project and meet its intended goals. Details and descriptions of each of these deliverables are outlined below:

Competitive Analysis:

Analysis and reviews of benchmark or inspirational content and subject matter such as the Internet, books, television, etc. that have similar communication objectives as those of the Interactive Project being created.

Websites, books, documentaries, etc. will be evaluated on their ease of use & comprehension, the information design, the visual design, content, and technology.

The competitive analysis will consist of the following:

- **Introduction**
- **Identifying Goals & Objectives**
- **Distinguish points of comparison**

  (those points relating to ***Add*** *em* ***Atom*** within the content being analyzed)
- **Recommendations & Conclusions**

User Definitions & Personas:

Identify the key target audience users around whom this project will be designed. Along with the development of user definitions, personas will also be developed in order to obtain a greater understanding of user goals and how people currently approach the subject matter at hand, while simultaneously outlining recommendations for interaction, information design, and technology requirements.

The user definitions & personas will consist of the following:

- **Introduction**
- **Personas for primary, secondary, and complimentary users:**

  (personal profile, background information, user needs, scenarios and special features used to accomplish their goals)
- **Requirements analysis**

  (based on user definition, personas, communication objectives, and goals)

Application / Information Architecture:

Assimilate all information gathered from project research, the competitive analysis, and the user persona definitions into an organized blueprint for the Interactive Tutorial that is being created.

The information architecture will consist of the following:

- **Overview of project architecture**
- **Process Flows**
- **Detailed Site Map** & **Preliminary Wire Frames**

Preliminary Artwork:

To convey the following:

- **Show visual representations of the elements within the content**
- **Show storyboard representations of interactive processes & scenarios**
- **Establish a thematic visual style for the content**
- **Develop a paper prototype for usability testing**

Usability Tests:

To convey the following:

- **Determine the project's ease of use, accessibility, and overall user comprehension and success in regards to the material and subject matter**
- **Determine if the information design is successful**
- **Determine if the visual design is successful**
- **Develop conclusions and recommendations for project improvement based upon the results and information gained from the usability tests**

User / Topic Research:

In the effort to ensure proper delivery of content and information for the specified target audiences, research has been done using qualified sources for academic objectives that relate to the particular medium and user groups this project will adhere to. The following are samples of online peer-reviewed journals and/or articles written by qualified individuals within the field of education.

Research Article #1 ----------

"Creativity in Schools using Macromedia's Flash"

ICT, Design Technology and Mathematics - Dr Geoff Dellow

Flash is normally associated with Web Site design and is intended for use by professional Designers along with a whole suite of software programs - the best known being Dreamweaver used for writing web sites in HTML. It is a very well written piece of software that can be used in many innovative ways.

However the use of Flash in the classroom has been explored by many schools resulting in a host of diverse projects, which suit the whole age range from year 3 to sixth form in secondary schools (seven to eighteen year olds). We find that it is highly motivating for all ages because it enables creativity and problem solving within challenging projects.

A personal approach to Creativity

I see myself as a very creative person and by that I mean that I have a great ability to analyze a problem and extract the core or crucial characteristics of it. I then think very widely as to possible solutions considering the most way out and unlikely solutions. Rejection of possible solutions is then suspended until an irrefutable scientific principle is violated.

This ability carries with it a trait that I question everything that is presented to me to enquire why it is the way it is. Most of this goes on internally as I have learnt that most people find this approach off-putting to normal conversation! !

As a result I have always pioneered innovative approaches to situations that I am in - Patented inventions when working in industry - Glaxo and Shell; novel solutions to lighting at home, unusual solutions to Holiday Homes attracting National attention when in business. And now new approaches to teaching which seek to encapsulate the experience that I went through in early life.

Approach to teaching

Tackling problems is a way of developing skills in Problem Solving and Creativity. We often turn to trying to solve someone else's very difficult problem but with Flash, students set themselves problems of their own making. This approach generates high motivation because the problem is of their own making and it suites the ability of the student.

When a student analyses the qualities of a new concept and really gets to grip with the understanding the properties of that concept, then he/she can start to explore what practical things can be done and postulate problems to be investigated.

The more sophisticated the qualities of the concept (in this case a piece of software) then the greater number and more varied can be the solutions to problems that are investigated.

Macromedia's Flash provides the environment for this kind of creative exploration of solutions to problems that are generated by the student her/himself. The vast majority of software being promoted for use in the classroom fail miserably by comparison.

Because of the great variety of sophisticated tools at the users disposal then the solutions can be varied and will satisfy the problem that the student has set himself in different ways.

Consistent with this approach the evaluation of the result is usually made by the student herself or her peers. The judgmental approach of a teacher is avoided. We have found that this is most effective when the student is asked to present his work after a short period of time when the student is able to view his work more objectively and hence with far greater perception.

The views of others

Strong support for using Flash is coming from several areas of the curriculum. The strongest is from the mathematical community - people like Prof Celia Hoyles, Lynne McClure of Oxford Brooks University (RECAP) and Toni Beardon of NRICH at Cambridge see it as developing "mathematical thinking" -

" I am fascinated by the development of mathematical thinking by children 'teaching' the computer to serve a specific purpose.. . We have Seymour Papert and Celia Hoyles and others to thank for much work on LOGO in this spirit and Anita Straker for LOGO and Basic, but time moves on and what you are doing with Flash is very innovative and exciting."

In the ICT field Prof Stephen Heppell of Ultralab is enthusiastic because he is "excited about the way this software gives children real control over their computers and lets them make things rather than consume things"

In Design Technology, projects that involve producing "virtual products" that serve as presentations of information or Prof R Kimbell and Dr D Barlex are including feelings within this area of the curriculum. Ray Peacock, former Chairman of DATA was impressed with the potential of Flash at their recent conference.

Flash projects usually encourage a team approach to performance and learning something being emphasised by David Hargreaves.

Several Boroughs have now taken on board the value of Flash Projects in their schools and many individual schools worldwide continue to work with Flash in isolation until they are "discovered".

What has been done?

Over the last 18 months I have systematically explored the use of Flash in the classroom reaching the point now where it has been used and tested with close to 1000 students in 16 schools of ages ranging from 7 to 16. Abilities range from those with learning and physical difficulties in special schools to Gifted and Talented students in a master class at Oxford Brookes University.

Many of the results of this work are to be found on my site at http://www.tygh.co.uk/students which is a little difficult to navigate at present because of the speed at which material has been added . This site is about to receive a major overhaul!

There is also a national wide following of this software and we are in contact with teachers and students globally. This was greatly enhanced by taking a stand at the BETT show earlier this year and the creation of a CD that enabled teachers to prepare themselves to teach Flash Projects over a period of three months at a nominal charge.

Findings

I am convinced that Flash has great potential to develop analysis, creativity, problem solving, higher thinking skills and evaluation with students from 7 (and possibly younger) to 18. It has the great advantage that it is a well designed commercial product being used by tens of thousands of very intelligent and creative problem solvers and the potential for students sharing learning with these professionals is straight forward through Usenet and the Flash Communities surrounding certain Web sites.

Not only does the software have merits educationally but at a time when the UK is looking to develop its intellectual expertise it provides excellent training for the commercial world.

All (without exception) students have thoroughly enjoyed their projects with Flash nearly all find the projects difficult and strongly challenging. As a result of using templates, they have come out of their projects with a feeling of success which has led to strong feelings of self-esteem and led to remarks by teachers that class behavior and learning in general has improved following a Flash project. This has been achieved by careful design of 'templates' that ensure that the files work and provide a starting opportunity for pupils to develop their skills to the level of their ability.

Philosophy

Not only does the exercise of using of Flash have great merits but, the way we have been teaching it and plan to in the future is innovative itself. Motivation of the student has always been kept as a prime factor. This is achieved by ensuring success with the teacher seen as facilitator, putting the student in charge of documentation to the minimum required for achieving the task. Finally analysis and evaluation, so important to useful creativity and problem solving, comes naturally as the students continuously make judgments about their work as they do it. Objectivity evolves as other members of the team voice opinions, discussion follows and compromises are made.

The role of the teacher is to promote discussion as to whether the product fits the design brief in a non-judgmental way and to facilitate the student in finding solutions to problems raised. This philosophy based on that of Malcolm Knowles and Carl Rogers appears to be more appropriate to the needs of present day students in primary and particularly secondary schools. It goes a long way to helping students have ownership of their education and feel that it is something that they really want to engage in.

It is believed that because these projects satisfy an innate curiosity in young people, they have a beneficial effect on the attitude to learning in the classroom, persuading many that involvement, clear thinking and difficult problem solving are to be relished.

---------- ***End Research Article #2***

Research Article #2 ----------

"Adults are from Earth; Children are from the Moon"
Designing for Children: A Complex Challenge

By Randy White; © 2004 White Hutchinson Leisure & Learning Group

One of the challenges we constantly face when designing for children is to create an environment (including equipment and furniture) that produces the desired behavior and outcomes - and deters undesirable behavior. This challenge holds true whether we're designing a children's environment for entertainment, edutainment, play or enrichment (early childhood education). Just as there is a gulf of misunderstanding between genders, often described with the analogy "women are from Venus; men are from Mars," likewise there is a gulf of misunderstanding between most adult designers of children's environments and the children they're designing for.

Kids will do the darnedest and most unexpected things when it comes to interacting with the environment. If you have any doubts about this, consider a recent news story:

> *A 7-year-old boy crawled inside an arcade-type crane machine at a Piggly Wiggly supermarket in Sheboygan, Wisconsin, and then couldn't get out. The website for Action 2News in Green Bay, Wisconsin, reported that when firefighters arrived, the child was sitting inside the machine among the stuffed animals. He had crawled into the 8-inch by 10-inch vending slot while his father talked on a pay phone three feet away. The child remained calm during the hour that it took a locksmith to free him, then made a quick dash for the restroom, said fire department officials.*

This story from the news is a good illustration of how children will make things in the environment that aren't meant to be interactive, interactive. And the younger the child is, the more likely this will happen. This is because of the vast differences in the way children and adults look at their environment. Adults view the environment in terms of form, shapes, and structures and as background. So if something like a couch is in a public place, adults will interpret it only for its socially acceptable use, for sitting upon. Children, on the other hand, interpret the environment holistically and evaluate it for all the ways they can interact with it. They use the environment to aid their development and improve themselves. They look for the environment's affordances -- the opportunities it affords them to do things. Also, children interpret the environment in terms of its possible function rather than its form.

So in the case of the couch, because children haven't yet acquired the social norms for its accepted use (and aren't developmentally ready to accept social norms for behavior), they see the couch as something that affords them opportunities for bouncing on, sprawling out on, climbing on, jumping over and hiding behind. A child as, if small enough, perceives a rock something to grasp and throw — it affords grasping and throwing. If the rock is larger, it could afford stepping on, looking under or climbing on.

Another simple example is a long straight hall in a building. A child sees it as affording her a chance to run, and run down the hall she will. Similarly, a wall 3-feet high is perfect for walking and balancing on. In all these cases, the child is not misbehaving. She is doing exactly what her brain is biologically wired to have her do, based upon the environment's affordances and her developmental age. She is fulfilling what is known as her development tasks, one of which is to explore and interact with the environment. When a child behaves in an environment in a way that adults see as improper, it is not usually the child's fault, but more often adults' fault for not designing the environment appropriately for children.

Environments for children need to be designed with careful consideration of four basic environmental needs children have:

- ***Movement***
  The environment needs to offer children an invitation to move within safe and tolerable limits, and every child will move to a different drummer. If too restricted, children become frustrated and fidgety, or they try to gain access to prohibited components of the environment.

- ***Comfort***
  A feeling of comfort is important to children's use of and exploration of the environment. There needs to be moderate and varied levels of stimulation for all the senses. Behavior is optimized at a comfort zone of stimulation, neither too little or too much. An overload of sensory stimulation and noise will exacerbate children's feelings of discomfort and result in undesired behaviors.

- ***Competence***
  Children need to feel successful in negotiating the environment. Yet the world at large forces them to constantly confront intimidating and frustrating experiences. Successful children's environments are designed to make children competent inhabitants and users.

- ***Control***
  Children need the ability to exercise control over the environment and acquire increased levels of autonomy. Children must have experiences that allow them to experiment and make decisions.

The balance of this article explores in greater detail the elements of design required to accomplish these four goals and create successful environments for children's use.

One of the challenges in designing environments for use by children is to offer them the affordances for the desired behaviors. Through deliberate design, you can keep children from using the environment in inappropriate ways by eliminating affordances for undesired behavior. When it comes to leisure and play areas, this is accomplished by offering children age-appropriate affordances that produce the desired outcomes. If children are drawn to the entertainment and play components, they will not be drawn to inappropriate use (in an adult's eyes) of the other elements in the environment. This requires that children be challenged and not become bored. Otherwise, they will start interacting with those other elements or sometimes become aggressive in their behavior. Of course, there is also the issue of eliminating affordances for the wrong behavior, such as not having throwable stones, or walls that can be climbed and walked, or long straight halls.

Children become bored when there's a mismatch between what they have the ability to do and what they are expected or want to do. They enjoy themselves when their skills match the developmentally appropriate task at hand. If they're challenged beyond their capability, they become anxious and often claim boredom as a defense. If not challenged enough, they're bored. In either case, a bored child will find ways to be challenged by climbing, running or other behaviors that match their abilities. Children prefer and are most drawn to play environments with high degrees of challenge, diversity, novelty and complexity. The type, quality and diversity of children's play environments directly affect the type, quality and diversity of their play.

Since children's developmental tasks and skill levels change constantly as they age, the point where boredom sets in is a moving target. Children's physical (fine and gross motor), intellectual and social skills are constantly advancing. This means that children's environments must offer what is known as graduated challenges, a range of challenges, as even the same age children have different levels of skills and acceptable challenge.

The ability children posses to interact with, control and transform their environment are very important to them. Children want to explore, manipulate and transform the environment. Environments that include loose parts that children can manipulate, move and construct with are immensely more engaging than static equipment and environments.

Most of young children's play centers around their incredible imaginations. The environment needs to promote and support imaginative role-play with props and loose parts. However, the environment needs to be open-ended so children can use their imaginations to develop their own play scripts. Highly scripted, structured and overly themed environments stifle children's creativity, short-circuit extended play and can quickly lead to boredom.

An important aspect for children's use of the environment is that they are more interested in the process of using the environment than achieving an end result like adults do.

And then there are the concepts known as anthropometrics and ergonomics, (sometimes referred to as human factors engineering) which means designing things to match children's physical sizes and abilities. This includes such characteristics as height, grip, reach, field of vision, etc., so that tasks can be performed with a minimum of stress and maximum of efficiency and safety. It doesn't do any good to design equipment that doesn't fit a child's anthropometrics and skills and isn't ergonomically correct. Either he will not be able to use the equipment or he will feel incompetent trying to, and neither outcome will make him desire to return. And poorly designed equipment, furniture and environments that don't match children's anthropometrics can actually be dangerous. If a shelf is too high and a child wants something on it, she will often find a way to get to it -- likely in an unsafe manner such as climbing on lower shelves that may not be designed to support the weight of a child. Ergonomically incorrect environments can injure children. Research is now showing that children, with their still growing musculoskeletal systems, may be susceptible to musculoskeletal injury (MSDs) by using improperly designed equipment such as standard adult-size computer keyboards and ergonomically incorrect computer workstations. Surveys report a high incidence of children's computer-related aches and pains, including discomfort with wrists, necks and hands.

OK, as complicated as all this sounds, it gets even more challenging.

There's the issue of children's attention spans, which can be much shorter than that of adults. So something that at first interests a child can 10 minutes later become boring. To overcome this challenge, the environment must offer a wide variety of options. Too little a variety of equipment and materials limits children's play options and leads to increased levels of boredom and aggression. Another factor that drives the need for variety is known as multiple intelligences. The theory of multiple intelligences challenges the traditional notion that intelligence is a single, fixed commodity. Rather, it says we all possess eight distinct and somewhat autonomous intelligences to differing degrees — linguistic, logical-mathematical, musical, spatial, bodily kinesthetic, interpersonal, interpersonal and naturalist. We tend to be most interested in activities that match our stronger intelligences. There are also distinct differences between the interests of girls and boys. Therefore, the variety of activities must appeal to the broadest range of multiple intelligences and to both genders.

The scale of the environmental space also influences children's behavior. Research shows that the more child-scaled the environmental space, the higher the quality and complexity of children's play will be, and the longer they will be preoccupied in the play. In other words, a child-scaled environment increases children's interest and concentration, and it delays boredom. In a large space, children are encouraged through reading the environment to move about from one thing to another, whereas in small-contained areas, they are more focused. Areas for different activities need to be well defined with identifiable boundaries in ways that children can interpret. The relationship between areas and activities, what we call adjacencies and zoning, also has an impact on children's behavior and the quality of their activities. Institutional size and looking buildings and large entries, lobbies and public spaces are very intimidating and uninviting for children. Children are most comfortable with residential looking buildings and residential scale spaces.

Other factors also influence children's enjoyment of play and entertainment. Indoors this includes the décor, colors, lighting and acoustics. And outdoors, nature and the abundant use of plants in informal settings have been shown to enhance children's concentration, reduce their stress, increase their feelings of well-being and help them further develop imagination and a sense of wonder. Children have a strong preference to play outdoors in a natural environment, as opposed to one built indoors.

Predictability and routine are important to children, as well. It helps give them a sense of control over the environment and their daily lives. There needs to be a balance between not too much sameness and not too much change and contrast -- what is called differences-within-sameness. This concept is best exemplified by nature, with its subtle changes of wind, light, sounds and its seasons. If an environment a child repeatedly visits is constantly changing, the child will experience discomfort and anxiety.

Children can decipher a well-designed environment. They can orient themselves, recognize how the space they are in connects to adjoining spaces and figure out how to get to a desired destination - a concept know as way finding. Children's short stature makes this especially challenging unless the environment is designed from a child's-eye view. Younger children don't read. So where signs work for adults, the environment itself needs to be designed to give children equivalent non-language way finding communication. An important aspect of younger children's orientation is known as transitioning. Children cannot process new environments as quickly as do adults. They need more time to adjust. The use of transitioning spaces and transparency from space to space greatly assists children with transitioning.

Safety is also a crucial consideration. The environment must be designed not only to prevent unsafe behavior or situations and injury, but also designed to minimize injury when an incident occurs. Situations where a child cannot evaluate the risk, such as head and finger entrapments, need to be avoided. However, to be interesting to children, equipment must present some risks, but risks where a child can evaluate the challenge. What are considered risks for older children can be hazards for younger children. Environments considered appropriate and safe for older children will often be dangerous to younger children, requiring age segregation of areas. Environments with activities that are safe when children are supervised can be dangerous if children are left unsupervised.

Children's familiarity with each other also affects their play and interactions with other children. A group together regularly in a childcare setting will interact differently both with the environment and with each other than will children who do not know each other. The same environment design won't necessarily work for both groups.

Another consideration: Children are also more sensitive to environmental hazards than adults are. This includes chemicals, VOC emissions (volatile off-gassing organic chemicals from building materials) and foods they are allergic to. Good air quality is also essential. Toxicity and sanitation are especially important considerations for the youngest children who will often mouth anything they come into contact with. Many designers overlook the aspect of selecting non-toxic indoor plants and outdoor vegetation in children's environments.

Accessibility for children with disabilities is another design challenge. Unfortunately, the Americans with Disabilities Act (ADA) fails to adequately address children's accessibility, as it focuses mainly on wheelchair accessibility for adults. Even the alternative ADA children's standards fail to address the environmental challenges faced by children with non-wheelchair mobility disabilities, including walkers, leg braces, limited vision, Attention Deficit Disorder (ADD) and Attention Deficient Hyperactivity Disorder (ADHD). The other problem is that following ADA standards during the design process can often make the environment and equipment unusable by able-bodied children. An approach known as universal design is required to make environments truly usable by the greatest number of children. Universal design is an approach to design that honors human diversity and addresses the right for everyone — from children to the elderly — to use all environments, products and information in an independent, inclusive, and equal way.

Durability and maintenance are important considerations in designing any environment for children's use. Children will give things more wear and tear than adults do and will definitely get things dirtier faster. Materials need to be durable and easy to clean and maintain. Using materials and finishes that can be sanitized is important, especially when with infants and toddlers will be present in the environment being designed.

Designing for children is no simple task; since most adult designers have a completely different perception of the environment than the users they are designing for. If you put children in an environment not properly designed for them, all kinds on unexpected and undesired behaviors and outcomes result. Children are going to use the environment in ways that their biology tells them to, so it's the responsibility of adults to design children's environments carefully to produce the desired behaviors. Positive outcomes for children's behavior in a leisure or education setting will be produced only when the environments have been design with a thorough knowledge of child development, play, anthropometrics, ergonomics, environmental factors, way finding, environmental psychology and universal design.

---------- ***End Research Article #2***

Competitive Analysis:

The competitive analysis reviews benchmark or inspirational content and subject matter such as the Internet, books, television, etc. that have similar communication objectives as those of the Online Application that is being created. In this particular analysis, a four websites and 2 school textbooks are evaluated according to their ease of use and level of learning comprehension, the presentation of information and visual design, as well as the technology being used for content presentation and delivery.

Other benchmark competitors were sought, specifically in the context of educational games such as chemistry sets, board games, and CD-ROMS. However, after searching several department stores including "**Discovery**", "**K-B Toys**", "**Wal-Mart**", and others, I found only one educational game that related to chemistry. Unfortunately, it was just a crude mixing set which contained synthetic materials to create various types of urethane and elastic type bounce balls for kids ages 6-10. There was not enough relevance to the project currently being created to consider that particular chemistry set a benchmark worthy of any beneficial comparison. Overall, outside of the Internet and textbooks, there seems to be a commercial void of educational and fun learning games for older kids, especially in the fields of science.

This competitive analysis specifically examines the following:

- **Difficulty or comprehension level of subject**
- **Design and Layout**
- **Features**
- **Navigation**
- **Usability**
- **Over Rating Score**

Each benchmark that is analyzed will be given an overall score or rating based on the following criteria:

*	**One star = Poor**
* *	**Two stars = Fair**
* * *	**Three stars = Good**
* * * *	**Four stars = Excellent**

The following websites have been analyzed based on similar goals or objectives to those of the Online Application being developed:

- 1. **Library.Advanced** – http://library.advanced.org/
- 2. **Chemical.Elements** – http://chemicalelements.com/
- 3. **Chemicool** – http://chemicool.com/

The following textbooks have been analyzed based on similar goals or objectives to those of the Online Application being developed:

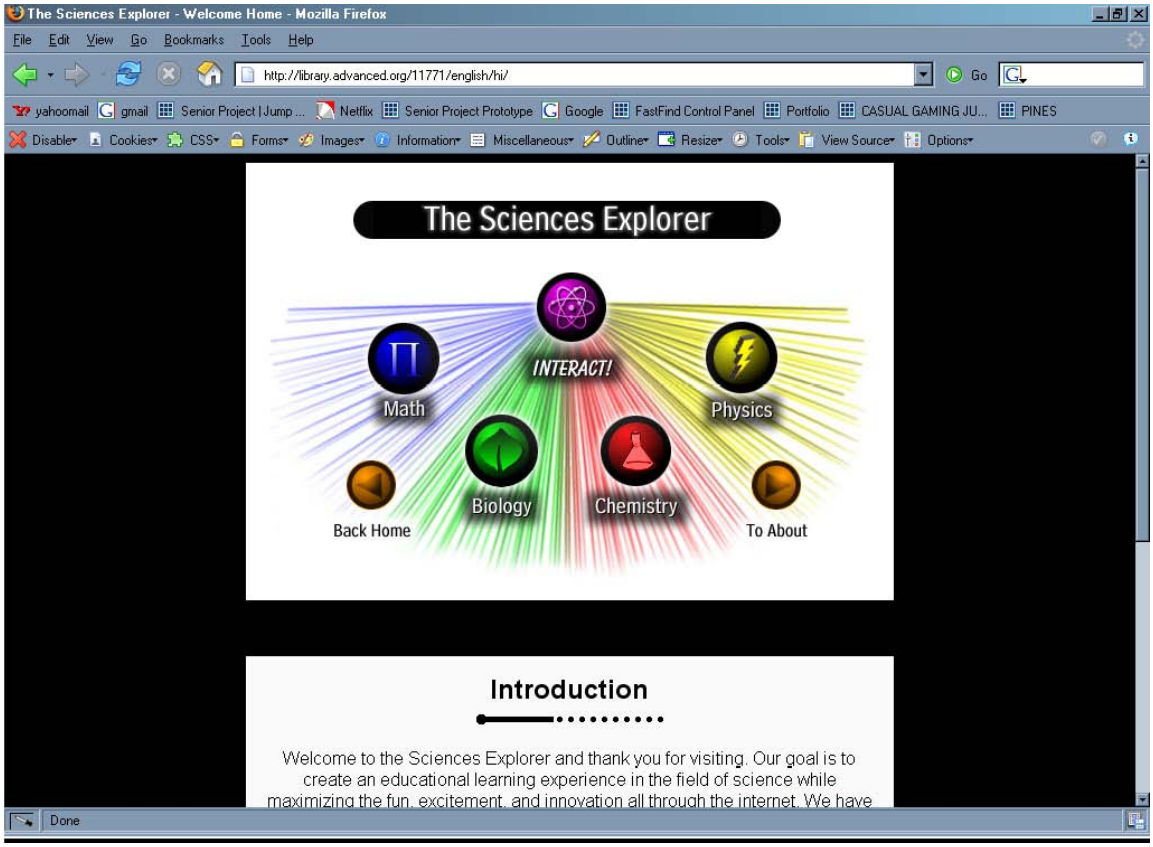
Chemistry For Changing Times (10th Edition)

J. W. Hill & D. K. Kolb; copyright 2004; Pearson Prentice Hall

Principles Of Physics (6th Edition)

F. J. Bueche & D. A. Jerde; copyright 1995; McGraw-Hill

Competitive Analysis # 1: Library Advanced - http://library.advanced.org/



Comprehension & Difficulty of Subject Matter:

The site is divided into 5 different categories covering educational subjects such as math, biology, chemistry, physics, and interactivity. For this particular analysis, the chemistry section of the website was chosen due to its specific relevance to the project at hand in relation to atomic structures and the provided interactive Periodic Table of Elements.

The site gives an overview of the Periodic Table, but the descriptive content seems to be more focused on the tables history (Developed by: Dimitri Mendeleyev) rather than providing a straight-forward explanation of how and why the elements are arranged and grouped the way that they are. The paragraph of explanation even tries to make a joke stating: „The person who developed this was Dimitri Mendeleyev, a Russian scientist whose hair was even worse than Einstein. Notice the improper use of the term "who's" (should be "whose") in addition to the humor level of the joke. This is one indication that brings about the conclusion that this site may have not been designed with advanced users in mind. However, the interactivity involved with the provided Periodic Table seems to have been developed with the consideration of slightly knowledgeable users in mind, those who are already have experience with calculating compounds at this level.

Comprehension & Difficulty Rating = * * (2 stars / Fair)

Features:

In contrast to the table's description, the provided interactive Periodic Table seems to have been developed with slightly experienced or knowledgeable users in mind. The interactivity involves clicking on the elements within the table. By clicking various element symbols, elements are added together in the calculator window to perform math functions involving the given set of various compound arrangements that were selected. The concept behind this interaction could serve the site and its users very well if only the programming behind it were up-to-date. Currently, the compound calculator does not work in modern version browsers.

It states that it „Requires Internet Explorer 3.0 or Netscape Navigator 2.0 or later. Due to this incompatibility, it is uncertain how well the calculator performs, especially in instances where it is not possible to form a compound based on how particular element interact (or don't interact) with other particular elements.

Features Rating = * * (2 stars / Fair)

Design & Layout:

The site maintains basic layout consistency throughout in terms of navigation and content display. Little attention has been applied to the site's branding treatment other than the graphical navigation links provided at the top of all pages. There is very minimal use of color in terms of design treatment. All HTML content falls into a centered-alignment, adding to the out-dated look and feel of this site.

Design & Layout Rating = * (1 star / Poor)

Navigation:

The global navigation is clearly and consistently indicated by the animated graphic at the top of each page. Status indication is apparent by the use of red text to indicate the current section the user is at. However, there is no clear or consistent treatment regarding sub-navigation within the five sections of the site. The user will at times be required to use the browser's „back‰ button in order to return to certain sub-category pages.

Navigation Rating = * * (2 stars / Fair)

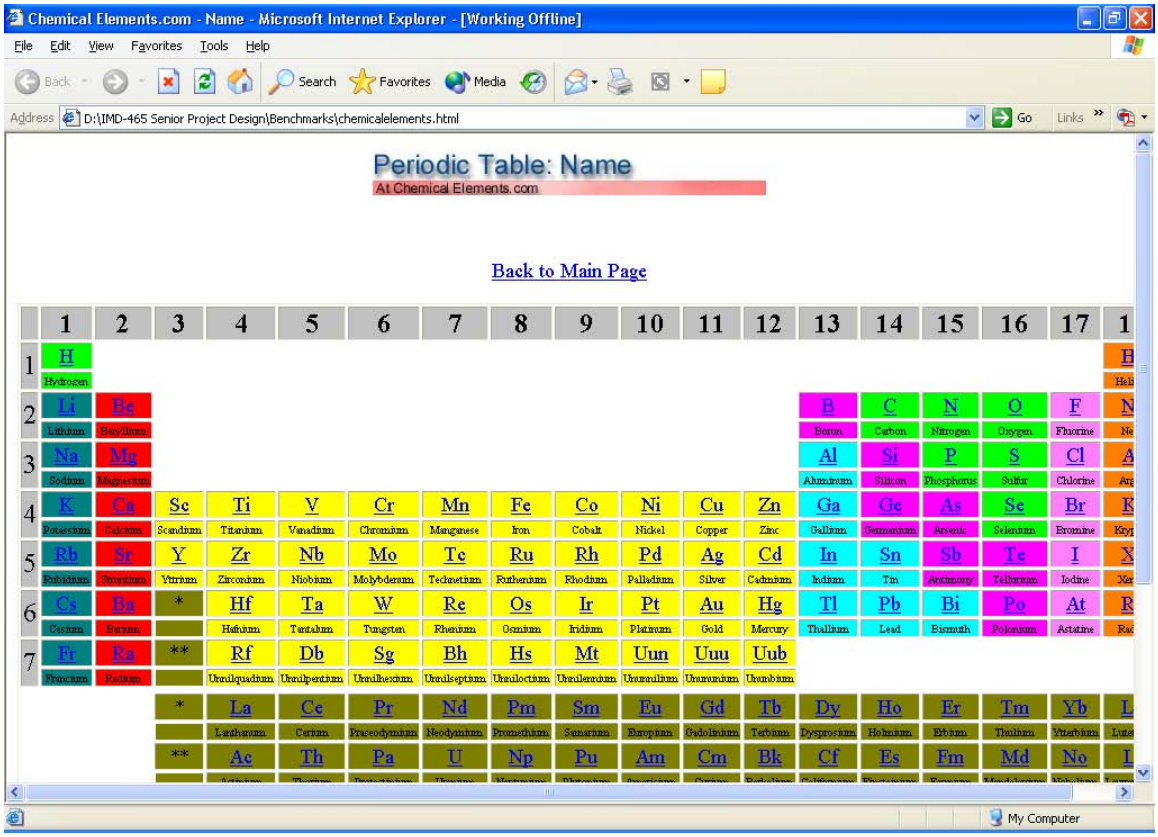
Usability:

Even though its subject matter is presented in a very watered-down fashion, the content may still be too general or broad for beginners. Also, the broken compound calculator may only add to a beginner's confusion and frustration, thus defeating the intent behind the site's educational goals. Based upon these findings, it is concluded that this site's content is intended for users who already have a little understanding of the fundamental concepts and principals involved with elements and the Periodic Table. Other than that, the site is only good for presenting a nice visual reference of the Periodic Table's arrangement according to element symbols and does not include the full element name, atomic number, or atomic mass.

Usability Rating = * (1 star / Poor)

Overall Rating Score = * * (2 stars / Fair)

Competitive Analysis # 2: Chemical Elements - http://chemicalelements.com/



Comprehension & Difficulty of Subject Matter:

The information and content provided by this particular website seems to have been designed with the consideration of various age and experience level users in mind. Through exploration of the provided interactive Periodic Table, users of all types can quickly engage themselves in this learning process regardless of their background knowledge of this subject and material. All elements are clearly labeled on the table using both the Atomic Symbol and the Element's full name.

By clicking any of the given elements, the user is able to learn about the specific physical properties that make up that particular element. There are also graphic representations of each element's atomic structure that illustrate the atom's energy levels (electron configuration) as well as the number of protons and neutrons within that atom's nucleus. Historical facts relating to the discovery of each element is also provided as supplemental information. In addition to providing detailed information about each element, the site also does a good job of explaining the arrangement of the Periodic Table by each of Element Groups (Alkali Metals, Alkaline Earth Metals, Transitional Metals, Other Metals, Metalloids, Non-Metals, Halogens, Nobel Gases, and Rare Earth Metals). This site serves very well for gathering detailed data about the individual elements and their compositions, but does not offer any insight on how the elements bond together to form chemical compounds.

Comprehension & Difficulty Rating = * * * (3 stars / Good)

Features:

The features within this site depend heavily upon interaction with the provided Period Table in order to access detailed information about individual elements. This particular information cannot be accessed through direct use of the sidebar navigation. The sidebar navigation does offer an interesting feature that allows the user to select how they want the Periodic Table to display according to following criteria: Show Table With (Name, Atomic Number, Atomic Mass, Electron Configuration, Number of Neutrons, Melting Point, Boiling Point, Date of Discovery, and Crystal Structure).

Features Rating = * * * (3 stars / Good)

Design & Layout:

The design and layout of this particular site maintains solid consistency throughout. The placement of the navigation bar can always be found in the left column of the screen with all information and content falling into the main view area at the right side of the navigation column. All HTML content is left aligned adding order to the visual hierarchy of information and content. The color choice for the site's branding is very bland, using an aqua-blue hue for the background color of the navigation column, a touch of pink in the header graphic, and white for the background color of the main content. In addition to weak color choices, the site is also absent of any specific logo or branding identity.

Design & Layout Rating = * * (2 stars / Fair)

Navigation:

The aqua-blue column that is located at the left side of each page clearly and consistently indicates the global navigation. Sub-Navigation typically resides in the header of the page's main content area. Status indication is not always clearly defined. When the page status is apparent, the status indication is represented by red or pink text links within the aqua-blue sidebar.

Navigation Rating = * * (2 stars / Fair)

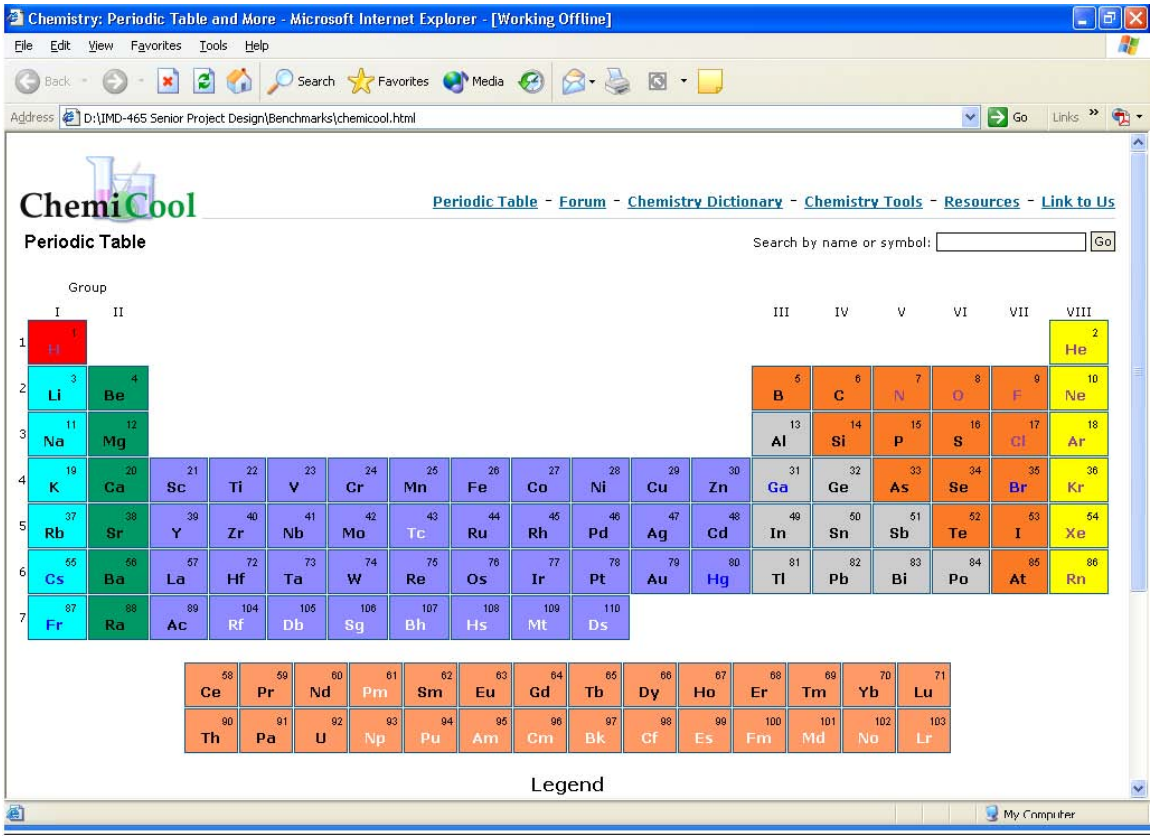
Usability:

Other than the issues relating to page status indication within the global navigation and the odd placement of sub-navigation at the tops of various tertiary pages, the site's content is quite accessible and relatively easy to comprehend. In spite of its bad design choices regarding the color treatment and site navigation, this website provides really good resources in terms of detailed, factual information about the Periodic Table and the physical properties of all the Elements within.

Usability Rating = * * * (3 stars / Good)

Overall Rating Score = * * * (3 stars / Good)

Competitive Analysis # 3: Chemicool - http://library.advanced.org/



Comprehension & Difficulty of Subject Matter:

The information and content provided by this particular website is presented with consideration to a broad range of users both experienced and non-experienced in regards to this subject matter. At first glance of the provided Periodic Table, there is not much detail given about the elements other than the atomic symbol, atomic number, and group classification.

However, once the user clicks on any given element within the table, they are presented with an abundance of information relating to that element's composition, properties, historical facts, etc. In addition to providing all of these detailed facts, the site also offers the user options for other resources to aid the learning experience such as a Chemistry Dictionary, Chemistry Tools section, User Forum, and a Resources page.

Comprehension & Difficulty Rating = * * * (3 stars / Good)

Features:

The features within this site include the provided interactive Period Table; detailed information relating to the definitions and physical properties of all atomic elements; a user Forum for communication, questions, and help; a Dictionary of chemistry terms and definitions; and a Resource page for additional information and related content.

Features Rating = * * * (3 stars / Good)

Design & Layout:

The design and layout of this particular site remains consistent throughout. The placement of the navigation bar can always be found in the header of all the site's pages. All HTML content is left aligned and arranged in side-by-side columns adding order to the visual hierarchy of information and content while conserving the amount of page area needed to present the content. The color choice for the site's branding is very simple and clean in appearance. Consistent branding has been established through the incorporation of the stylized logo that is always displayed in the left corner of all the page headers within the site. Various colors (blue, green, lavender, and black) are used to denote text hierarchy in regards to sub-navigation, page headings, section titles, and other descriptive text content. All text and content are placed on top of a white HTML background.

Design & Layout Rating = * * * (3 stars / Good)

Navigation:

Navigation is kept quite simple and consistent through the placement within the header of each page. Naming conventions are intuitive and easy to understand and status indication is presented in by a contrasting text color along with an accompanying page title and heading. Almost any section within this site can be accesses quickly by referring to global navigation bar at the top of the pages. Sub-navigation consistently falls just underneath the global navigation and just above a page's heading or title.

Navigation Rating = * * * (3 stars / Good)

Usability:

The simplicity of this site's visual designs in addition to the information design (content choice, organization, and navigation) performs quite well in regards to user interaction, accessibility, content comprehension, and overall site functionality. The overall design of this site does a really good job of presenting this particular subject matter in a way that can be easily understood across a wide range of audiences or user types.

Usability Rating = * * * (3 stars / Good)

Overall Rating Score = * * * (3 stars / Good)

User Requirements

Visual Design & Technological Accessibility:

Requirements define the parameters or establish the rules and guidelines in which a project must adhere throughout the design process. Based upon target audience definitions, user goals, and project platform (delivery medium), the requirements for successfully interacting with this Online Application depend upon how accessible the content is in regards to visual design, technological requirements, and overall usability.

Technological Requirements for User Accessibility consist of the following:

Users must have Internet Access, either at home, library, school, etc. on either a PC or Macintosh platform computer

Users must have an up-to-date, or commonly used browser version (preferably a W3C standards compliant browser such as Mozilla FireFox. Or the more common, Internet Explorer 5.5 & higher can also be used)

Users must have an up-to-date Flash Plug-in installed with their browser in order to view the various process demonstrations (animations) and to participate in the construction activities that involve Flash-based user interaction (selecting, moving, and manipulating graphical elements on the user's screen)

Users must have a color monitor with a screen resolution of at least 728px X 1024px (Note: px=pixels)

The logo must be clickable as an extra option for returning to the intro page

Users must be old enough (7th grade & up) to comprehend the basic concepts being demonstrated (beginner, younger, and/or special-needs users may require adult assistance to get them started)

Visual Design Requirements for User Accessibility consist of the following:

- Clear and consistent labeling conventions in regards to navigation and hierarchy of content and information display
- Layout must support branding and global navigation on all pages in addition to providing tutorial content, process animations, construction interactivities, and accessibility to either a Reference Guide, or a reference glossary of defined terms and basic concepts
- Layout must be modular to accommodate the current amount of content as well as future flexibility in regards to content expansion
- Graphics must be visually engaging while still portraying the physical realism of the concepts at hand
- The Artwork must be visually and appealing across all target audience age levels
- (7^{th} grade & up)
- The Brand & Logo for the Online Application must be consistently displayed on pages
- Static Images and graphics must be optimized to reduce download time
- ALT tags should be included for all images
- TITLE tags should be included in the HEAD of all pages
- HTML will be implemented for the presentation of static or non-dynamic content
- CSS will be implemented for visually styling content and defining layout
- Flash will be used to create process demonstrations, user interactions, and the Atom Character
- Pages will need to be crosschecked for accessibility and consistency across different platforms and various browser types
- Copyright and other legal information will be clearly and consistently displayed at the foot of each page

User Definitions:

The target audiences for this online application will consist of Primary, Secondary, and Complimentary user types, which are defined as the following:

Primary Users:

(7^{th} & 8^{th} grades) Middle School Science Students

(9^{th} – 12^{th} grades) High School Science Students

Secondary Users:

People who are generally interested atomic chemistry, particle physics, and / or science in general, for their work, fun, or recreation. More specifically, a teacher or instructor that uses the application in order to inform students and or to reinforce their current lesson plans

Complimentary Users:

Thought of as those individuals who may at some time or another use this online application as a source of inspiration, and / or benchmark comparison for a particular project they are designing, which may not necessarily share similarities in content or subject matter

Primary User Persona:

Janine Hamilton

"Science and Chemistry bore me! I'd rather be out having fun and doing almost anything else."

Personal Profile

Janine is a high school student who enjoys atheletics and social activity. She would much rather spend her free time outside, playing on the court or out shopping at the mall rather than expose herself to any sort of scientific subject matter just for the enjoyment or recreation. She usually does all that she can to avoid confronting such content, such as hardly ever participating in class discussions or activities that involve math or science.

Background

- 16 yrs old, high school student
- Good Academics Overall
- Optimistic and Outgoing
- Athletic

Attributes

- Moderate Internet User
- Has 1 computer at home
- cable connection
- Prefers online research to library and book research

User Needs

- Intuitive labeling & organization
- Accurate information & content
- Positive Feedback
- Successful Interactions
- Quick & easy comprehension
- Engaging visuals to hold interest

Scenario

Janine has a Physical Science class this year and her teacher is currently finishing up lessons on atomic structures and he is about to introduce the students to chemistry.

In order to asses how well the students are going to take to this subject, the science teacher has decided to introduce the students to the "Add'em Atom" online application as a fun and ecuational primer, to the upcoming class lessons.

The current homework assignment is for each student in the class to use the internet (at home or in the library) to play the online application "Add'em Atom". After interacting with the various tutorials, demonstrations, and animations; the students are required to write a 3-page paper about what they learned.

Janine's grade is starting to slip and it is very important that she do this assignment before next week's report card grades are averaged and sent home.

Secondary User Persona:

Alex Lancaster

"Teaching science to kids is my calling. I go out of my way to find and provide my students with lessons that are both fun as well as educational."

Personal Profile

Alex Lancaster is a high school science teacher who is sincerly devoted to his students and his teaching career.

Background

- 36 yrs old, high school teacher
- Reputation as a fun teacher
- Encourages students to explore
- Creative activity & lesson planner

Attributes

- Heavy Internet User
- Has 2 computers at home
- cable connection
- Has 1 laptop computer (wireless)
- Loves technology & innovation

User Needs

- Online activities that compliment class science lessons
- Accurate information & content
- Successful Interactions
- Quick & easy comprehension for the level of his students
- Engaging visuals to hold interest

Scenario

Alex is a Physical Science teacher and he is currently finishing up lessons on atomic structures. He is about to introduce the students to chemistry but he is unsure of their current comprehension level.

In order to asses how well the students are going to take to this subject, Alex is considering the approach of to introducing his students to the "Add'em Atom" online application as a form of fun and ecuational primer, to his upcoming class lesson plans.

Complimentary User Persona:

Mr. & Mrs.Takahami

"It is our business objective to find inspirations for the development of our projects from all different types of media formats"

Professional Profile

Mr. & Mrs. Takahami own their own business developing user centered designs and interactive projects for various large scale corporations.

In order to stay ahead of their competition, Mr. & Mrs. Takahami are always searching "outside-of-the-box" for fresh and innovative approaches. By searching through different media formats for design inspirations, the Takahamis always deliver top-quality and innovative projects to their clients.

Background

- Maried Professionals
- Master Degrees
- Business success oriented
- Dynamic development team

Attributes

- Heavy Internet Users
- Both have 1 computer at home each
- Both have 1 laptop at work each
- cable connection
- Perform and apply project research across a variety of media formats

User Needs

- Inspiration for new project approaches
- Intuitive labeling & organization
- Solid Accessibilty & Usability tactics
- Successful Interactions
- Quick & easy comprehension
- Engaging or innovative visuals

Scenario

Mr. & Mrs. Takahami have just recently been contracted by one their biggest clients to develop an educational family home game that is based on rounds of player triviaand alternating rounds of various forms of player activities.

It is up to the Takahamis to create and develop the trivia questions as well as to create various activities in which the players will be required to perform during the game. The Takahamis are in the need for some fresh inspiration in regards to creating player activities that are fun and that correlate to the educational game's trivia content.

They know that one of the game catagories is Science, so they must seek out different types of scientifically based interactive projects in order to develop inspirations for the player activities, as well as for finding additional scientific based facts in which they can apply to the Science trivia section of the game they are developing.

Mr. & Mrs. Takahami have found the online interactive tutorial "Add'em Atom" and seek to incorporate some of the facts and activity concepts ito their game design.

Information Architecture:

Information architecture assimilates information gathered from project research, competitive analysis, and the user-persona definitions, into an organized blueprint for ***Add'em Atom***. The information architecture contains a conceptual site map and flow charts illustrating various user processes, along with preliminary wire frames which have been developed to define specific content placement, including information layout, site navigation, user interactions, visual design, etc.

Site Map:

Site maps are ways to visually represent how different pages, sections, and sub-sections within a website (or application), correlate to one another in regards to their hierarchal arrangement of content and subject matter that is contained within. Particularly, the site map shows all of ***Add'em Atom's*** paths, in terms of the global-navigation, sub-level navigation, and other interactive options available to the user. The order and structure of this Online-Tutorial is represented within the site map and is visually arranged according to how the topics and pages relate to one-another in regards to content. All pages and sections have been given a unique numeric identification that marks them based on their chronological succession from the "Introduction" page.

Process Flow Charts:

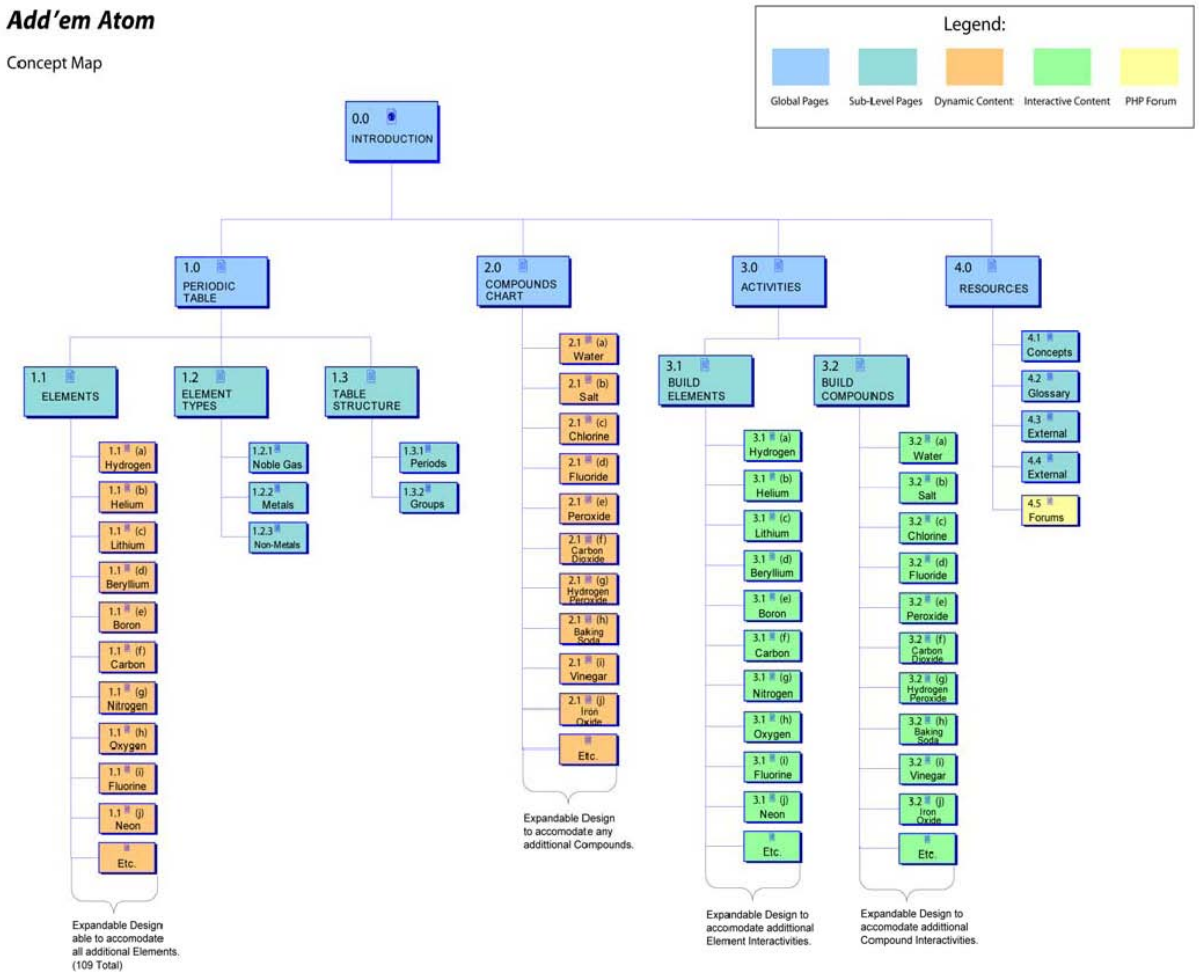
Process flow charts illustrate specific steps and procedures that a user will become involved with as they work through the tutorials and activities within ***Add'em Atom***. The charts provide a means for understanding the behavior of different processes, program functions, and potential user-scenarios simply by illustrating the "step-by-step" logic behind how a script or application interacts with its environment, the user, and other devices such as when querying a database to delivery specific, requested content.

Wire Frames:

Wire frames are important tools to use, especially when dealing with the design and layout of information within a specifically defined area such as a web page, table-cell, div element, i-frame, etc. The wire frames provide a "loose" glimpse of what a page or section of a website (or application) might look like upon the addition of general content such as text, image-placeholders, graphic areas, etc. along with the inclusion of design factors like key project and user-centered design requirements.

Add'em Atom

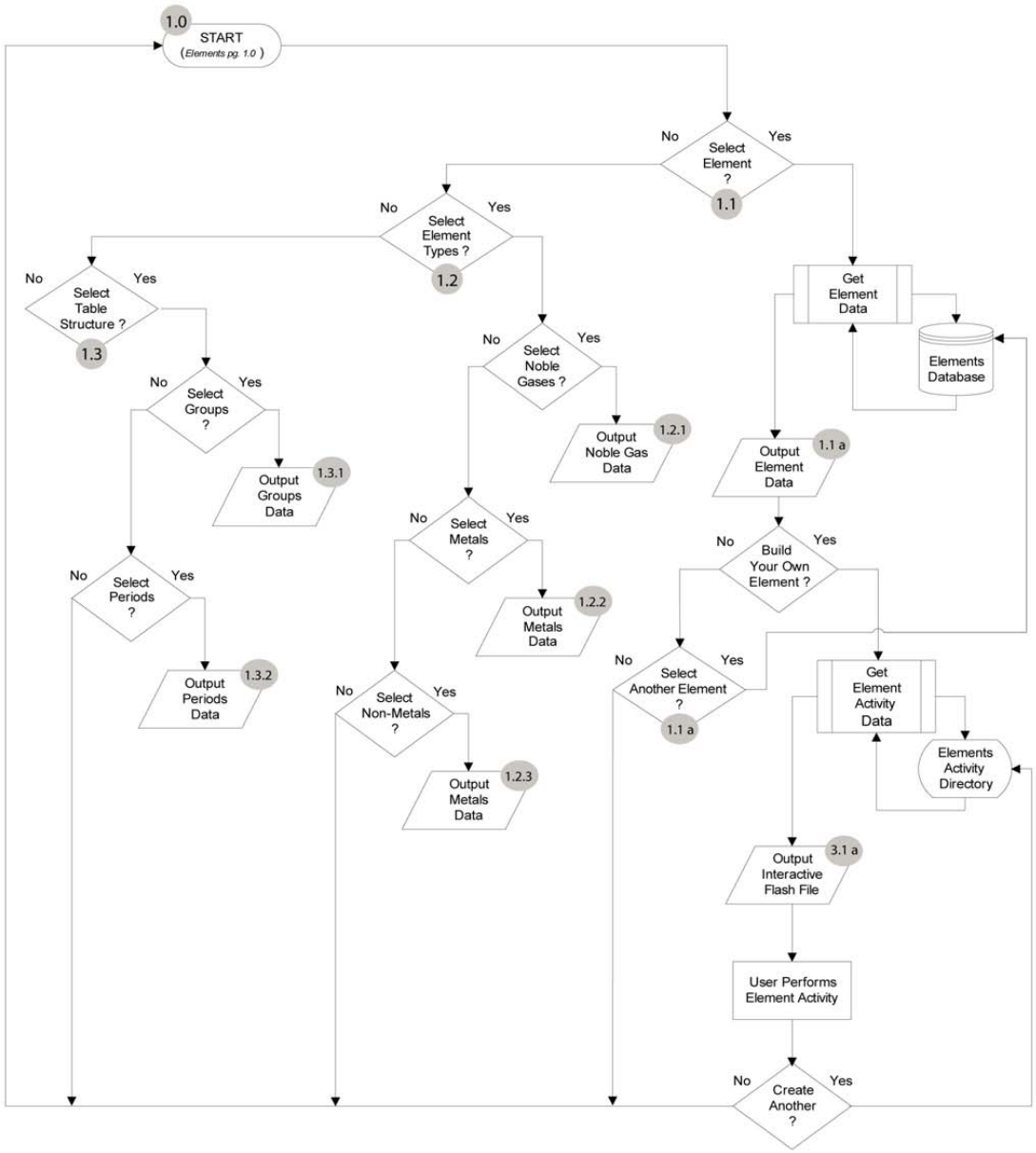
Concept Map

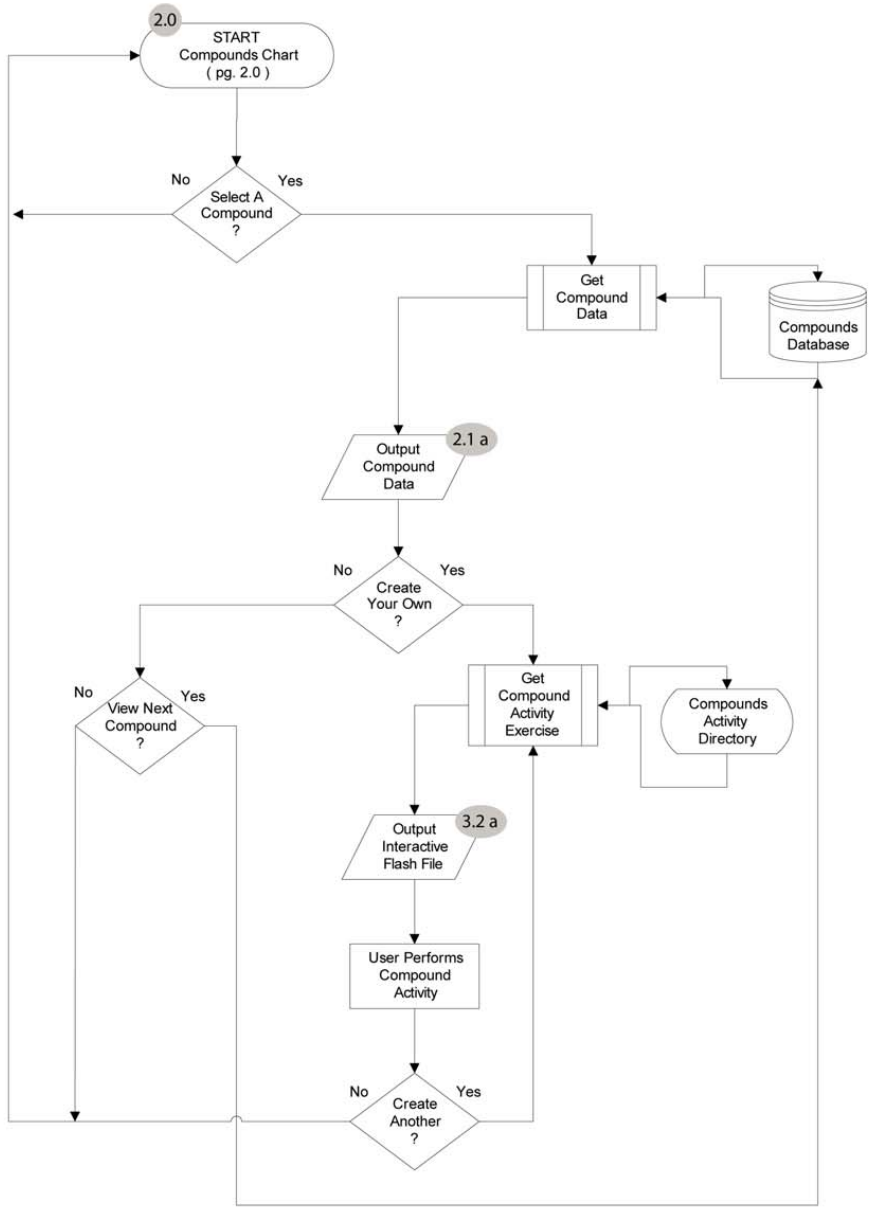


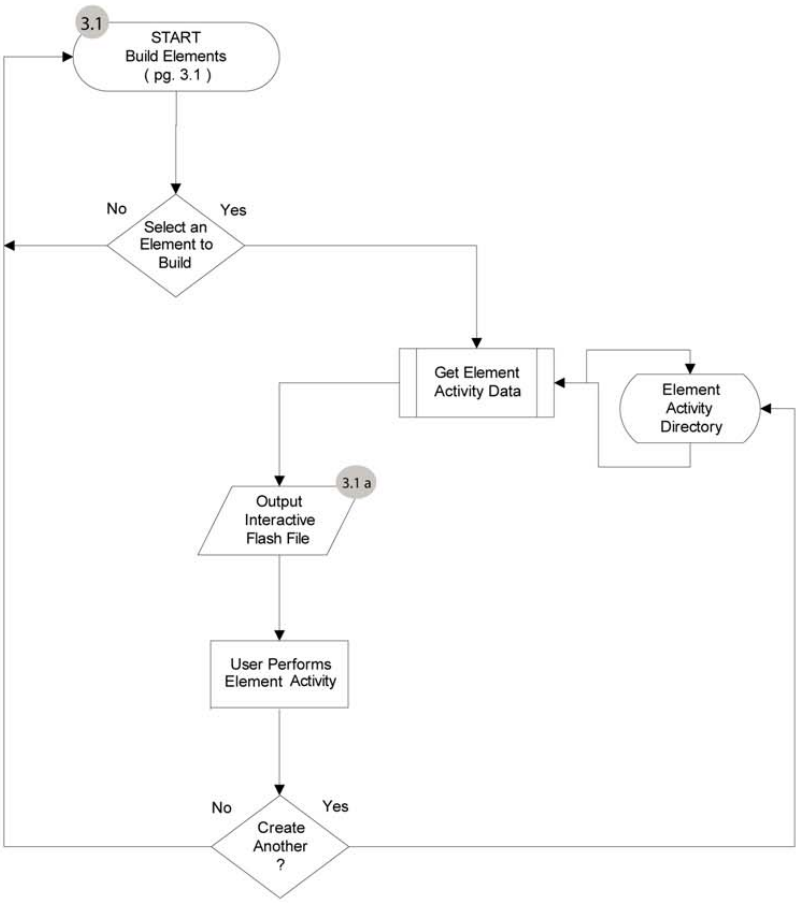
Add'em Atom

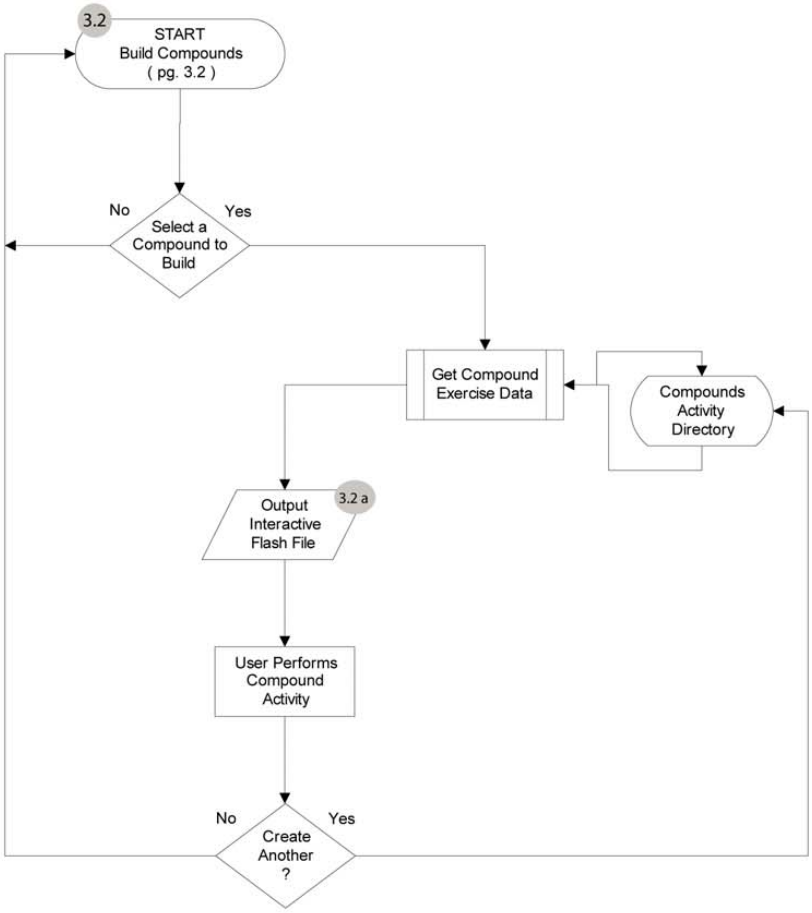
Periodic Table Process Flow

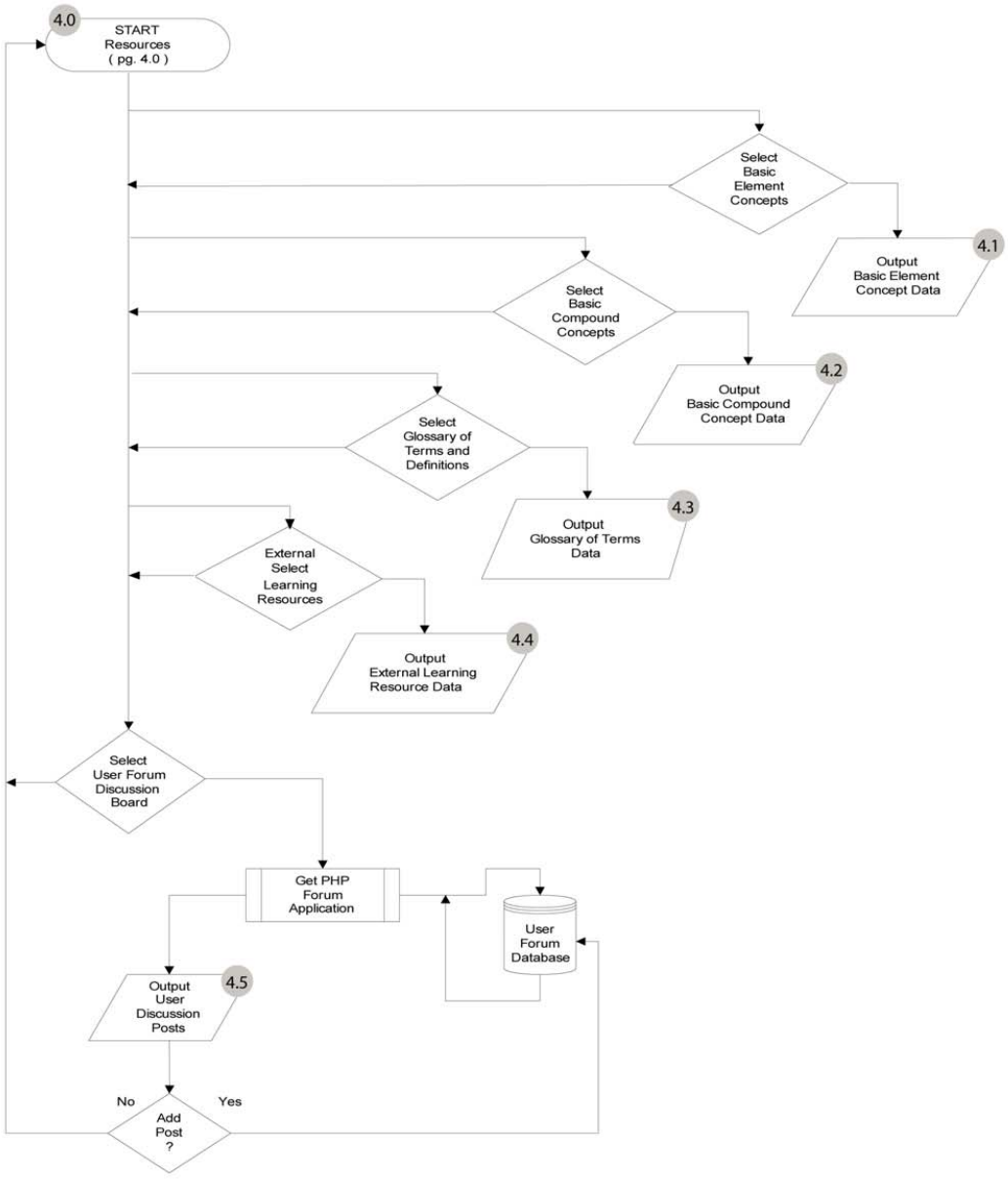
Periodic Table - #1.0 Elements - #1.1 Element Info - #1.1 a Element Types - #1.2 Table Structure - #1.3 Element Activity - #3.1 a.

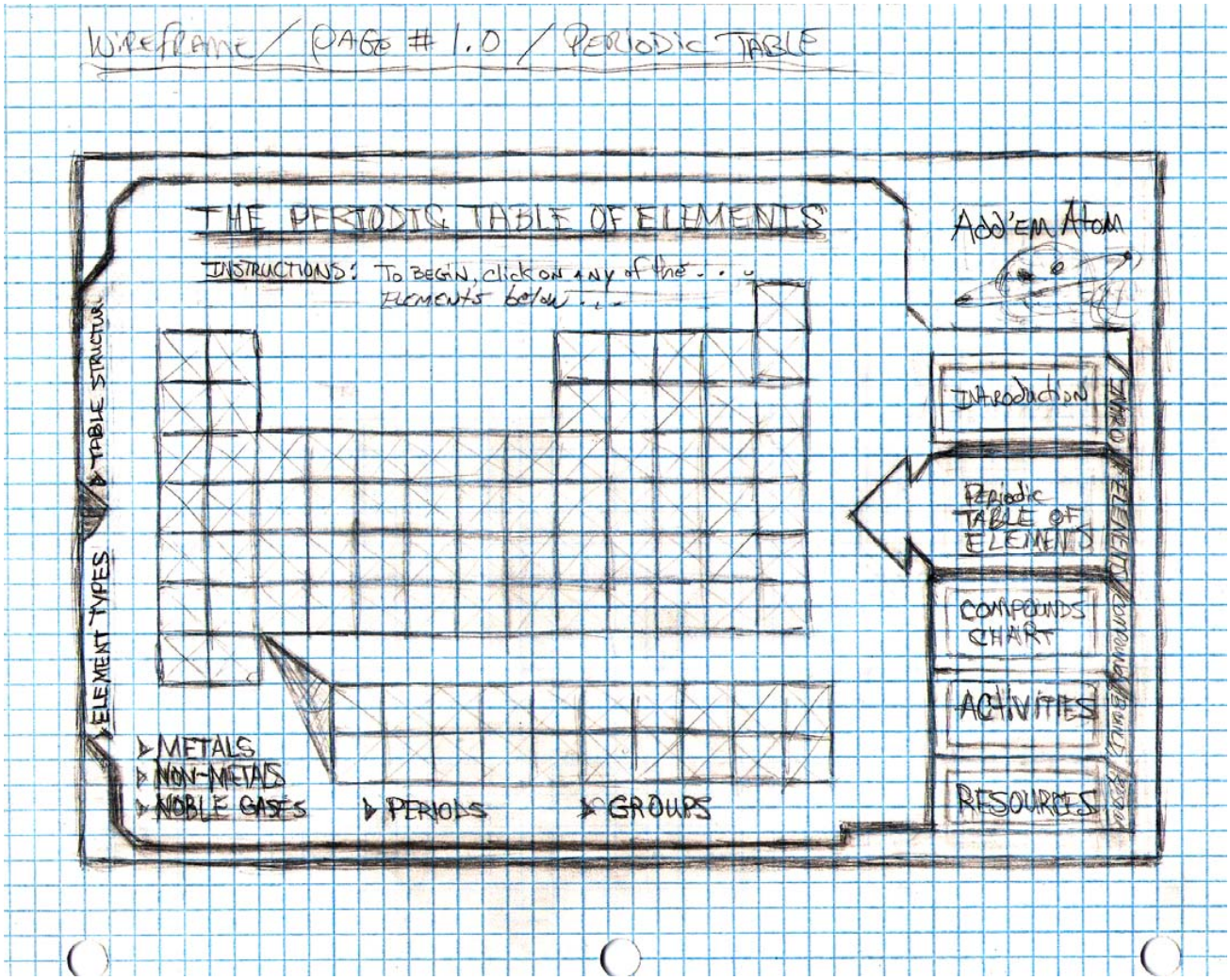


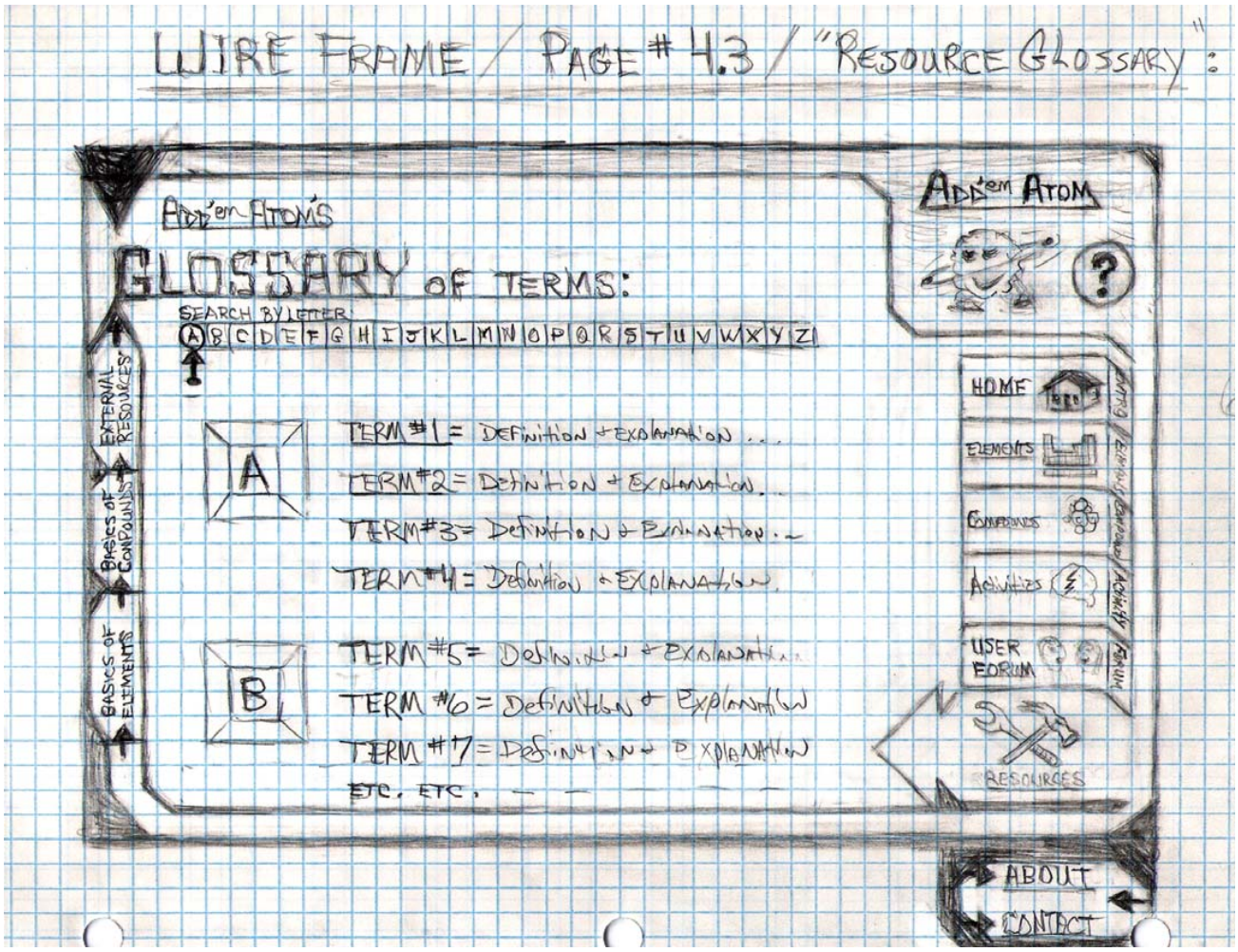












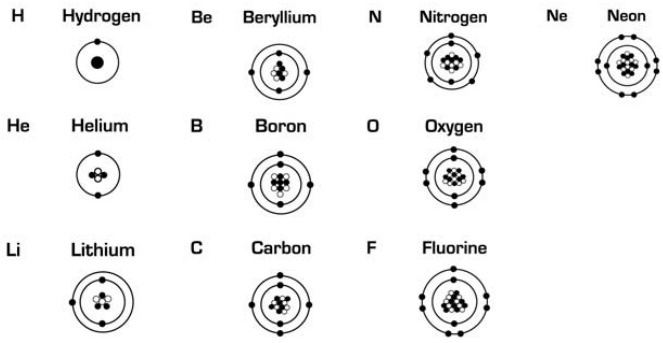
Preliminary Artwork:

Below are the preliminary artwork designs for the ***Add'em Atom*** online application, including the character design for the branding logo as well as the artwork for the animated avatar character, named ***Add'em Atom***. The artwork for the first ten elements is also illustrated below:

Character Design:

Logo Design:

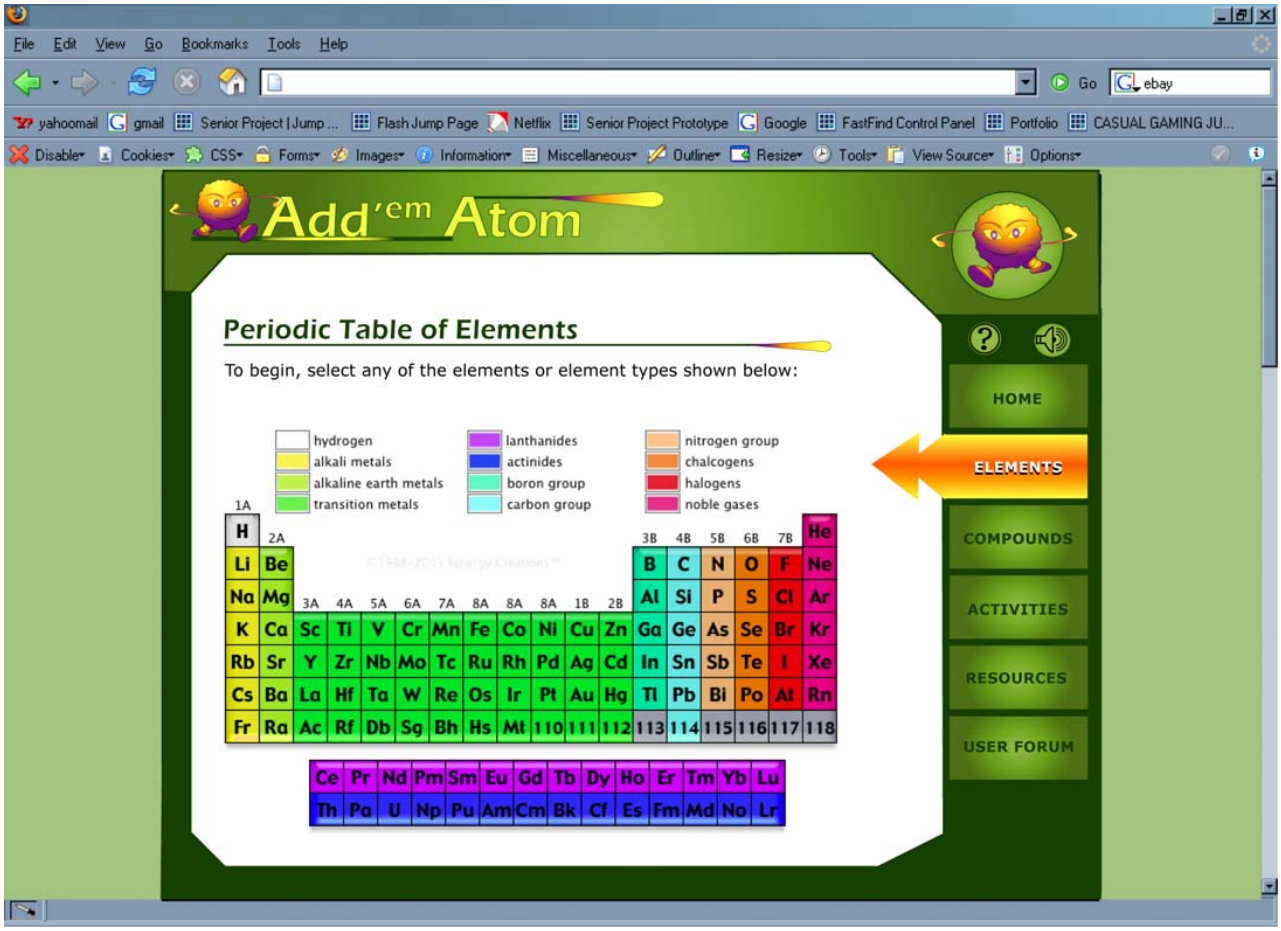
Element Design:



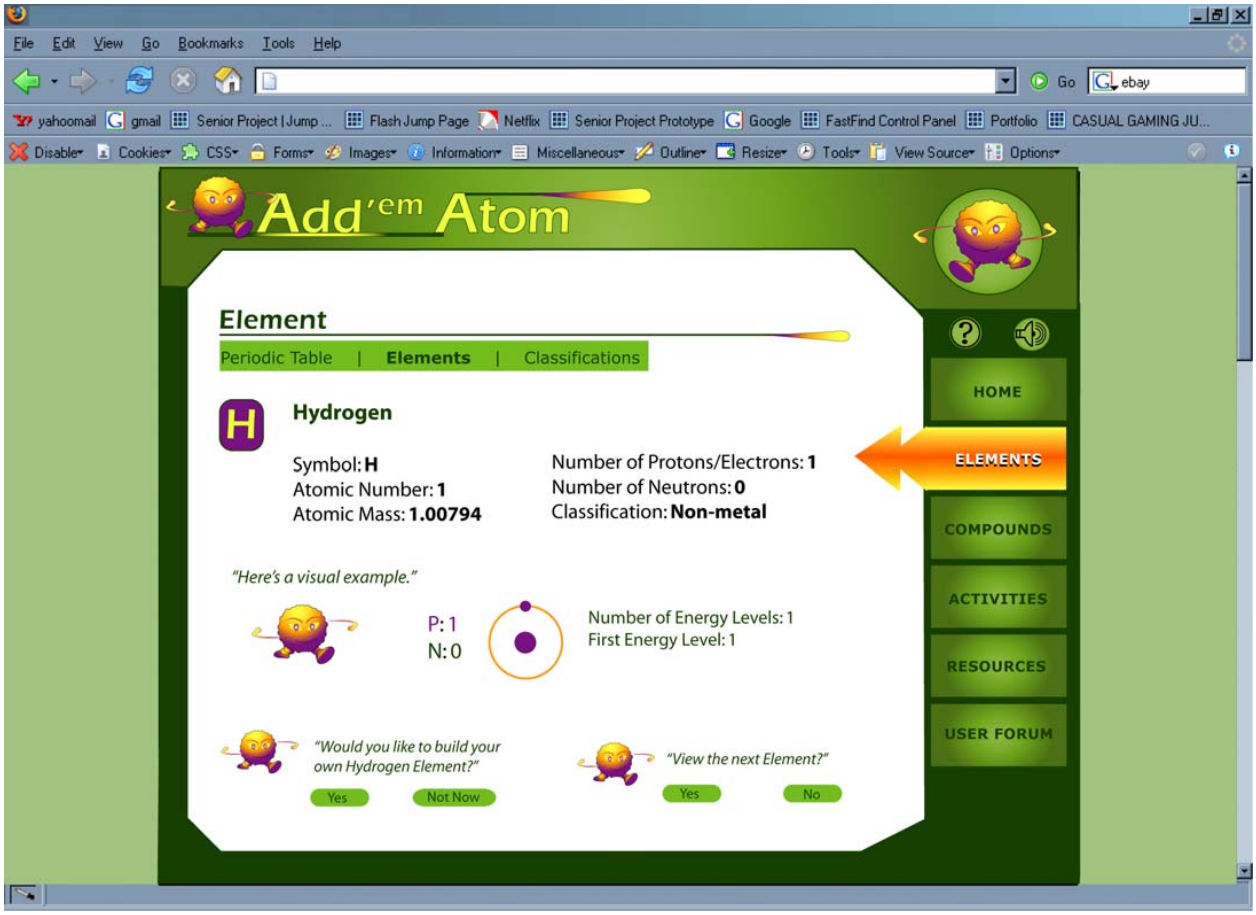
Interface Visual Comps:

Below are the visual comp designs for the ***Add'em Atom*** online application. These comps illustrate the layout, artwork, global & sub-navigation for the "Periodic Table" page, the "Hydrogen Element" page, and the "Resource Glossary" page.

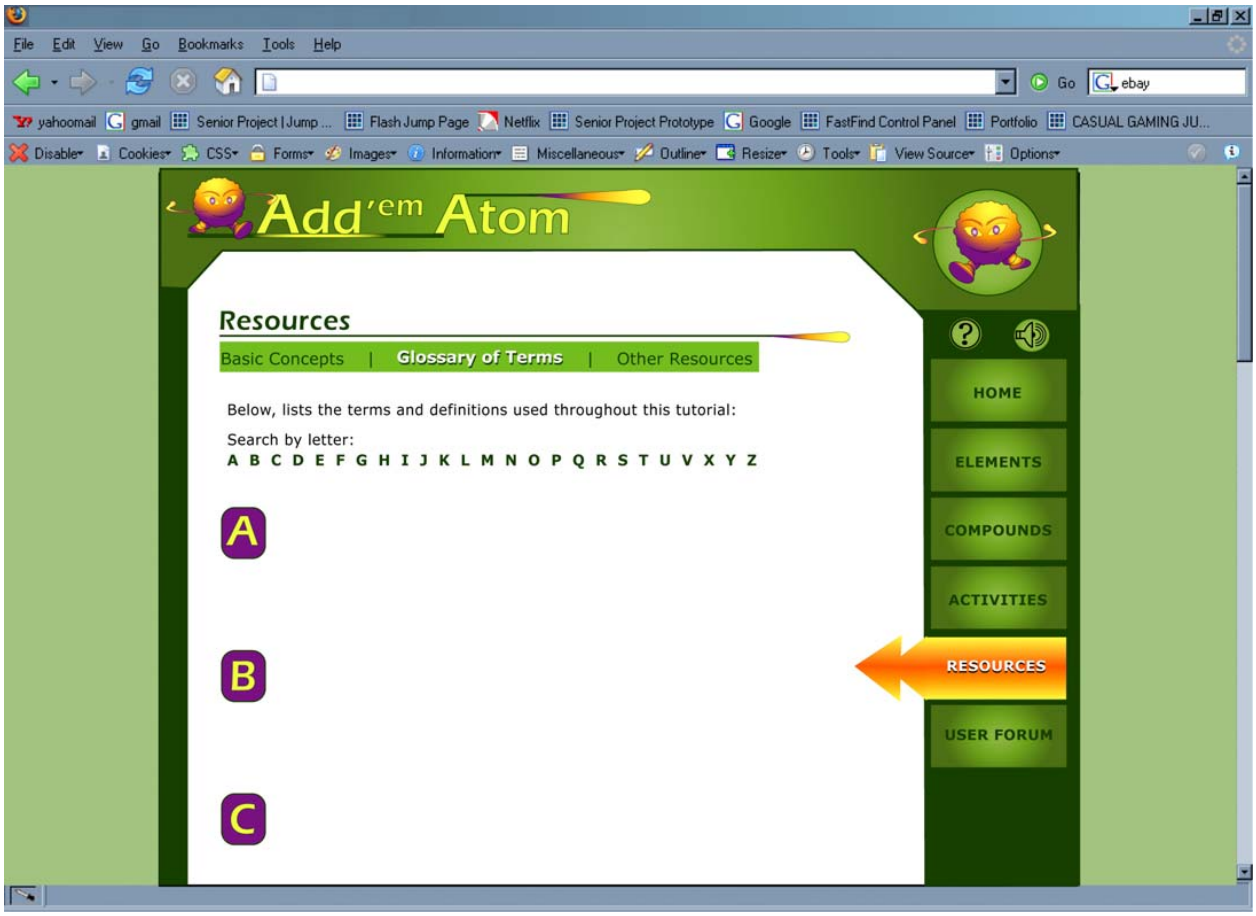
Periodic Table Visual Comp:



Hydrogen Element Visual Comp:

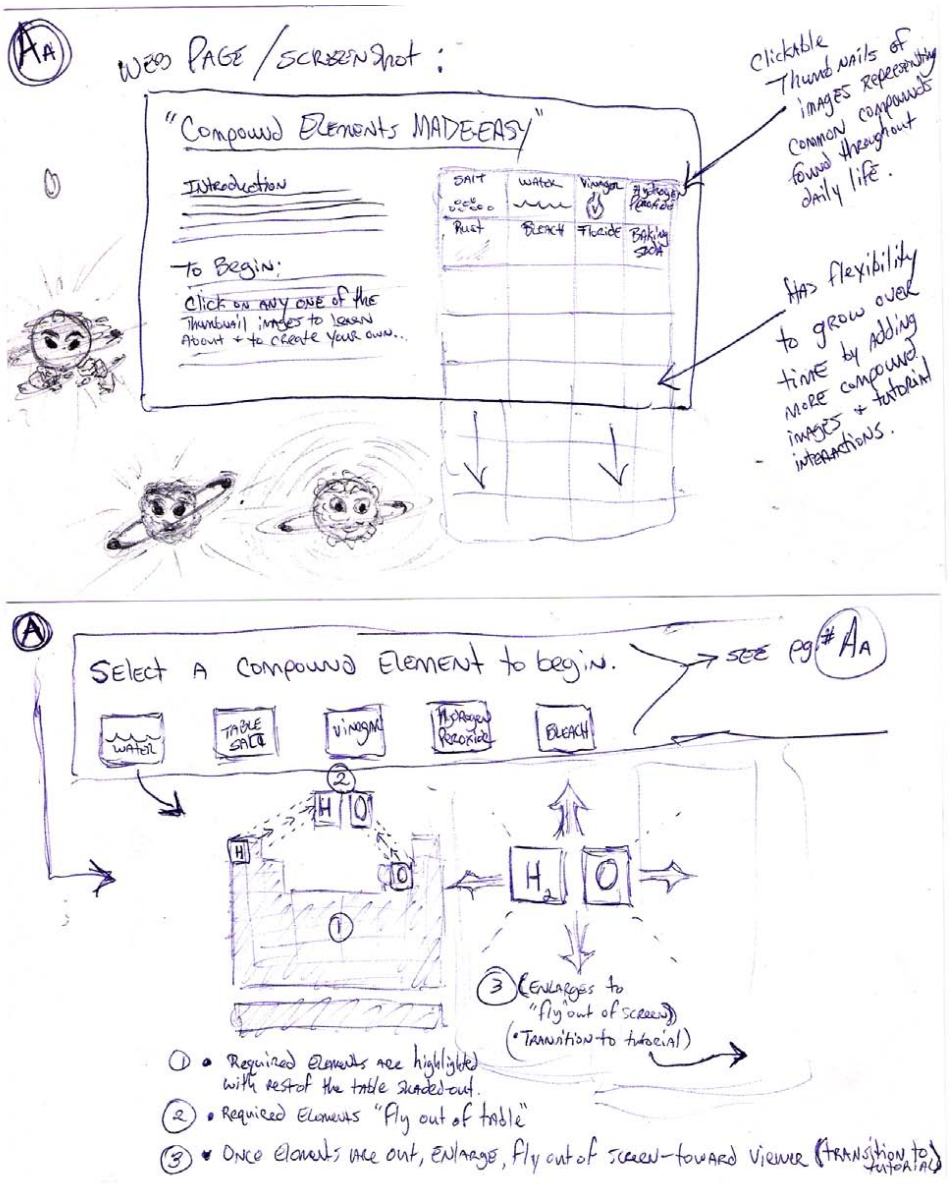


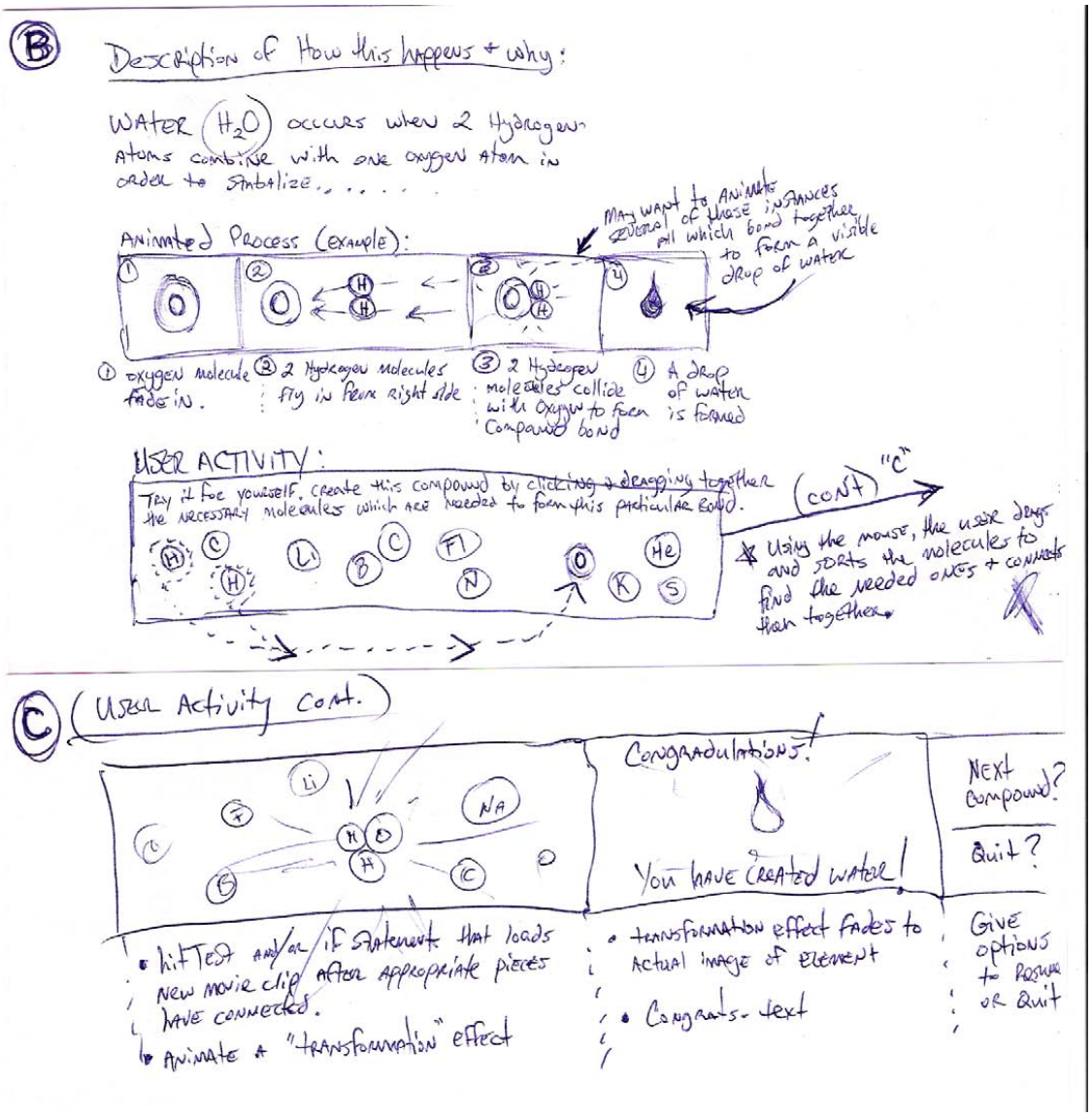
Resource Glossary Visual Comp:



Storyboards of Interactive Processes:

Below are the storyboards, which illustrate the user interactions within the "Compounds" section of the ***Add[em] Atom*** application.





Project Branding:

This section contains the project branding ***Add'em Atom*** along with the logo style guide and the branding concept note.

Branding in color (at different scales):

Style Guide:

Font Face: Eurostile
Font Colors: Yellow with Dk. Green Outline
Background Color: Lt. Green
Character Colors: Orange & Purple Gradients

Branding in black & white (at different scales):

Style Guide:

Font Face: Eurostile
Font Colors: Yellow with Dk. Green Outline
Background Color: Lt. Green
Character Colors: Orange & Purple Gradients

Branding Concept Note:

The concept for ***Add'em Atom's*** visual branding is designed specifically for the project's target audience groups, which are middle school & high school students. The mood of the branding should reflect "fun" and "energetic" emotion through the use of bright and vivid colors along with a visually interesting character that can add personification to the project.

Typography

The font selected for use in the logotype is *Eurostyle*. Chosen for its somewhat "techy" appearance, it conveys a hip up-to-date feeling, without being too dramatic or unreadable. As a sans-serif typeface, it contrasts with the character in the logo symbol, providing a visual balance between the rounded character and the logotype. Eurostyle can appeal to a wide range of students in the target audience, from the youngest to the oldest.

Color

Each color selected in the logotype and logo symbol were chosen because of their ability to convey a feeling of excitement, energy, fun and wealth of knowledge – all of which can be found in the ***Add'em Atom*** application. Complimentary colors, such as purple and orange really "pop" against one another, adding life to the character, even when he's static.

Character Design

Add'em Atom is an animated atom with electron orbits for arms, a face within the nucleus, and two legs. Though male in gender, the colors chosen to help bring ***Add'em Atom*** to life are gender neutral. Illustrated with animation in mind for the future, his static pose is already somewhat animated, and the colors help reinforce the allusion to momentum and the potential force that resides in every atom.

Usability Evaluation

Methodology

The methodology behind the user testing of this project involved specific task scenarios that were performed by users, which were just outside of the target audience group defined by this project. Due to time constraints brought about by technical issues involving production, the user testing turned out to be much more informal than originally intended. It was my intent to test up to ten users from the defined target audience group, which are middle school and high school students in grade levels 8th & up, as well as an instructor that teaches physical science on such a level. It was intended that the interactions and comments from users of this particular group be recorded using a web-cam and the screen-capturing program "Camtasia", in addition to the notes being collected as I performed the role of the test observer.

However, time limitations became a conflict in regards to recruiting users from the primary target audience and so usability testing was performed using just four, 7th grade students and their biology teacher. User tests and evaluation of the "Add'em-Atom" project could only be performed using those students, which were available during the remaining time-frame, while under the terms and circumstances that the testing environment allowed. Due to the age level of the provided test subjects along with having to adhere to school policies and regulations, these tests could not be performed using the online version of "Add'em-Atom" because of Internet access restrictions assigned to the school's computers. Nor, could these test subjects be visually recorded without prior parental and administrative consent. All of these factors contributed to informal user test sessions with minimal hard data collected in terms of being able to accurately record user comments, expressions, and interactions.

The data assimilated from the results of these tests are compiled only from my experience as the test facilitator and as the note-taking observer.

Test Instruments & Environment

The usability testing of "Add'em-Atom" was held at the location of West Hall Middle School, on two separate days using a borrowed laptop computer along with printed user test scenarios and post questionnaire sheets for those to be tested. No additional software or recording devices were used other than Internet Explorer (for running "Add'em-Atom" locally on the laptop) and my own shorthand notation (for noting user actions, comments, and suggestions).

On the day of Friday February 23rd, 2007; usability tests were performed with two students during the 6th period time slot (last class before bus loading & dismissal). Distractions were abundant as many of the students in the class felt the need to interject their own comments and questions, distracting both the student who was performing the test as well as myself who was trying to observe and take proper notes. The results of this test round are somewhat inconclusive and it's hard to determine the accuracy of the data collected during this particular session. However, this round of testing did manage to reveal a couple of technical issues that are significant enough to create certain usability problems across all audiences and user groups. The results of these findings, along with a sample of the given test scenarios are outlined below.

User Testing – Performance Tasks

The students who performed the usability tests on the "Add'em-Atom" application were given the following five tasks to perform as a gauge to measure the effectiveness of the project in relation to how well it meets the defined goals and objectives that are required for its success.

Usability Task Sheet:

(See the following page of this document)

Usability Test Results:

(See the section following the "Usability Task Sheet" within this document)

User Performance Tasks / User Task Sheet:

Thank you for participating in the "Add'em-Atom" usability evaluation. In a moment you'll be asked to perform a few basic tasks using a computer and a science application called "Add'em-Atom".

Please do your best to complete the following tasks provided below.
Note: * * There is no right or wrong method for any of these tasks. * * *

The tasks are only given as a means for the developer to see how well this system works for you and to determine its success as a beneficial and user-friendly product.

*** * *** If you feel the need to express your thoughts out loud, please do so. However, if you require help in trying to complete any of the tasks, please be aware that the test observer is not allowed to tell you any definite solution.

*** * *** You may at anytime chose to skip a task and move on to the next one, if you feel there is no solution available, or if you feel that task is taking too long to complete. Just let the observer know you are skipping and explain your reason(s) why.

Let's Begin! . . .

1.) Starting from the "Add'em-Atom" Home page, explore the various links and options available throughout, to find details and information about the atomic element named "Nitrogen (N)".

2.) Return to the Home page and then perform the following: Find the definition for the term "Lanthanide".

3.) Now, got to the section titled "Activities" and see if you are able to complete 3 successful "Element" or "Compound" exercises (choose one or the other).

4.) Within "Add'em-Atom", see if you can find out the name of the Atomic Classification that the Element "Oxygen (O)" belongs to.

5.) Find the Compound named "Hydrogen-Sulfide" and see if you can determine what type of chemical bond it has.

User Testing Results – Evaluation of Tasks Performed

The two students who participated in the first session of usability testing (*Test Session #1 - 2/23/2007*) led to the following findings, which were collected during my observations as the test facilitator, taking notes of the interaction responses and verbal feedback given by the students as they performed these Tasks.

Participant #1: (*Session #1*)

Task #1: **Degree of Success:**

Successful –
Achieved in less than a couple of minutes.

Problems / Usability Issues Found:

Cross-Browser Incompatibility –
Student made verbal comment regarding the display of the pop-up images that appear when hovering over elements in the Periodic Table, even though the element needed to complete the task was not really affected.

"The pop-ups are a cool effect…is the rest of the page supposed to look like that?"

Cause of the Problem –
There exists common bug regarding Internet Explorer's non-standards compliancy. Asynchronous JavaScript and CSS are being used to display the hovering pop-up effects and due to the differences in how standards-based and non-standard browsers treat the "box-model" display method.

Solution to the Problem –
Some of the code behind these functions will need to be edited or appended to in order to specifically handle the given situation for Internet Explorer. Note: Other browsers will need to be checked for consistency as well.

Task #2: Degree of Success:

Successful –
The user achieved the task with some delay. He hesitated using the glossary at first by arriving at the "Resource" section, then navigating back out to the "Home" page. A few moments passed in which he re-read the contents on the "Home" page, then suddenly returned to the "Resource" section and searched the "Glossary" to successfully find the answer.

Problems / Usability Issues Found:

Nothing Critical –
The student had some delay, in which he later stated:

> **"I thought I remembered seeing that word on the home page for some reason"**

Cause of the Problem –
Together we concluded that he probably remembered seeing the term "Lanthanides" above the Periodic Table when he was trying to complete Task #1, as well as slight confusion regarding the wording of how the Task was posed.

Solution to the Problem –
No solution seems to be needed for this particular situation.

Task #3: Degree of Success:

Successful –
The user chose and completed the 3 Element constructions as requested by the given task, then went on to complete two more in addition before I mentioned that he did not need to go any farther. His reply:

> **"Oh! … Sorry, I got distracted by playing and didn't know I had already done all three of them. "**

Problems / Usability Issues Found:

Nothing Critical –
The student did mention the lack of audio treatment when comparing wrong selections to the proper ones.

> **"Why is there no sound for when I win? Is something broke? Did I do something wrong?"**

Cause of the Problem –
There is no audio file currently created for the success scenarios within the "Activities" section.

Solution to the Problem –
An audio file will soon be incorporated into that feature to compliment the audio that currently exists for the error scenarios within the "Activities" section.

Task #4: Degree of Success:

Unsuccessful –
The user chose to abandon Task #4 after spending a few minutes searching for the answer. At first, he chose the appropriate section, which is the "Elements" section with the Periodic Table. After "hovering around for just a moment he navigated to the "Resource" section and spent a good deal of there time trying to find the solution, but gave up after he could not find it there.

> **"It seems like this is where I should be looking, but I can't seem to find anything to help."**

Problems / Usability Issues Found:

Unobvious Labeling Convention –
A couple of options could have been explored to find the answer for this Task, such as by clicking on the Element of "Oxygen (O)" on the Periodic Table, as well as navigating through the different "Classes" shown above the Periodic Table.

Cause of the Problem –
The "Classes" shown above the Periodic Table do not have the large pop-up graphics like those that appear when the Elements are hovered over. After skipping this Task, we concluded that he might have found it sooner if the "Classes" carried the same visual treatment as the Elements.

Solution to the Problem –
Create larger graphics to be incorporated along with the Element graphics that appear upon hovering.

Task #5: **Degree of Success:**

Successful –
He was able to find the Compound rather quickly by navigating to the "Compounds" section where he selected the appropriate Compound Model, then found the answer within the details given for that particular Compound. The user commented:

"That was pretty easy to do."

Problems / Usability Issues Found:

There are no issues to be resolved for this Task at the time.

Participant #2: (*Session #1*)

Task #1: **Degree of Success:**

Successful –
This student had no problem completing this Task and found the answer very quickly by referencing the Periodic Table within the "Elements" section and clicking the correct graphic that represents "Nitrogen (N)".

Problems / Usability Issues Found:

No New Issues Found –
(Pre-Existing Issue of Cross-Browser Incompatibility)
Though not mentioned by this particular user, the issue of browser cross-compatibility still exists along with the proposed solutions being considered, as they are described in the findings collected as Participant #1 performed this same Task (Task #1).

Task #2: **Degree of Success:**

Unsuccessful –
This user who is obviously rushing through the task, mistakenly settled for the page detailing information for the Element Class named "Actinides" rather than "Lanthanides" which was needed to successfully complete this particular Task.

Problems / Usability Issues Found:

User Error –
This student assumed that he was on the relevant page without double-checking the requirements for this Task. Without any questions, or contemplations that could be observed, he moved right along to the next Task confidently saying:

"O.k., I found it."

Cause of the Problem –
The user misread and/or misunderstood the requirements for this Task, probably due to the fact that it was late in the school day and all of the other students in the class were being loud and rowdy as they waited for the buses to be announced to take them home.

Solution to the Problem –
The obvious solution determined to remedy the user error that resulted from this Task is to try and establish a more suitable environment in which test participants can concentrate and perform the given Tasks without any distractions and interferences from other students or situational factors.

Task #3: **Degree of Success:**

Successful –
Although the user completed this Task with success, a bit of frustration became apparent as he chose to select various atoms at random in a hurried effort to rush through the Compound Activities. As wrong choices were being made, "*grunts*" & "groans" could be heard amongst other "*mumblings*" of dissatisfaction. I even heard a touch of profanity as he continued into the 2nd & 3rd Activity for this Task.

Problems / Usability Issues Found:

User Error –
This user succeeded in finishing this Task, but only after the elimination of all wrong options for the first Task Activity, and the elimination of all but one wrong option for the other two Tasks that succeeded. No patience was given for trying to determine the proper method for successfully completing these Activities, and so it seems as though there was no beneficial knowledge or value gained by this user from performing these Tasks in such a manner.

Cause of the Problem –
This student would not slow down enough to fully read and comprehend the Task's requirements, overlooked the directions given by "Add'em-Atom's" instruction screen, and never once referred to the "Atomic Hints" which are provided within the content of the these Activities.

Solution to the Problem –
As mentioned in the solution given for this participant's attempt at completing Task #2, an obvious solution is to try and establish a more suitable environment in which test participants can concentrate and perform the given Tasks without any distractions and interferences from other students or situational factors.

Task #4: **Degree of Success:**

Unsuccessful –
After just a minute or so of clicking through different sections of "Add'em-Atom", this user chose to abandon the Task stating:

"Who cares…this is stupid anyway."

The participant then got up and went over to the other side of the room to sit and talk among some of the other students.

Problems / Usability Issues Found:

(See the problems & solutions defined for this user in the Task Evaluations described above (Tasks #1 - #3).

Conclusions Based Upon Testing Session #1:

Test Location Issues:

A quite and non-disruptive environment in which to test the "Add'em-Atom" application is crucial to quality fact finding that results from properly collecting true user data.

Only one student or test participant should be allowed at the computer at a time. It was an obvious distraction to both the test subjects, including myself because other students were constantly asking questions, giving advise, opinions, and making various comments during much of the test session.

Technical Issues Found:

This testing session (Session #1) did reveal a couple of minor usability issues. Specifically, technical problems that until now had gone unnoticed soon became apparent as "Add'em-Atom" under went the first testing session using a laptop computer and the Internet Explorer browser.

In addition to the browser compatibility issue, I became aware (though not mentioned by the test participants) that some areas of important content are initially hidden due to the layout of the interface, which requires a good deal of page scrolling to view content that goes beyond the browser window's page fold. Much of this occurs in situations where limited screen dimension is available as when using lower resolution monitors (such as the laptop I used for this particular test session), those below 1024 X 768 display capability.

Also, it was noted during Participant #1's evaluation, that there is a need to create hovering image effects for the Atomic Element Classes like those effects currently applied to the Elements of the Periodic Table.