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A DIGITAL FLORA OF SOUTHEASTERN IDAHO

by

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To the Graduate Faculty:

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ABSTRACT

Modern technology facilitates quicker and more efficient processing of scientific information. There is an increasing desire and need for biological information to be in formats that extend the effectiveness of this data. Plant identification is a task that can readily benefit from digitized materials. The usability of both technical keys and visual field guides can be enhanced by combining them with a flexible interface that only a digital format can provide.

I have developed an image-based digital field guide and key for the common, native plants in Southeastern Idaho. This digital resource makes identifying plants more efficient for botanists, students, and recreationists. A major objective for this project is to connect biological information with a wide variety of users.

Introduction

With the rapid growth in information technology, the scientific process is becoming faster and easier. One facet of this is the ability to retrieve biological information and connect that information to a wide range of users. There is an increasing desire and need for biological information to be in digital formats that facilitate the use of modern technology to access this information (Smith and Blagoderov 2012). This digitized information can be utilized beyond making collections more available to researchers, by providing access for education and the general public (Beaman and Cellinese 2012, Viscardi 2011).

Immense amounts of biological information are stored in the form of natural history collections in museums and universities (Viscardi 2011). These specimens represent the foundation of our understanding of biodiversity and ecosystems change (Cook et al. 2014, Viscardi 2011, Smith and Blagoderov 2012). Museum specimens help enable our understanding of ecosystem complexity, diversity and sustainability. However, there is a disconnect between those scientists who collect specimens to study diversity and the students who need to understand and appreciate biodiversity (Powers et al. 2014). Digitization is a gateway to bring biological specimens and natural history collections into the classrooms and into the hands of citizen scientists. Digitizing collections creates new pathways for distribution and use which allow educators and students who are not present at the institutions housing collections to incorporate the collections into inquiry-driven and active lesson plans (Cook et al. 2014). With organizations including the National Science Foundation (Advancing Digitization of

Biodiversity Collections; Integrated Digitized Biocollections) and programs such as the

NSF-sponsored AIM-UP (Advancing Integration of Museums into Undergraduate

Programs) are seeking to modernize and expand the role of natural history collection

into undergraduate biology education, a new and important dimension is being added

to learning that appeals to the technology-oriented next generation of scientists

(Powers et al. 2014).

Botany is a field of the natural sciences that benefits from the digitization of

resources. Herbaria are vast repositories of plant specimens with associated ecological

and taxonomic information. Botanists use the irreplaceable herbarium specimens and

their associated collection data for research that goes beyond identification into

investigations of ecosystems change over time, genetic analysis and evolutionary

change (Culley 2013). The usefulness of these specimens is accompanied by barriers

that inhibit their use. Herbarium specimens are very delicate to handle and deteriorate

with time and use. A researcher must to go to the physical location of the voucher or

physically transport them in order to utilize these valuable specimens (Culley 2013).

Recently, there has been a push to digitize herbarium specimens so that these fragile

resources can be preserved and the data made available to researchers and other user

groups (iDiGBio; Consortium of the Pacific Northwest Herbaria). The digitizing process

includes taking high resolution images of the voucher and connecting those images with

the information on the labels and link it all in a searchable database (Smith and

Blagoderov 2012). This format allows the vouchers to be used without being physically

handled and also allows a researcher to access the image and information from

anywhere with an internet connection (Consortium of the Pacific Northwest Herbaria).

Herbaria have realized the value of digitizing their specimens in order to preserve them while at the same time making them more available to users (Kemp 2015). Herbaria have joined forces and combined their botanical voucher databases together to create online consortia where the information from many herbaria and millions of specimens can all be accessed through a common web interface (Consortium of the Pacific Northwest Herbaria).

Plant identification has traditionally been practiced by using plant keys and manuals in the form of books (Woodland 2009). Botanical texts are often technical and term-based, making them difficult to use. They can be very intimidating for those who are not trained in botanical terminology (Kelly 2002). Field guides, while having a more visual format, can also be hard to use to identify plants because they are limited in printed space to show quality pictures along with useful descriptions and may not include all the species present in the geographic area covered. These hard copy texts are often cumbersome to carry and use in the field. The task of identifying plants this way is time consuming because it requires the user to search through physical pages to compare descriptions and images and to follow a specific progression through a key to reach the resulting identification (Woodland 2002).

The logical next step in the evolution of botanical identification is following the example of the herbarium consortia to digitize and link information to improve its ease of use and access. Creating digital online keys for botanical identification would increase the usability of these types of resources, including digitized herbarium vouchers. A

digital key could combine the breadth and rigor of technical texts with the more visual aspects of field guides while enhancing both with a flexible interface that only a digital format can provide.

Idaho is a region that has many opportunities for research and recreation involving plants. The varied ecological regions reflect its diverse plant species. There is a need for digital plant identification resources that focus specifically on the regions and plant species of Idaho. Working as a botanist for the U.S. Forest Service in the Caribou-Targhee forest, I spent many hours in the field and office questing through numerous technical keys and guides in order to identify plants. The existing botanical texts that cover the plants of Idaho, such as the Flora of the Pacific Northwest (Hitchcock & Cronquist 1973) and Intermountain Flora (Cronquist et al. 1972), are large volumes that contain difficult technical keys encompassing a much larger area than is often relevant. The field guides that are available, like Plants of the Rocky Mountains (Kershaw et al. 1998) and Great Basin Wildflowers (Blackwell 2006), focus on surrounding states and only overlap portions of Idaho. Often I would need to look up and compare species in multiple books to find enough information and visual aids to make a positive identification. A botanical work that combines the available information and images about plants of a specific region would be a valuable resource. The ease of use and time saving features of a digital key will shave off hours of searching and reduce the physical space of such a resource.

The requirements that a digital key and guide would need to meet to be a worthwhile and advantageous resource are:

- **Efficiency** - to be more portable and easier to use than hard copy resources

- **Simplicity** - to be accessible to a variety of users

- **Location based** - to focus on the plants of a specific area, and

- **Visual** - to take advantage of the strengths of a digital interface.

As a resident of Southeastern Idaho and a student at Idaho State University, I see a need for a digital botanical key that can facilitate and promote research, education and recreation in this area. The focus of my Master's project is to create a digital key and field guide for Southeastern Idaho that will include photographs and descriptions for common, native plants of this area. This will be a useful resource for botanists, including employees of government agencies, who are identifying and locating plants in the region. Digital resources for species identification are not only useful for researchers but can be the foundation of new modes of education tools and public access (Thompson 2005).The University has many biology and ecology classes where students could benefit from being able to identify plants quickly for research and class projects. A digital guide could also be incorporated into science lesson plans for K-12 students as an introduction to plants and ecology. The many recreation areas and opportunities in southeastern Idaho, specifically around the Pocatello, attract people who are curious about the natural world. An easy to use digital plant key could aid recreationists in having more fulfilling outdoor experiences by adding a botanical dimension and awareness to their usual activities.

The main purpose of this project is to connect people with valuable information. By creating a digital plant key and guide for Southeastern Idaho, botanical information will be more readily available and easily usable by a wider range of people. This type of digital format allows for quicker and more direct interactions with the desired information. The use of this type of digital key will be less technical than hard copy keys because the visual structure allows for a more direct and flexible interaction as well as defined terms in pop ups with illustrations and hyperlinks. The digital search configuration is much faster to use when searching for specific plants and identifying unknown species than searching through hard copy resources. A set of drop down lists allows botanical terms to be concrete and consistent which makes them easier to manage for users who are both familiar and unfamiliar with the terms. A greater number of quality images can be made available in digital format than are typically available in hard copy guides because of the restriction on space with printing. The option to view larger images and zoom in on specific areas of the digital images are further advantages over printed images. This digital guide is an online resources but it has the structure to be converted to an offline application.

Methods

Plant List

A user-friendly digital interface was created using a list of native plants of Southeastern Idaho. My goal in making the list was to have a group which represents the plant species of the region that could be identified in the field using visual characteristics.

The plant list was developed using lists that I obtained from groups of local botanists. The local chapter (Sawabi) of the Native Plant Society supplied some lists that their group had made during nature walks in local areas. The Idaho State University Biology Department's Fall and Spring Flora classes have lists that were compiled by the past and current instructors, which I also used. Botanists who work and volunteer at the Ray J. Davis Herbarium at the Idaho Museum of Natural History on the ISU campus added input and guidance for building the lists. I also created lists as I hiked local trails, identifying plants and taking photographs. Combining all these lists resulted in a compilation of rare and common, native, non-native and weedy species as well as noxious species that these local botanists had observed over the last several years at a variety of sites in the area. This was a much larger number of species than I desired to cover for the project. The final number of species included in the key would be limited by the amount of information that would be included in the plant description and characteristics, the amount of data used in an offline application, the time it would take to complete the research and digital key development, and available images. There would also need to be enough species to represent the flora of the area to make the key

valuable to users. A target number between 250-300 species was deemed to be a reasonable and efficient amount.

To reduce the master list of over 1500 species, I narrowed it by using only gymnosperms and angiosperms (and not using non-vascular and non-seed plants), and filtered it further by focusing on the common, native plants. I reasoned that these are the plants that widest variety of users would encounter and utilize. This gave me coherent criteria for which plants to include and to remove from the list in order to develop a functional list that would eventually be used for the digital key and guide. I didn't use any subspecies or varieties for the reason that they are difficult to tell apart and usually require more involved keying than looking at basic visual characteristics. The differences in subspecific taxa require a deeper level of understanding than I wanted to be required for the use of the key I was creating.

Many botanical resources were used to research species characteristics, including whether they are native or introduced, and their abundance (see Works Cited sections: Field Guides for Plant Information, Technical Keys for Plant Information, and Others Sources for Plant Information). How common the species are was in some cases a difficult factor to quantify. Some of the major influences that helped to determine if the species were common enough to include in my list were 1) my own experience with the flora of the area, 2) input from local botanists and 3) the repetitive occurrence on different plant lists. In addition, I used the extremely valuable occurrence data associated with species vouchers that were pulled from the herbarium database. Local species represented by the most specimens in the herbaria in the Consortium of Pacific

Northwest Herbaria database were used to rank their commonness (Consortium of the

Pacific Northwest Herbaria). The final list includes 294 species from 57 families.

(Appendix A)

Plant Characteristics

A large portion of the data I collected for the project was in the form of

information and photographs of the targeted plants. During the periods that the plants

were identifiable, such as in flower or fruit, I went to local areas where I could find

native plants to document and photograph them. I concentrated on taking pictures of

the plant characteristics that would be referred to in the plant descriptions, including

flower structure, fruit type, and leaf characteristics (Table 1). My photos, as well as

others donated by local photographers and botanists were used to accompany the

species description on the species page and for thumbnails in the search results. These

images in a JPEG format were organized by family and species in digital folders to allow

them to be uploaded to the database.

This key and guide is an interpretation of one way to identify a group of plants

using visual characteristics (Woodland 2009). For the key to be easy to use and appeal

to a wide variety of users, it focuses on easy to observe characteristics of the plants. This

format, while straightforward is still an effective identification procedure for most

plants. I did not select characteristics that required a microscope or a lot of experience

to determine. The color, shape and arrangement of flowers, fruit, leaves and overall

form were determined to be the characteristics that would be the most useful in visual

identification (Woodland 2009). I classified these into categories which I determined

would be diagnostic but not overly complicated descriptors that could be used as

straight-forward search categories. These characteristics are the categories that will be

used to structure and organize the database and interactive search. The characteristic

categories were filled with character states which could be used to group plants with

shared features. If the category was leaf shape then the character state would be

varieties of leaf shapes, such as palmate or lanceolate (Table 1). The character states are

botanical terms that are used often in describing plants. I researched each term to find a

foundational definition that could be included in the webpage to assist in identification

(Harrington 1985). I also created digital line drawings for each of the character states.

These are important to the visual aspect of the key because the illustrations can easily

be compared with each other and to the unknown plant. I personally did the artwork for

the digital illustrations because I wanted them focused on the specific term and to be

consistent in style and size so that they could be easily integrated into the webpage.

 The Ray J. Davis Herbarium, following the most current taxonomy, uses the APG3

(Angiosperm Phylogeny Group, version 3) system to organize their specimens into

families and assign family names (Stevens 2001). I used the same format to be

consistent with the affiliated herbarium. I used the most recent scientific names and

classification, while sometimes including in the description of the plant the recent and

well known synonyms (USDA 2015). The descriptions and characteristics for each

species were compiled from hardcopy botanical resources as well as reliable online

resources (see Works Cited sections: Field Guides for Plant Information, Technical Keys

for Plant Information, and Others Sources for Plant Information). The species

descriptions describe the plant characteristics and habitats and contain other

information about the plant such as if it is poisonous.

As I was researching in a variety of field guides, texts, and websites, I took note

of aspect of these resources that were user friendly and appealing and also which

aspects were frustrating or difficult to use in order to include or avoid these ideas in my

own digital key.

Database

The data on each species were used to create a MySQL database that would the

feed search interface. The database table is structured with the characteristic categories

as columns containing one character type for each category in the rows for each species.

I went through each plant in the list and assigned it an appropriate character state for

each category based on the information and photographs that I had collected. This

information was compiled into an EXCEL spreadsheet that could easily be converted into

a CSV file which was uploaded as a table into the database. The scientific name of the

plant is the unique identifier that all the data for that plant are connected to. The

photos, plant descriptions, appropriate character type, common name, and family

names are all tied together with the individual scientific name. This database structure

allows the search to pull all the plants that contain a selected character type into a

results page. The search can function by selecting one character type per category with

one or multiple categories in use. The more categories used the more narrow the search will be with typically a smaller number of species in the results.

Website

I designed the search webpage to be a visual, interactive interface that could be used by experienced botanists as well as those unfamiliar with botanical terms. I was able to create the foundations of the webpages using html5 and CSS3 code and with the help of an IT professional, develop it into a functional interface for the database (Parker 2012, Cook & Garber 2012). The website needed to have an interactive and visual method to search the data using the character types in the characteristic categories. We created drop down lists for each category that were filled with the terms of the character types. The illustrations were incorporated into website below the appropriate drop down menu. The illustrations are in the same order as the terms in order to be congruent. We integrated the definitions as popup boxes so that they could be easily viewed without leaving the search page.

There is a need to be able to search for plants by name if they are already known in order to access the descriptions or images. We created text boxes where the name and family of the plants could be typed in and the database would be searched for matching entries. Since scientific names are often difficult to spell, the text fields have an autofill function which give suggestions based on letters being typed matching the information in the database.

As part of the aesthetic portion of the website, I created the header for the web pages that includes images of Idaho native plants that I have taken and the title of the project. The web pages have a consistent and neutral color theme to not distract from the content images or text. The font was chosen to be one that is easy to read whether on a large high definition computer screen or a small touchscreen device. The website is responsive so that the size of the browser window or the size of the device screen do not affect the functionality of the website (Appendix B).

Mobile Version

I am currently working with a developer to transform the website into a mobile application.

Beta Testing

An important part of the success of this project is that it is user friendly. In order to get a sample for how a variety of people would respond to the interface, I had a group of people beta test the website. I had a group of selected and volunteer individuals use the website key and guide. This group included experienced botanists, college level biology students, and people who have little experience with plant identification, and a third grade teacher. These people answered questions on a form that asked about their experience with plant identification, the use of the plant key and guide and how that compared to using a hard copy guide. This information was delivered to me and I was able to read and count the responses on how well they were

able to interact with the interface and the data. A large sample of the beta test surveys

came from the Spring Flora class. I went to the class and gave a short demo on how the

website and key functioned. They then had samples of native plants that they identified

using the digital key on mobile phones and laptops. They then filled out a paper survey

with feedback about the website. Other samples came from people who I asked or

volunteered to test the web page. The link to the website, some plant photos and a

questionnaire were emailed to them.

Results

Website

The resulting product is an interactive plant key and guide (Figure

1). http://idahoplants.sytes.net
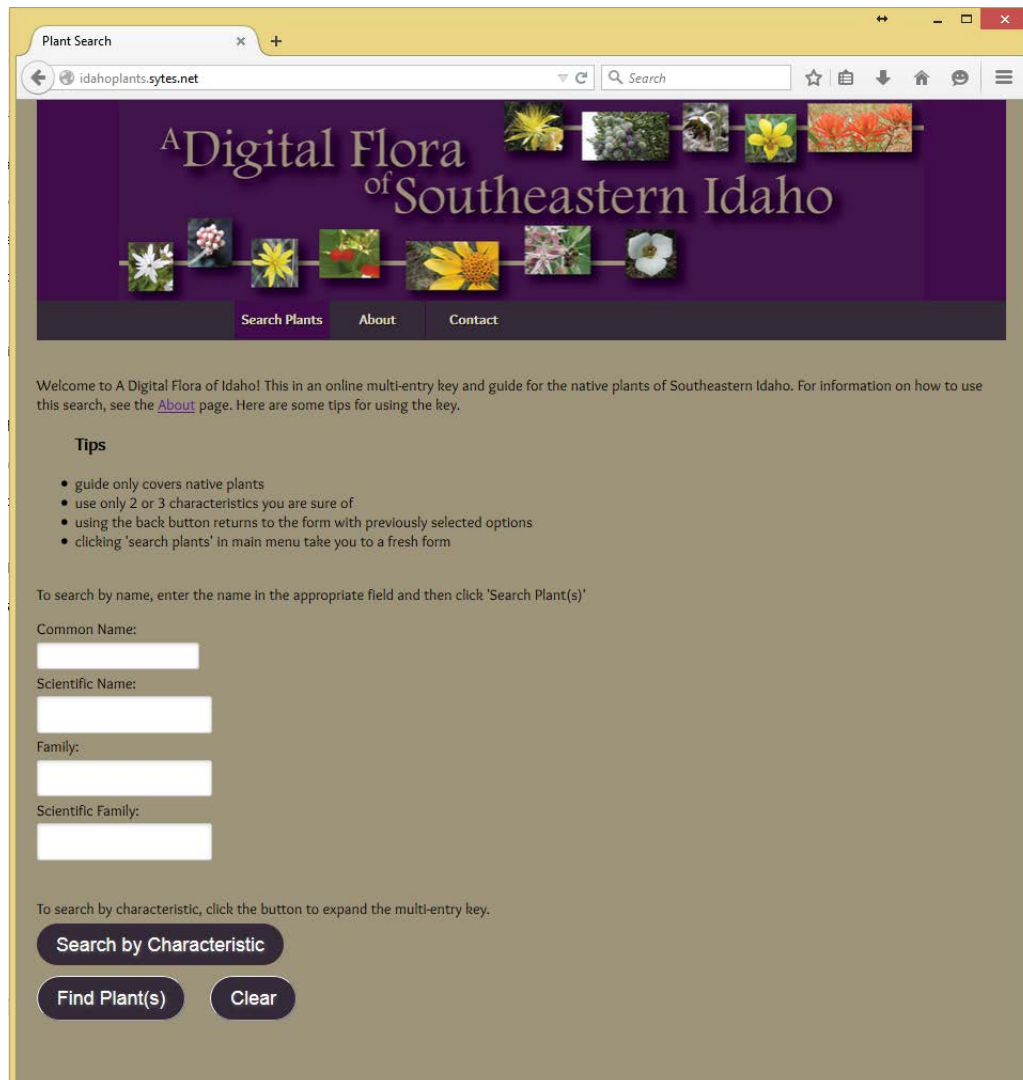
Figure1. the home page for the project

The website has four main text fields where the common and scientific name of

the plant can be entered, if the user wants to search by a known plant name (Figure 2).

These fields have an autofill feature that will bring up options from the database that

match what the user is typing (Figure 3). When clicking on the desired option brought

up in the autofill box, the text box is filled with that name. There are similar fields for

the common and scientific family names. After filling in the name, tapping the 'Find

Plant(s)' button will take the user to a page where they can access the images and

species descriptions.

Figure 2. text fields used for search

Figure 3. when typing the auto-fill feature predicts options from the database.

If the user wants to use the key feature of the search page, they can click on a 'Search by Characteristic' link to drop down the option for the key (Figure 4).

Figure 4. 'Search by Characteristics' link below the text field

The key options address visual characteristics of plants that might be used for

identification (Figure 5). The overall form of the plant is the first characteristic used

here, followed by the characteristics of the flower: color, type and arrangement. Leaf

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shape and arrangement are also included along with fruit color and type. The seasons for flowering and fruiting are included as characteristics for narrowing the search.

Each characteristic has a title and drop down menu where the user can select the desired character state (Figure 6). For each of the character states that include botanical terms, there are plain illustrations showing the character states. The illustrations include the term that matches those used in the character states drop down menu (Figure 6). A basic definition of the term will also show up when hovered over with the arrow or tapped on with touch screen devices (Figure 7).

Figure 5. multi-entry, characteristics key that is revealed by clicking the 'Search by Characteristics' link

Figure 6. Each characteristic has a drop down list and illustrations for the character states

Figure 7. botanical terms are defined in popups that appear when hovering over the illustration

The user can select one character state for one or more of the characteristic categories in order to perform the search (Figure 8). There is no need to fill out all of the categories if all of the divisions cannot be determined. Once the user has filled out the form, they can then click the 'Find Plant(s)' button at the bottom of the page which will take them to a results page. There is also a 'clear' button that will reset the form options.

Figure 8. one or more characteristics can be selected to refine the search but not all need to be filled out.

The results of the search show all of the plants in the database that fit the criteria selected in the key. At the top of the page, a results count is shown. This page shows a thumbnail image of plants, which is a photo of the flower or other identifying characteristic such the leaf if the flower is inconspicuous, lacking, or only available for a short time as in many shrubs. The species and common names of the plant and the

Figure 9. The results page shows all the plants for the database that fit the selected criteria. The thumbnail image and the name of the plants are links to their species pages.

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family names show up in the list for the search result. The thumbnail and species name are links to the species page (Figure 9).

The species page contains the information about and pictures of the species (Figure 10). This page has the common name as a title for that page with the species' scientific name underneath as a subtitle. The family names are on underneath the species names. The next component is the description of the plant. There are sections that complement the characteristics addressed in the key. The sections for 'form and size', 'flower', 'leaves', and 'fruit' contain simplified descriptions using basic terms and measurements that are helpful in identification for a variety of users. The 'Found' section addresses

Figure 10) The species page show the descriptions and images of the species.
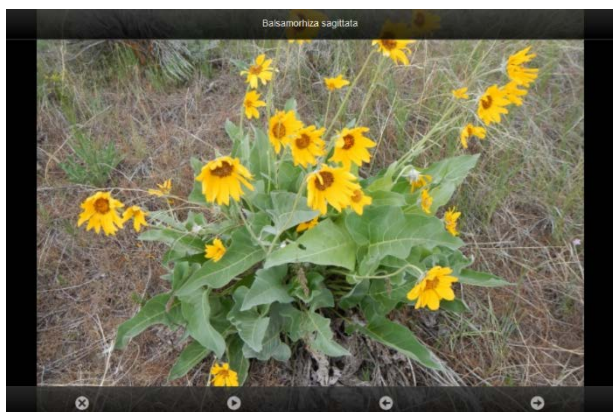
Figure 11. When an image in the species page is clicked on, a slide show of larger images appears. The images for that species can be easily viewed by clicking or swiping to the next image.

the general environment where the plants can be found and a general elevation level. There is an 'Other' section that contains other important information about the plant

that might help with identification such as how to tell it apart from similar species. If a

recent synonym is listed, it is put in this section. The images of the species are the final

component of the species page. These are the photos that I collected in the field and

from other botanists and photographers. The images can be viewed in a slide show by

double clicking on one of the images. The slideshow enlarges the image and allows the

user to view them by swiping or clicking through them (Figure 11).

The user can also combine the name search and the characteristics search.

Entering 'sunflower' into the common family name text box and then selecting yellow

for the flower color, and then performing the search will generate a results page with all

the member of the sunflower family with yellow flowers that are on the database.

There is a 'search plants' button in the

main menu at the top of the pages that allows the

user to return to the key (figure 12). There is an

'About' button in the main menu that takes the

user to a page that contains more information
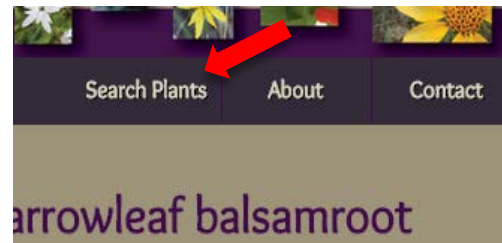
Figure 12. The search plants button in the menu allows the users to return to the key.

about the project and instructions on how to use each field. There is also a 'Contact tab

that has a form that the user is able to use to submit feedback or questions that will

then be email to me.

User Feedback

The comments from the beta testing stage were typically positive. The students

from the Spring Flora class found the key and guide to be useful and informative. There

were a total of 19 students in the class that gave feedback. Most of these were amateur botanists who had very little experience with identifying plants outside of that class and few who classified themselves as experienced botanists. There was about 69% who said the key interface was user friendly and useful. There were about 31% who said the interface was mostly user-friendly and somewhat useful and none who said it was not user friend or not useful. There was about 70% from the class who said that they would rather use the digital key and guide to identify plants than a hard copy field guide. There were about 30% who said that would probably use both the digital key and a hard copy guide. The comments mostly gave the implications that the main reason that they would want to have a book along in the field is in case of loss of data connection, which could be eliminated by having an offline downloadable app, and that their device's battery might run out. There were none who said they would not want to use the digital key to identify plants in the field. All of the students said they would use the digital key and guide for school, work, or recreation purposes or a combination of the three options.

There were comments concerning the interface of the key. Users commented on the usefulness of the definition pop ups in enhancing the terms and illustrations. Several of the testers commented on how useful the illustrations were for visual comparisons. Some of the users suggested eliminating the drop menus and having the selection be by clicking on the illustration. Some testers that were using touch screen devices said that the "Search by Characteristics" link was difficult to click on because it was small. A few users commented that some of the character states were confusing. There was a

suggestion to include the number of plants found in the results page. Several users

requested a larger plant list. Some of these comments have been incorporated into the

website.

The testers commented on how the digital interface compared with a book

guide. A common comment made was that the digital interface was faster and easier to

use than a book. A few users said that a book is mainly useful if they already knew the

plant or had a good idea what it was, while they were able to find and identify an

unknown plant using the digital key. One user said that the observations required by the

format of the key made them look at the plants and understand the characteristic better

than they had before. This help them to remember that plant and it characteristics for

the future.

The fourth grade teacher explored the website and gave comments on how the

digital key and guide could be incorporated into her class projects and lesson plans. Her

class does a project on leave identification, in which her students collect leaves and then

try to identify what plant they came from. She said that the digital key would be a fitting

tool to help the children with this particular project. She plans on using the digital key in

a unit on plants, where she will show the children picture of plants or have plants they

have collected, and have them use the visual characteristics to identify the plant. The

teacher also said that this would be an applicable tool for their section on observation

and classification.

Discussions

Comparison to Other Digital Resources

There are other tools similar to the one I have created here but they differ in many ways. Other online plant keys that I have found are usually text based with a set of options or questions to choose from. The option based keys are essentially a list of text describing character options, much like a paper dichotomous key but often with more than just two options to pick from (Meyer et al. 2007; MountainNature.com; Lady Bird Johnson Wildflower Center). There were no visual aids, beside the species photos with the descriptions, to compare an unknown plant with. I found the lists of text tedious to read and time consuming especially if I was unsure of the terms. With the question-based keys, I have found that it is difficult to keep track of which questions have been answered. Also there are many more steps in the form of web pages to work through to get to a results page in comparison to the digital interface I have produced.

There are some offline plant identification apps available as well, but they too vary in content and design from mine. There is a sophisticated pattern recognition technology that has been applied to leaf shape. A smart phone can be used to take a picture of a leaf and the software will recognize the leaf shape to identify it (Leafsnap). This works well with most tree species and leaves, but when the technology is applied to other plant characteristics it doesn't seem to be very successful (Slatalla 2014). Other available apps are basically an electronic field guide with no key feature. They have thumbnail images of the plants that are contained in the database, but cannot be keyed out by characteristic in order to identify them (About Edible and Medicinal Plants,

USDA). There is an app for identifying the weeds of Missouri that has an interface using drop down boxes and options. It does have some pop up images that can be used to assist with the terms that are being used, but the user cannot view the image and the drop down list at the same time. Also, the terminology that is used is not defined in words just with illustrations (Bradley 2013). It may be an uncomfortable interface for an inexperienced user, but was effective with my own knowledge and experience.

There is an organization called High Country Apps that has partnered with Universities, museums and herbaria to create plant identification apps for some states of the Pacific Northwest and the West (High Country Apps). They do a very effective and professional job of creating a visual interface that is easy to use and provides useful images and information. When I started my project there were no digital keys like this that covered Idaho, but High Country Apps released an app for Idaho while I was working on mine (Idaho Wildflowers). They contacted the Idaho Museum of Natural History and Ray J. Davis Herbarium for help with plant lists of Southeastern Idaho. I supplied a revised version of my master list and some other information for them to use, as well as helped the Ray J. Davis herbarium provide locations in Southeastern Idaho that are good to find native plants. The High Country app uses a multi-entry key with visual characteristics to identify plants of the entire state of Idaho. They have fewer categories that focus on the plant form and more that address environment and location than the categories I chose to use. They have a list compiled of 805 plants both native and introduced for the entire State of Idaho, while my list contains 294 native

species for Southeastern Idaho. In many ways these two digital interfaces and content

are similar but also have variations that make them unique.

User Feedback and Modifications

   Overall, the beta test users found the website interface to be user-friendly and the

key to be useful. There were many who suggested that the drop down list could be

removed and to have the selection of character state be by clicking the illustrations.

Some of the same users and others commented on how helpful the pop-up definition

boxes were. The original design idea was to have the illustrations as selection buttons,

but I felt that it would add to the functionality of the key to have the definitions of the

character state terms easily available. The pop ups were the smoothest functional way

to include the definitions without adding extra step and going to different windows or

crowding up the key by adding the definition as text on the page. I therefore decided to

keep the format as it was. The 'Search by Characteristics' button was originally just text

as a link. Some said that the link was hard to tap on a touch screen device because it

was too small. The link was made into a button that was larger and easier to tap. These

were the only consistent and common criticisms of the functionality of the website and

key. There was a mistake in the coding for flower type so that function was working

improperly. This may have resulted in some of the difficulty some students had when

using the key. This also may be the reason for some of the less positive reviews about

usability. This mistake has been corrected.

The students also commented on features they liked about the key. Several students commented on the usefulness of the illustrations and how that added ease of use. The students commented on how much faster using the digital interface was than a book. Several also said that it is very hard to find plants in a traditional field guide unless you already know what the plant was and that with the digital interface they could identify a plant even if they didn't have an idea what it might be. Many students commented that the more they tried the key, the easier it got to use. With that, they found that if they used only 2 or 3 characteristics it was much easier to get to a results list that included the plant they were trying to identify. By using only 2 or 3 characteristics that they were sure of, they had more success than filling out most of the form and being unsure about the selected character states. After reading these comments, I realized that this would be an important idea to include into the how to use section of the 'About' page.

As mentioned previously, many users commented that they would use this digital key instead of a book. The limitation mention for using a book instead was that cell phones and other devices did not often have a data connection in many areas where they were identifying plants. This would be resolved by having an offline application for the digital key.

Future Improvements

There are some improvement that could still be made. The first improvement would be to expand the plant list to include naturalized and invasive species. This would widen the uses of this project to include agricultural, range management, and conservation

aspects, as well as education for flora classes. Broadening the range of species that is covered in the list would improve its vitality. Focusing on specific popular recreation areas such as the Grand Teton National Park would help create greater awareness and appreciation for those precious natural resources.

I would like to incorporate some of the new technology that I don't have access to yet. The shape recognition technology would be a nice addition to incorporate. I would also like to add a citizen science aspect for adults or guided grade school classes. I would like to have a feature where users could take images of plants they have found and upload the photo and geolocation using the smart phones features into a database that could be used to understand biodiversity and ecosystem change. One of the limitations of this would be that there would have to be a moderator that continually checked if the images that were uploaded were identified correctly and had the necessary information to make them usable. I would like to incorporate a way for users to create their own plants lists, of things they have found, or even be able to make list by location.

Overall, I feel that the project was successful and the product is solid. One thing that I would like to revisit or change is how the character states are grouped in the categories. The current character states are standalone which is effective in limiting result lists, but there are some states that are similar or variable among plants species that could be grouped for to simplify use. This could be a more usable format for the character states to allow for a margin of uncertainty in the user. This would require revisiting the character states and the illustrations.

This digital interface can be expanded into other natural history collections. This visual format would be effective in identifying mammal, birds, reptiles, insects and more. It could also be used as a study tool for other science classes.

This project can reach beyond a tool to identify plants. Educators who are teaching biology benefit from incorporating digital resources into lessons and activities (Cook et al. 2014; Powers et al. 2014). This key and guide can be used as a tool for educator guided experiences on observation and variation in grade school children, and ecology and diversity in high school and undergraduate levels. It can spike interest in biology which can lead to education, career, and recreation choices geared around protecting our natural environment (Powers et al. 2014). My own educational and career paths have all stemmed from an interest in plant identification at a young age.

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Table 1. Characteristics and character states used to structure the database and search interface.

Form	Flower Color	Flower Type	Flower Arrangement
tree	Purple	floret	head
shrub	Yellow	regular	spike
forb	Blue	irregular	raceme
grass	white	bell	umbel
	Pink	tubular	panicle
	Red	non-flowering	cyme
	green		corymb
	brown		catkin
			solitary
Leaf Shape	**Leaf Arrangement**	**Fruit Color**	**Fruit Type**
linear	alternate	red/orange	berry
lanceolate	opposite	blue	drupe
ellitpic	basal	white	pome
ovate	whorled	green	capsule
obovate		brown	follicle
cordate			pod
palmate			achene
pinnate			caryopsis
dissected			schizocarp
trifolate			samara
cuenate			cone
			nutlet
Flowering Time	**Fruiting Time**		
early spring	late spring		
spring	summer		
summer	fall		
fall			

Appendix A. List of taxon used for key and guide, organized alphabetically by scientific family

Name	Scientific Name	Family	Scientific Family
black elderberry	Sambucus cerulea	Elderberry	ADOXACEAE
red elderberry	Sambucus racemosa	Elderberry	ADOXACEAE
tapertip onion	Allium acuminatum	Amaryllis	AMARYLLIDACEAE
textile onion	Allium textile	Amaryllis	AMARYLLIDACEAE
skunkbrush sumac	Rhus trilobata	Sumac	ANACARDIACEAE
poison ivy	Toxicodendron radicans	Sumac	ANACARDIACEAE
sharptoothed angelica	Angelica arguta	Carrot	APIACEAE
water hemlock	Cicuta douglasii	Carrot	APIACEAE
widewing springparsely	Cymopterus purpurascens	Carrot	APIACEAE
cow-parsnip	Heracleum maximum	Carrot	APIACEAE
fernleaf loveage	Ligusticum filicinum	Carrot	APIACEAE
fernleaf biscutroot	Lomatium dissectum	Carrot	APIACEAE
desert biscutroot	Lomatium foeniculaceum	Carrot	APIACEAE
Gray's biscutroot	Lomatium grayi	Carrot	APIACEAE
nineleaf biscutroot	Lomatium triternatum	Carrot	APIACEAE
turkey peas	Orogenia linearifolia	Carrot	APIACEAE
western sweetroot	Osmorhiza occidentalis	Carrot	APIACEAE
common yampah	Perideridia montana	Carrot	APIACEAE
spreading dogbane	Apocynum androsaemifolium	Dogbane	APOCYNACEAE
milkweed	Asclepias speciosa	Dogbane	ASCLEPIADACEAE
rough-fruited fairybells	Disporum trachycarpum	Asparagus	ASPARAGACEAE
feathery false Solomon's seal	Maianthemum racemosum	Asparagus	ASPARAGACEAE
starry false Solomon's seal	Maianthemum stellatum	Asparagus	ASPARAGACEAE
common yarrow	Achillea millefolium	Sunflower	ASTERACEAE
pale agoseris	Agoseris glauca	Sunflower	ASTERACEAE
littleleaf pussytoes	Antennaria microphylla	Sunflower	ASTERACEAE

rosy pussytoes	*Antennaria rosea*	Sunflower	ASTERACEAE
heartleaf arnica	*Arnica cordifolia*	Sunflower	ASTERACEAE
twin arnica	*Arnica sororia*	Sunflower	ASTERACEAE
low sagebrush	*Artemisia arbuscula*	Sunflower	ASTERACEAE
silver sage	*Artemisia ludoviciana*	Sunflower	ASTERACEAE
tarragon	*Artemisia dracunculus*	Sunflower	ASTERACEAE
black sagebrush	*Artemisia nova*	Sunflower	ASTERACEAE
big sagebrush	*Artemisia tridentata*	Sunflower	ASTERACEAE
threetip sagebrush	*Artemisia tripartita*	Sunflower	ASTERACEAE
Hooker's balsamroot	*Balsamorhiza hookeri*	Sunflower	ASTERACEAE
cutleaf balsamroot	*Balsamorhiza macrophylla*	Sunflower	ASTERACEAE
arrowleaf balsamroot	*Balsamorhiza sagittata*	Sunflower	ASTERACEAE
dusty maiden	*Chaenactis douglasii*	Sunflower	ASTERACEAE
green rabbitbrush	*Chrysothamnus viscidiflorus*	Sunflower	ASTERACEAE
elk thistle	*Cirsium scariosum*	Sunflower	ASTERACEAE
tapertip hawksbeard	*Crepis acuminata*	Sunflower	ASTERACEAE
Modoc hawksbeard	*Crepis modocensis*	Sunflower	ASTERACEAE
grey rabbitbrush	*Ericameria nauseosa*	Sunflower	ASTERACEAE
Navajo fleabane	*Erigeron concinnus*	Sunflower	ASTERACEAE
spreading fleabane	*Erigeron divergens*	Sunflower	ASTERACEAE
streamside fleabane	*Erigeron glabellus*	Sunflower	ASTERACEAE
purple cusion fleabane	*Erigeron poliospermus*	Sunflower	ASTERACEAE
shaggy fleabane	*Erigeron pumilus*	Sunflower	ASTERACEAE
aspen fleabane	*Erigeron speciosus*	Sunflower	ASTERACEAE
elegant aster	*Eucephalus elegans*	Sunflower	ASTERACEAE
Engelmann's aster	*Eucephalus engelmannii*	Sunflower	ASTERACEAE
curlycup gumweed	*Grindelia squarrosa*	Sunflower	ASTERACEAE
broom snakeweed	*Gutierrezia sarothrae*	Sunflower	ASTERACEAE
sneezeweed	*Helenium autumnale*	Sunflower	ASTERACEAE
oneflower helianthella	*Helianthella uniflora*	Sunflower	ASTERACEAE
sunflower	*Helianthus annuus*	Sunflower	ASTERACEAE
showy goldeneye	*Heliomeris multiflora*	Sunflower	ASTERACEAE
wooly hawkweed	*Hieracium scouleri*	Sunflower	ASTERACEAE
large-flower skeleton-plant	*Lygodesmia grandiflora*	Sunflower	ASTERACEAE
tarweed	*Madia glomerata*	Sunflower	ASTERACEAE
pineapple weed	*Matricaria discoidea*	Sunflower	ASTERACEAE

lobeleaf groundsel	*Packera multilobata*	Sunflower	ASTERACEAE
Rocky Mountain groundsel	*Packera streptanthifolia*	Sunflower	ASTERACEAE
skeletonweed	*Pleiacanthus spinosus*	Sunflower	ASTERACEAE
plantain goldenweed	*Pyrrocoma uniflora*	Sunflower	ASTERACEAE
western coneflower	*Rudbeckia occidentalis*	Sunflower	ASTERACEAE
western ragwort	*Senecio integerrimus*	Sunflower	ASTERACEAE
tall ragwort	*Senecio serra*	Sunflower	ASTERACEAE
arrowleaf ragwort	*Senecio triangularis*	Sunflower	ASTERACEAE
Canada goldenrod	*Solidago canadensis*	Sunflower	ASTERACEAE
threenerve goldenrod	*Solidago velutina*	Sunflower	ASTERACEAE
stemless mock goldenweed	*Stenotus acaulis*	Sunflower	ASTERACEAE
western aster	*Symphyotrichum ascendens*	Sunflower	ASTERACEAE
meadow aster	*Symphyotrichum campestre*	Sunflower	ASTERACEAE
Eaton's aster	*Symphyotrichum eatonii*	Sunflower	ASTERACEAE
spineless horsebrush	*Tetradymia canescens*	Sunflower	ASTERACEAE
white mule's ear	*Wyethia helianthoides*	Sunflower	ASTERACEAE
mule's ear	*Wyethia amplexicaulis*	Sunflower	ASTERACEAE
rough cocklebur	*Xanthium strumarium*	Sunflower	ASTERACEAE
Oregon grape	*Berberis repens*	Barberry	BERBERIDACEAE
Grey Alder	*Alnus incana*	Birch	BETULACEAE
water birch	*Betula occidentalis*	Birch	BETULACEAE
Torrey's cryptantha	*Cryptantha torreyana*	Borage	BORAGINACEAE
roundspike cryptantha	*Cryptantha humilis*	Borage	BORAGINACEAE
manyflower stickseed	*Hackelia floribunda*	Borage	BORAGINACEAE
spotted stickseed	*Hackelia patens*	Borage	BORAGINACEAE
ballhead waterleaf	*Hydrophyllum capitatum*	Borage	BORAGINACEAE
flatspine stickseed	*Lappula redowskii*	Borage	BORAGINACEAE
western stoneseed	*Lithospermum ruderale*	Borage	BORAGINACEAE
oblongleaf bluebells	*Mertensia oblongifolia*	Borage	BORAGINACEAE
silverleaf phacelia	*Phacelia hastata*	Borage	BORAGINACEAE
varileaf phacelia	*Phacelia heterophylla*	Borage	BORAGINACEAE

Scouler's popcornflower	*Plagiobothrys scouleri*	Borage	BORAGINACEAE
Holboell's rockcress	*Boechera holboellii*	Mustard	BRASSICACEAE
American wintercress	*Barbarea orthoceras*	Mustard	BRASSICACEAE
tower rockcress	*Turritis glabra*	Mustard	BRASSICACEAE
spreading-pod rockcress	*Boechera divaricarpa*	Mustard	BRASSICACEAE
Drummond's rockcress	*Boechera stricta*	Mustard	BRASSICACEAE
Lyall's rockcress	*Boechera lyallii*	Mustard	BRASSICACEAE
silver rockcress	*Boechera puberula*	Mustard	BRASSICACEAE
sicklepod rockcress	*Boechera sparsiflora*	Mustard	BRASSICACEAE
western tansymustard	*Descurainia pinnata*	Mustard	BRASSICACEAE
tall draba	*Draba praealta*	Mustard	BRASSICACEAE
Carolina draba	*Draba reptans*	Mustard	BRASSICACEAE
western wallflower	*Erysimum capitatum*	Mustard	BRASSICACEAE
mountain pepperweed	*Lepidium montanum*	Mustard	BRASSICACEAE
western bladderpod	*Physaria occidentalis*	Mustard	BRASSICACEAE
twinpod	*Physaria acutifolia*	Mustard	BRASSICACEAE
green princessplume	*Stanleya viridiflora*	Mustard	BRASSICACEAE
picklypear	*Opuntia polyacantha*	Cactus	CACTACEAE
twin berry	*Lonicera involucrata*	Honeysuckle	CAPRIFOLIACEAE
Utah honeysuckle	*Lonicera utahensis*	Honeysuckle	CAPRIFOLIACEAE
mountain snowberry	*Symphoriocarpos oreophilus*	Honeysuckle	CAPRIFOLIACEAE
ballhead sandwort	*Eremogone congesta*	Pink	CARYOPHYLLACEAE
King's sandwort	*Eremogone kingii*	Pink	CARYOPHYLLACEAE
field chickweed	*Cerastium arvense*	Pink	CARYOPHYLLACEAE
Douglas's catchfly	*Silene douglasii*	Pink	CARYOPHYLLACEAE
Menzies' campion	*Silene menziesii*	Pink	CARYOPHYLLACEAE
longstalk starwort	*Stellaria longipes*	Pink	CARYOPHYLLACEAE
mountain lover	*Paxistima myrsinites*	Staff-tree	CELASTRACEAE
fourwing saltbrush	*Atriplex canescens*	Chenopod	CHENOPODIACEAE
shadscale	*Atriplex confertifolia*	Chenopod	CHENOPODIACEAE
winterfat	*Krascheninnikovia lanata*	Chenopod	CHENOPODIACEAE
greasewood	*Sarcobatus vermiculatus*	Chenopod	CHENOPODIACEAE
Rocky Mountain beeplant	*Cleome serrulata*	Cleome	CLEOMACEAE

redosier dogwood	*Cornus sericea*	Dogwood	CORNACEAE
lance-leave stonecrop	*Sedum lanceolatum*	Stonecrop	CRASSULACEAE
Common Juniper	*Juniperus communis*	Cypress	CUPRESSACEAE
Utah juniper	*Juniperus osteosperma*	Cypress	CUPRESSACEAE
Rocky Mountain juniper	*Juniperus scopulorum*	Cypress	CUPRESSACEAE
softleaf sedge	*Carex disperma*	Sedge	CYPERACEAE
Douglas' sedge	*Carex douglasii*	Sedge	CYPERACEAE
needleleaf sedge	*Carex duriuscula*	Sedge	CYPERACEAE
Geyer's sedge	*Carex geyeri*	Sedge	CYPERACEAE
Hood's sedge	*Carex hoodii*	Sedge	CYPERACEAE
smallwing sedge	*Carex microptera*	Sedge	CYPERACEAE
Nebraska sedge	*Carex nebrascensis*	Sedge	CYPERACEAE
Liddon sedge	*Carex petasata*	Sedge	CYPERACEAE
foothill sedge	*Carex tumulicola*	Sedge	CYPERACEAE
valley sedge	*Carex vallicola*	Sedge	CYPERACEAE
blister sedge	*Carex vesicaria*	Sedge	CYPERACEAE
common spikedrush	*Eleocharis palustris*	Sedge	CYPERACEAE
smallfruit bulrush	*Scirpus microcarpus*	Sedge	CYPERACEAE
field milkvetch	*Astragalus agrestis*	Pea	FABACEAE
Torrey's milkvetch	*Astragalus calycosus*	Pea	FABACEAE
browse milkvetch	*Astragalus cibarius*	Pea	FABACEAE
lesser rushy milkvetch	*Astragalus convallarius*	Pea	FABACEAE
freckled milkvetch	*Astragalus lentiginosus*	Pea	FABACEAE
woollypod milkvetch	*Astragalus purshii*	Pea	FABACEAE
American licorice	*Glycyrrhiza lepidota*	Pea	FABACEAE
silver lupine	*Lupinus argenteus*	Pea	FABACEAE
velvet lupine	*Lupinus leucophyllus*	Pea	FABACEAE
silky lupine	*Lupinus sericeus*	Pea	FABACEAE
sticky purple geranium	*Geranium viscosissimum*	Geranium	GERANIACEAE
Richardson's geranium	*Geranium richardsonii*	Geranium	GERANIACEAE
golden currant	*Ribes aureum*	Gooseberry	GROSSULARIACEAE
wax current	*Ribes cereum*	Gooseberry	GROSSULARIACEAE
toad rush	*Juncus bufonius*	Rush	JUNCACEAE
Baltic sedge	*Juncus balticus*	Rush	JUNCACEAE
Colorado rush	*Juncus confusus*	Rush	JUNCACEAE
Dudley's rush	*Juncus dudleyi*	Rush	JUNCACEAE
swordleaf rush	*Juncus ensifolius*	Rush	JUNCACEAE

nettleleaf giant hyssop	*Agastache urticifolia*	Mint	LAMIACEAE
wild mint	*Mentha arvensis*	Mint	LAMIACEAE
skullcap	*Scutellaria galericulata*	Mint	LAMIACEAE
common duckweed	*Lemna minor*	Duckweed	LEMNACEAE
sego lily	*Calochortus nuttallii*	Lily	LILIACEAE
yellow glacier lily	*Erythronium grandiflorum*	Lily	LILIACEAE
leopard lily	*Fritillaria atropurpurea*	Lily	LILIACEAE
yellow bell	*Fritillaria pudica*	Lily	LILIACEAE
Lewis flax	*Linum lewisii*	Linum	LINACEAE
smoothstem blazingstar	*Mentzelia laevicaulis*	Loasa	LOASACEAE
Munro's globemallow	*Sphaeralcea munroana*	Mallow	MALVACEAE
foothill deathcamas	*Zigadenus paniculatus*	Trillium	MELANTHIACEAE
meadow deathcamas	*Zigadenus venenosus*	Trillium	MELANTHIACEAE
lanceleaf springbeauty	*Claytonia lanceolata*	Miner's Lettuce	MONTIACEAE
Miner's lettuce	*Claytonia perfoliata*	Miner's Lettuce	MONTIACEAE
fireweed	*Chamerion angustifolium*	Evening Primrose	ONAGRACEAE
tall annual willowherb	*Epilobium brachycarpum*	Evening Primrose	ONAGRACEAE
firechalice	*Epilobium canum*	Evening Primrose	ONAGRACEAE
fringed willowherb	*Epilobium ciliatum*	Evening Primrose	ONAGRACEAE
spreading groundsmoke	*Gayophytum diffusum*	Evening Primrose	ONAGRACEAE
tufted evening primrose	*Oenothera cespitosa*	Evening Primrose	ONAGRACEAE
spotted coralroot	*Corallorhiza maculata*	Orchid	ORCHIDACEAE
striped coralroot	*Corallorhiza striata*	Orchid	ORCHIDACEAE
Western rattlesnake plantain	*Goodyera oblongifolia*	Orchid	ORCHIDACEAE
slender-spire orchid	*Piperia unalascensis*	Orchid	ORCHIDACEAE
scentbottle	*Platanthera dilatata*	Orchid	ORCHIDACEAE
desert paintbrush	*Castilleja chromosa*	Broomrape	OROBANCHACEAE

yellow paintbrush	*Castilleja flava*	Broomrape	OROBANCHACEAE
red paintbrush	*Castilleja miniata*	Broomrape	OROBANCHACEAE
elephant heads	*Pedicularis groenlandica*	Broomrape	OROBANCHACEAE
Brown's peony	*Paeonia brownii*	Peony	PAEONIACEAE
longhorn steer's-head	*Dicentra uniflora*	Poppy	PAPAVERCEAE
fringed grass of Parnassus	*Parnassia fimbriata*	Grass of Parnassus	PARNASSIACEAE
common monkeyflower	*Mimulus guttatus*	Lopseed	PHRYMACEAE
pink money flower	*Mimulus lewisii*	Lopseed	PHRYMACEAE
subalpine fir	*Abies lasiocarpa*	Pine	PINACEAE
Engelmann's spruce	*Picea engelmannii*	Pine	PINACEAE
white bark pine	*Pinus albicaulis*	Pine	PINACEAE
lodgepole pine	*Pinus contorta*	Pine	PINACEAE
limber pine	*Pinus flexilis*	Pine	PINACEAE
singel-leaf pinyon	*Pinus monophylla*	Pine	PINACEAE
Pondersona pine	*Pinus ponderosa*	Pine	PINACEAE
Douglas fir	*Pseudotsuga menziesii*	Pine	PINACEAE
maiden blue-eyed Mary	*Collinsia parviflora*	Plantain	PLANTAGINACEAE
Wasatch beardtongue	*Penstemon cyananthus*	Plantain	PLANTAGINACEAE
blue penstemon	*Penstemon cyaneus*	Plantain	PLANTAGINACEAE
hotrock penstemon	*Penstemon deustus*	Plantain	PLANTAGINACEAE
fircracker penstemon	*Penstemon eatonii*	Plantain	PLANTAGINACEAE
low beardtongue	*Penstemon humilis*	Plantain	PLANTAGINACEAE
Palmer's penstemon	*Penstemon palmeri*	Plantain	PLANTAGINACEAE
matroot penstemon	*Penstemon radicosus*	Plantain	PLANTAGINACEAE
woolly plantain	*Plantago patagonica*	Plantain	PLANTAGINACEAE
lanceleaf figwort	*Scrophularia lanceolata*	Plantain	PLANTAGINACEAE
Indian ricegrass	*Achnatherum hymenoides*	Grass	POACEAE
Columbia needlegrass	*Achnatherum nelsonii*	Grass	POACEAE
rough bentgrass	*Agrostis scabra*	Grass	POACEAE
mountain brome	*Bromus carinatus*	Grass	POACEAE
pinegrass	*Calamagrostis rubescens*	Grass	POACEAE
squirreltail	*Elymus elymoides*	Grass	POACEAE

thickspike wheatgrass	*Elymus lanceolatus*	Grass	POACEAE
slender wheatgrass	*Elymus trachycaulus*	Grass	POACEAE
Idaho fescue	*Festuca idahoensis*	Grass	POACEAE
needle and thread grass	*Hesperostipa comata*	Grass	POACEAE
prairie Junegrass	*Koeleria macrantha*	Grass	POACEAE
common reed	*Phragmites australis*	Grass	POACEAE
Kentucky bluegrass	*Poa pratensis*	Grass	POACEAE
Sandberg bluegrass	*Poa secunda*	Grass	POACEAE
bluebunch wheatgrass	*Pseudoroegneria spicata*	Grass	POACEAE
grand collomia	*Collomia grandiflora*	Phlox	POLEMONIACEAE
tiny trumpet	*Collomia linearis*	Phlox	POLEMONIACEAE
scarlet gilia	*Ipomopsis aggregata*	Phlox	POLEMONIACEAE
carpet phlox	*Phlox hoodii*	Phlox	POLEMONIACEAE
longleaf phlox	*Phlox longifolia*	Phlox	POLEMONIACEAE
parsnipflower buckwheat	*Eriogonum heracleoides*	Buckwheat	POLYGONACEAE
shrubby buckwheat	*Eriogonum microthecum*	Buckwheat	POLYGONACEAE
cushion buckwheat	*Eriogonum ovalifolium*	Buckwheat	POLYGONACEAE
sulphur-flower buckwheat	*Eriogonum umbellatum*	Buckwheat	POLYGONACEAE
American bistort	*Polygonum bistortoides*	Buckwheat	POLYGONACEAE
darkthroat shootingstar	*Dodecatheon pulchellum*	Primrose	PRIMULACEAE
Columbian monkshood	*Aconitum columbianum*	Buttercup	RANUNCULACEAE
baneberry	*Actaea rubra*	Buttercup	RANUNCULACEAE
Colorado blue columbine	*Aquilegia coerulea*	Buttercup	RANUNCULACEAE
yellow columbine	*Aquilegia flavescens*	Buttercup	RANUNCULACEAE
western columbine	*Aquilegia formosa*	Buttercup	RANUNCULACEAE
twolobe larkspur	*Delphinium nuttallianum*	Buttercup	RANUNCULACEAE
subalpine larkspur	*Delphinium barbeyi*	Buttercup	RANUNCULACEAE
slim larkspur	*Delphinium depauperatum*	Buttercup	RANUNCULACEAE
sagebrush buttercup	*Ranunculus glaberrimus*	Buttercup	RANUNCULACEAE
Macoun's buttercup	*Ranunculus macounii*	Buttercup	RANUNCULACEAE

Fendler's meadow-rue	*Thalictrum fendleri*	Buttercup	RANUNCULACEAE
tobacco brush	*Ceanothus velutinus*	Buckthorn	RHAMNACEAE
Saskatoon serviceberry	*Amelanchier alnifolia*	Rose	ROSACEAE
mountian mahogany	*Cercocarpus ledifolius*	Rose	ROSACEAE
black hawthorn	*Crataegus douglasii*	Rose	ROSACEAE
wild strawberry	*Fragaria virginiana*	Rose	ROSACEAE
largeleaf avens	*Geum macrophyllum*	Rose	ROSACEAE
old man's whiskers	*Geum triflorum*	Rose	ROSACEAE
Mallow-leaf ninebark	*Physocarpus malvaceus*	Rose	ROSACEAE
tall cinquefoil	*Potentilla arguta*	Rose	ROSACEAE
early cinquefoil	*Potentilla concinna*	Rose	ROSACEAE
slender cinquefoil	*Potentilla gracilis*	Rose	ROSACEAE
shrubby cinquefoil	*Potentilla fruticosa*	Rose	ROSACEAE
chokecherry	*Prunus virginiana*	Rose	ROSACEAE
antelope bitterbrush	*Purshia tridentata*	Rose	ROSACEAE
Wood's rose	*Rosa woodsii*	Rose	ROSACEAE
nutka rose	*Rosa nutkaensis*	Rose	ROSACEAE
thimbleberry	*Rubus parviflorus*	Rose	ROSACEAE
fragrant bedstraw	*Galium boreale*	Madder	RUBIACEAE
northern bedstraw	*Galium aparine*	Madder	RUBIACEAE
narrowleaf cottonwood	*Populus angustifolia*	Willow	SALICACEAE
quaking aspen	*Populus tremuloides*	Willow	SALICACEAE
Bebb willow	*Salix bebbiana*	Willow	SALICACEAE
narrowleaf willow	*Salix exigua*	Willow	SALICACEAE
Geyer willow	*Salix geyeriana*	Willow	SALICACEAE
shining willow	*Salix lucida*	Willow	SALICACEAE
yellow willow	*Salix lutea*	Willow	SALICACEAE
Scouler's willow	*Salix scouleriana*	Willow	SALICACEAE
bastard toadflax	*Comandra umbellata*	Sandwood	SANTALACEAE
Rocky Mountain maple	*Acer glabrum*	Soapberry	SAPINDACEAE
bigtooth maple	*Acer grandidentatum*	Soapberry	SAPINDACEAE
boxelder	*Acer negundo*	Soapberry	SAPINDACEAE
gooseberryleaf alumroot	*Heuchera grossulariifolia*	Saxifrage	SAXIFRAGACEAE
bulbous woodland-star	*Lithophragma glabrum*	Saxifrage	SAXIFRAGACEAE
smallflower woodland-star	*Lithophragma parviflorum*	Saxifrage	SAXIFRAGACEAE

side-flowered miterwort	*Mitella stauropetala*	Saxifrage	SAXIFRAGACEAE
common cattail	*Typha latifolia*	Cattail	TYPHACEAE
stinging nettle	*Urtica dioica*	Nettle	URTICACEAE
western valerian	*Valeriana occidentalis*	Valerian	VALERIANACEAE
hookedspur violet	*Viola adunca*	Violet	VIOLACEAE
goosefoot violet	*Viola purpurea*	Violet	VIOLACEAE
sagebrush violet	*Viola vallicola*	Violet	VIOLACEAE

Appendix B. The original code for the website

PHP Server/Page Files
about.php

```php
<?php
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}
include ('header.php');
?>
<title>Idaho Plants Home</title>
</head>

<body>
<script>
  (function(i,s,o,g,r,a,m){i['GoogleAnalyticsObject']=r;i[r]=i[r]||function(){
  (i[r].q=i[r].q||[]).push(arguments)},i[r].l=1*new Date();a=s.createElement(o),
  m=s.getElementsByTagName(o)[0];a.async=1;a.src=g;m.parentNode.insertBefore(a,m)
  })(window,document,'script','//www.google-analytics.com/analytics.js','ga');

  ga('create', GoogleAnalyticsID, 'auto');
  ga('send', 'pageview');

</script>

<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>
<!-- start menu -->
<div id="navigation" class="clearfix">
<ul class="clearfix">
    <li><a href="index.php"><span>Search Plants</span></a></li>
    <!--<li><a href="addPlant.php"><span>Add Plants</span></a></li>-->
    <li class="menuactive"><a class="menuactive"
href="about.php"><span>About</span></a></li>
```

```
    <li><a href="contact.php"><span>Contact</span></a></li>
</ul>
<a href="#" id="pull">Menu</a>
</div>
<!-- end menu -->
<div class="content">
<h1>A Digital Flora of Southeastern Idaho</h1>
<ul><h3>Tips</h3>
        <li>guide only covers native plants</li>
        <li>use only 2 or 3 characteristics you are sure of</li>
        <li>using the back button returns to the form with previously selected options</li>
        <li>clicking "search plants" in main menu take you to a fresh form</li>
</ul>

<h2>About the Project</h2>
<p>This digital key and guide covers the common native plants (angiosperms and gymnosperms)
of Southeastern Idaho. In the future, the project will be expanded to cover the invasive and
noxious species that occur in the area.</p>
<!--For a list of references click here.-->
<p>The illustrations for the key were digitally draw by me for the purposes of this project.</p>
<p>Most of the images provided in this project are one I personally took in areas around
Southeastern Idaho. There are also images provided by Susan Wakley and Lana Coombs.</p>
<p>Dick Anderson (-2015) a volunteer at the Ray J. Davis Herbarium and cherished friend gave
permission for his wonderful botanical photos to be used for this project before he passed away.
I included many of his photos, marked with his name, in gratitude and memory of a kind and
quiet photographer, botanist and friend.
This is the project I engaged in for my Master's thesis as a student at Idaho State University.
Through my work as a botanist and my education in ecology, I saw that there was a need for a
digital plant guide for the native plants of Southeastern Idaho. I wanted the key to be easy to
use with a visual, interactive interface that anyone who was interested in identifying plants
could use. I hope this becomes a fun and useful tool to help people be engaged with the natural
world.</p>
<p>-Ashelee Rasmussen</p>

<h2> Ray J. Davis Herbarium </h2>

<p><img style="max-width:300px; display:block; margin:auto;" class="left"
src="img/Herbariumplaque.jpg" alt="Herbarium Plaque" width="100%" />
```
The Ray J. Davis Herbarium is part of the Idaho Museum of Natural History which is located on
the Idaho State University campus. The herbarium was established in 1931 by Ray J. Davis who
was a professor of botany at ISU from 1930-1965. Davis' work in collecting plants throughout
Idaho, culminated in the publication in the "Flora of Idaho". Dr. Karl Holte became curator in
1965 and built the herbarium collections until his retirement in 1997. He now serves as Curator
Emeritus. Dr. Rick Williams is presently serving as curator since his appointment in 2008. Dr.

Williams is a professor in the Biology Department at ISU and pursue research in pollination biology at the Rocky Mountain Biological Laboratory.</p>

<p>The Ray J. Davis Herbarium currently houses about 80,000 vascular plant specimens. The bulk of the collections is made up of specimens from Idaho, emphasis on southeastern Idaho, and surrounding western states, but there is also material from across the U.S. and other foreign countries. These plant vouchers are physical evidence of species distribution and identification. The specimen information are important records for conservation and restoration. These vouchers are important sources of valuable information for researchers, students and the public.</p>
<p>I worked in the Ray J. Davis Herbarium for several year during my time as an undergraduate at ISU. I quickly came to see the valuable gem the Davis Herbarium is for the botanical community of Idaho and the world. The information held in the herbarium was difficult to access unless a person visited the herbarium. The physical handling of the fragile specimens is detrimental to the specimens. The Ray J. Davis Herbarium, along with the Idaho Museum of Natural History, is in the process of digitizing the precious collections by taking high resolution images and entering the collection information into a database. The Ray J. Davis herbarium digital specimens along with many other herbaria collections are available to use on the Consortium of Pacific Northwest Herbaria website. (http://www.pnwherbaria.org)</p>

<hr/>

<h2>How to Use</h2>
<p>To use the plant key, use the drop down lists to select one option from one or more plant characteristic. You DO NOT have to fill in every field. The search works best if you use only 2 or 3 characteristics you are sure of. Use the example illustrations of general shapes to help you visually match options. Hovering over (or tapping on for touch screen devices) the illustrations will pop up a definition for that term. Do your best to match your specimen you are trying to identify with the terminology. If the results don't match your specimen, don't be afraid to retry the search with another option that is similar, or eliminate the characteric you are unsure of.</p>

<p>Click the "find plants" button at the bottom of the page. A list of plants that fit the search criteria will be generated. Clicking on thumbnail or name will take you to a page with more pictures and information about that plant. Clicking on the photos on the species page will bring up a slide show of larger images, that can be scrolled through</p>

More...
<div class="shcontent">

        <h3>Name</h3>
   <p>To search by "common name" "scientific name" "common family" name or "scientific family" name, type in the name in the appropriate field, and click the "find plants" button. </p>

<h3>Form</h3>

<p>To search by "Form" select from the drop down list the growth form that best fits, use the illustrations for reference.</p>

<h3>Flower Color</h3>

<p>To search by "Flower Color" select from the drop down list the flower color that best fits. Keep in mind that color is often variable, so if one color doesn't work, try a color that is similar, like blue and purple.</p>

<h3>Flower Type</h3>

<p>To search by "Flower Type" select from the drop down list the flower shape that best fits, use the illustrations for reference. Sometimes flower shapes can look like more that one option, choose the one that best fits, but you may need to try more than one.</p>

<h3>Flower Arrangement</h3>

<p>To search by "Flower Arrangement" select from the drop down list the pattern of how the flowers are arranged that best fits, use the illustrations for reference. Use the definitions that pop up when the images are clicked on for additional help.</p>

<h3>Leaf Shape</h3>

<p>To search by "Leaf Shape" select from the drop down list the leaf shape that best fits, use the illustrations for reference. Leaf shape is often variable and can change based on where they are located on the plant. Pick the most common leaf shape. You may need to try a few that are similar, like "lanceolate" and "elliptic."</p>

<h3>Leaf Arrangement</h3>

<p>To search by "Leaf Arrangement" select from the drop down list the pattern of how the leaves are arranged in relation to the main stem that best fits, use the illustrations for reference.</p>

<h3>Fruit Color</h3>

<p>To search by "Fruit Color" select from the drop down list the fruit color that best fits. This refers to the fruits at maturity, many fruits change color as they grow and mature. If they are mottled or striped, choose the color that covers the majority of the fruit.</p>

<h3>Fruit Type</h3>

<p>To search by "Fruit Type" select from the drop down list the fruit type that best fits, use the illustrations for reference. Use the definitions that pop up when the images are clicked on for additional help.</p>

<h3>Flowering Period</h3>

<p>To search by "Flowering Period" select from the drop down list the period that best fits. Timing changes from year to year, by dividing the flowering season into 4 periods instead of

months, natures timing can be better described. Typically months can fall into these categories: early spring=March-April, spring=May-June, summer=July-August, fall=September-October.</p>

```
        <h3>Fruiting Period</h3>
    <p>To search by "Fruiting Period" select from the drop down list the period that best fits.
Timing changes from year to year, by dividing the fruiting season into 3 periods instead of
months, natures timing can be better described. Typically months can fall into these categories:
spring=May-June, summer=July-August, fall=September-October.</p>
</div>
</div>
<!--
<form action="<?php echo $_SERVER['PHP_SELF'] ?>" method="post">
<input type="submit" name="plants" value="all plants" />
</form>
<div>
<?php
        if ($_POST['plants']) {
//Query for plants
$result = mysqli_query ($link, "SELECT * FROM `plants` ORDER BY id DESC");
$num_plants = mysqli_num_rows($result);

echo'<table>
            <thead>
                    <tr>
                            <th>Name</th>
                            <th>Scientific Name</th>
                            <th>Flower Color</th>
                            <th>Leaf Shape</th>
                            <th>Fruit Type</th>
                    </tr>
            </thead>
            <tbody>';

for($i=0; $i<$num_plants; $i++) {
            $plantinfo = mysqli_fetch_assoc($result);    // get all the fields from the query
        echo '
                                    <tr>
                                        <td>'.$plantinfo['name'].'</td>
            <td>'.$plantinfo['s_name'].'</td>
              <td>'.$plantinfo['fl_color'].'</td>
              <td>'.$plantinfo['leaf_shape'].'</td>
              <td>'.$plantinfo['fruit_type'].'</td>
                                    </tr>
        ';
```

```
                                          }
                                  echo '</tbody>
                                          </table>';
                                  }
                  else{
                          //maybe display an ad or something
                  }
?>
</div>-->
</body>
</html>
```

addPlant.php

```php
<?php
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
   die('Connect Error (' . mysqli_connect_errno() . ') '
       . mysqli_connect_error());
}

if (isset($_POST['uploadCSV'])){
        $auctionDate = mysqli_real_escape_string($link,$_POST['auctionDate']);
}
if ($_FILES[csv][size] > 0) {

   //get the csv file
   $file = $_FILES[csv][tmp_name];
   $handle = fopen($file,"r");

   //loop through the csv file and insert into database
   do {
     if ($data[0]) {
                        //check for duplicates and update if already in database
                        $check_sname = mysqli_query($link, "SELECT * FROM `plants` WHERE
s_name='".addslashes($data[1])."'");
                        $iteminfo = mysqli_fetch_assoc($check_sname);     // get all the fields
from the query
                        if (strtoupper($iteminfo['s_name']) ==
strtoupper(addslashes($data[1]))){
                                mysqli_query($link, "UPDATE `plants` SET
name='".addslashes($data[0])."',s_name='".addslashes($data[1])."',family='".addslashes($data[2
]))."',s_family='".addslashes($data[3])."',form='".addslashes($data[4])."',fl_color='".addslashes($
```

```php
data[5])."'",fl_type='".addslashes($data[6])."'",fl_arran='".addslashes($data[7])."'",leaf_shape='".ad
dslashes($data[8])."'",leaf_arran='".addslashes($data[9])."'",fruit_color='".addslashes($data[10])."
'",fruit_type='".addslashes($data[11])."'",fl_time='".addslashes($data[12])."'",fruit_time='".addslas
hes($data[13])."'",size='".addslashes($data[14])."'",flower='".addslashes($data[15])."'",fruit='".adds
lashes($data[16])."'",leaves='".addslashes($data[17])."'",found='".addslashes($data[18])."'",Notes='
".addslashes($data[19])."' WHERE id='".$iteminfo['id']."'");
                    }
                    else{
        mysqli_query($link, "INSERT INTO plants(`name`, `s_name`, `family`, `s_family`, `form`,
`fl_color`, `fl_type`, `fl_arran`, `leaf_shape`, `leaf_arran`, `fruit_color`, `fruit_type`, `fl_time`,
`fruit_time`, `size`, `flower`, `fruit`, `leaves`, `found`, `Notes`) VALUES
        (
                                    '".addslashes($data[0])."',
            '".addslashes($data[1])."',
            '".addslashes($data[2])."',
            '".addslashes($data[3])."',
                                    '".addslashes($data[4])."',
                                    '".addslashes($data[5])."',
                                    '".addslashes($data[6])."',
                                    '".addslashes($data[7])."',
                                    '".addslashes($data[8])."',
                                    '".addslashes($data[9])."',
                                    '".addslashes($data[10])."',
                                    '".addslashes($data[11])."',
                                    '".addslashes($data[12])."',
                                    '".addslashes($data[13])."',
                                    '".addslashes($data[14])."',
                                    '".addslashes($data[15])."',
                                    '".addslashes($data[16])."',
                                    '".addslashes($data[17])."',
            '".addslashes($data[18])."',
                                    '".addslashes($data[19])."'
        )
    ");
                    }
        }
    } while ($data = fgetcsv($handle,1000,",","'"));
    //

    //complete
    echo '<script>alert("File Uploaded to Database");</script>';
}

//Get form info and add to database
```

```php
if ($_POST['plant'])
  {
    $name = $_POST['name'];
    $sName = $_POST['sName'];
                $family = $_POST['family'];
                $sFamily = $_POST['sFamily'];
                $form = $_POST['form'];
                $flColor = $_POST['flowerColor'];
    $flType = $_POST['flowerType'];
                $flarran = $_POST['flowerArran'];
                $leafShape = $_POST['leafShape'];
                $leafArran = $_POST['leafArran'];
                $fruitColor = $_POST['fruitColor'];
    $fruitType = $_POST['fruitType'];
                $habitat = $_POST['habitat'];
                $elevation = $_POST['elevation'];
                $flTime = $_POST['flowerTime'];
                $fruitTime = $_POST['fruitTime'];
                $general = $_POST['general'];
                $found = $_POST['found'];


                //Query for the Scientific Name that matches the given name
    $check_sname = mysqli_query($link, "SELECT s_name FROM `plants` WHERE
s_name='".$sName."'");
                //check typed text fields to make sure they have values
    if ($sName == "")
    {
      echo "Field Scientific Name is empty!";
    }
    else if ($name == "")
    {
      echo "Please include a name!";
    }
                else if ($family == "")
    {
      echo "Please include the family name!";
    }
                else if ($sFamily == "")
    {
      echo "Please include a Scientific Family name!";
    }
                // Use query to make sure there isn't already a plant with the same scientific
name
    else if (mysqli_num_rows($check_sname) != 0)
```

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```php
    {
        echo "Error with adding plant: a plant with that scientific name already exists!";
    }
    else
    {
                        // If there are no errors, make entries safe and enter input into the
database
                        $name = mysqli_real_escape_string($link, $name);
                        $sname = mysqli_real_escape_string($link, $sname);
                        $family = mysqli_real_escape_string($link, $family);
                        $sFamily = mysqli_real_escape_string($link, $sFamily);
                        $found = mysqli_real_escape_string($link, $found);
                        $general = mysqli_real_escape_string($link, $general);
        mysqli_query($link, "INSERT INTO `plants` (`name`,`s_name`, `family`, `s_family`,
`form`,`fl_color`, `fl_type`, `fl_arran`, `leaf_shape`, `leaf_arran`,`fruit_color`, `fruit_type`,
`habitat`, `elevation`, `fl_time`, `fruit_time`, `general`, `found`) VALUES
('".$name."','".$sName."','".$family."','".$sFamily."','".$form."','".$flColor."','".$flType."','".$flarra
n."','".$leafShape."','".$leafArran."','".$fruitColor."','".$fruitType."','".$habitat."','".$elevation."','
".$flTime."','".$fruitTime."','".$general."','".$found."')");

        if (mysqli_error($link))
            echo mysqli_errno($link) . ": " . mysqli_error($link). "\n";
        else
        {
            echo "<p>plant Added.<br/> <a href='index.php'>Return</a> or <a
href='addPlant.php'>Add Another</a></p>";
            mysqli_close($link);
        }
    }
  }
  else
  {
include ('header.php');
?>
<title>Add Plants</title>
</head>
<body>
<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>

<div>
<h3>Upload CSV file to plant database</h3>
```

```html
<p>Make sure the CSV file is in the correct order (Name, Scientific Name, Family, Scientific
Family, Form, Flower Color, Flower Type, Flower Arrangement, Leaf Shape, Leaf Arrangement,
Fruit Color, Fruit Type, Habitat, Elevation, Flower Time, Fruit Time, Size, Flower, Fruit, Leaves,
Found, Notes)</p>
<form action="<?php echo $_SERVER['PHP_SELF'] ?>" method="post" enctype="multipart/form-
data" id="addTitle" name="addTitle">
<label for="csv">CSV File:</label>
<input name="csv" type="file" id="csv" />
<input type="submit" name="uploadCSV" value="Upload CSV" />
</form>
<br/>
<br/>
</div>

    <div>
    <form action="<?php echo $_SERVER['PHP_SELF'] ?>" method="post">
            <ul>
      <li>
              Name: <input type="text" name="name" required />
                     </li>
        <li>
          Scientific Name: <input type="text" name="sName" required />
        </li>
        <li>
              Family: <input type="text" name="family" required />
                     </li>
        <li>
              Scientific Family: <input type="text" name="sFamily" required />
                     </li>
         <li>
              Form: <select name="form" required />
        <option value="tree" >tree</option>
        <option value="shrub" >shrub</option>
        <option value="forb" >forb</option>
        <option value="grass" >grass</option>
        </select>
    </li>
    <li>
              Flower Color: <select name="flowerColor" required />
        <option value="purple" >purple</option>
        <option value="yellow" >yellow</option>
        <option value="blue" >blue</option>
        <option value="white" >white</option>
        <option value="pink" Selected>pink</option>
```

```html
    <option value="red" >red</option>
    <option value="green" >green</option>
    <option value="brown" >brown</option>
    </select>
</li>
 <li>
            Flower Type: <select name="flowerType" required />
    <option value="composite" >composite</option>
    <option value="regular" >regular</option>
    <option value="irregular" >irregular</option>
    <option value="bell" >bell</option>
    <option value="tubular" Selected>tubular</option>
    </select>
</li>
 <li>
            Flower Arrangement: <select name="flowerArran" required />
    <option value="head" >head</option>
    <option value="spike" >spike</option>
    <option value="raceme" >raceme</option>
    <option value="umbel" >umbel</option>
    <option value="panicle" >panicle</option>
    <option value="cyme" >cyme</option>
    <option value="corymb" >corymb</option>
    </select>
</li>

<li>
            Leaf Shape: <select name="leafShape" required />
    <option value="linear" >linear</option>
    <option value="lanceolate" >lanceolate</option>
    <option value="elliptic" >elliptic</option>
    <option value="ovate" >ovate</option>
    <option value="obovate" >obovate</option>
    <option value="cordate" >cordate</option>
    <option value="palmate" >palmate</option>
    <option value="pinnate" >pinnate</option>
    </select>
</li>
<li>
            Leaf Arrangement: <select name="leafArran" required />
    <option value="alternate" >alternate</option>
    <option value="opposite" >opposite</option>
    <option value="whorled" >whorled</option>
    <option value="basal" >basal</option>
```

```html
		</select>
	</li>
	<li>
			Fruit Color: <select name="fruitColor" required />
		<option value="red" >red</option>
		<option value="blue" >blue</option>
		<option value="white" >white</option>
		<option value="green" >green</option>
		<option value="brown" >brown</option>
		</select>
	</li>
	<li>
			Fruit Type: <select name="fruitType" required />
		<option value="berry" >berry</option>
		<option value="capsule" >capsule</option>
		<option value="cone" >cone</option>
		<option value="drupe" >drupe</option>
		<option value="pod" >pod</option>
		<option value="achene" >achene</option>
		<option value="schizocarp" >schizocarp</option>
		</select>
	</li>
	<li>
			Habitat: <select name="habitat" required />
		<option value="forest" >forest</option>
		<option value="openDry" >open/dry</option>
		<option value="openMoist" >open/moist</option>
		<option value="riparian" >riparian</option>
		</select>
	</li>
	<li>
			Elevation: <select name="elevation" required />
		<option value="alpine" >alpine</option>
		<option value="montane" >montane</option>
		<option value="steppe" >steppe</option>
		<option value="lowlands" >lowlands</option>
		</select>
	</li>
	<li>
			Flowering Period: <select name="flowerTime" required />
		<option value="April" >April</option>
		<option value="May" >May</option>
		<option value="June" >June</option>
		<option value="July" >July</option>
```

```html
                <option value="August" >August</option>
                <option value="September" >September</option>
                </select>
        </li>
        <li>
                    Fruiting Period: <select name="fruitTime" required />
                <option value="April" >April</option>
                <option value="May" >May</option>
                <option value="June" >June</option>
                <option value="July" >July</option>
                <option value="August" >August</option>
                <option value="September" >September</option>
                <option value="October" >October</option>
                <option value="November" >November</option>
                </select>
        </li>
        <li>
                    General:  <textarea cols="30" rows="5" name="general" required ></textarea>
                        </li>
        <li>
                    Found: <textarea cols="30" rows="5" name="found" required ></textarea>
                        </li>

</ul>
    <br/>
    <input type="submit" name="plant" value="Add Plant"/>
    </form>
    </div>

</body>
</html>
<?php
        }
?>
```

autosuggest.php

```php
<?php
  $db = new mysqli('localhost', 'user', 'password', 'database');

        if(!$db) {

                echo 'Could not connect to the database.';
        } else {
```

```php
            if(isset($_POST['queryString'])) {
                    $queryString = $db->real_escape_string($_POST['queryString']);

                    if(strlen($queryString) >0) {

                            $query = $db->query("SELECT name FROM plants WHERE name
LIKE '%$queryString%' LIMIT 10");
                            if($query) {
                            echo '<ul>';
                                    while ($result = $query ->fetch_object()) {
                            echo '<li onClick="fill(\''.addslashes($result-
>name).'\');">'.$result->name.'</li>';
                            }
                            echo '</ul>';

                            } else {
                                    echo 'OOPS we had a problem :(';
                            }
                    } else {
                            // do nothing
                    }
            } else {
                    echo 'There should be no direct access to this script!';
            }
        }
?>
```

<h1 style="text-align:center">autosuggest1.php</h1>

```php
<?php
  $db = new mysqli('localhost', 'user', 'password', 'database');

        if(!$db) {

                echo 'Could not connect to the database.';
        } else {

                if(isset($_POST['queryString'])) {
                        $queryString = $db->real_escape_string($_POST['queryString']);

                        if(strlen($queryString) >0) {

                                $query = $db->query("SELECT s_name FROM plants WHERE
s_name LIKE '%$queryString%' LIMIT 10");
                                if($query) {
```

```php
                        echo '<ul>';
                                while ($result = $query ->fetch_object()) {
                        echo '<li onClick="fill1(\".addslashes($result-
>s_name).'\');">'.$result->s_name.'</li>';
                        }
                        echo '</ul>';

                        } else {
                                echo 'OOPS we had a problem :(';
                        }
                } else {
                        // do nothing
                }
        } else {
                echo 'There should be no direct access to this script!';
        }
    }
?>
```

autosuggest2.php

```php
<?php
  $db = new mysqli('localhost', 'user', 'password', 'database');

        if(!$db) {

                echo 'Could not connect to the database.';
        } else {

                if(isset($_POST['queryString'])) {
                        $queryString = $db->real_escape_string($_POST['queryString']);

                        if(strlen($queryString) >0) {

                                $query = $db->query("SELECT DISTINCT family FROM plants
WHERE family LIKE '%$queryString%' LIMIT 10");
                                if($query) {
                                echo '<ul>';
                                        while ($result = $query ->fetch_object()) {
                                echo '<li onClick="fill2(\".addslashes($result-
>family).'\');">'.$result->family.'</li>';
                                }
                                echo '</ul>';
```

```php
                        } else {
                                echo 'OOPS we had a problem :(';
                        }
                } else {
                        // do nothing
                }
        } else {
                echo 'There should be no direct access to this script!';
        }
    }
?>
```

autosuggest3.php

```php
<?php
  $db = new mysqli('localhost', 'user', 'password', 'database');

        if(!$db) {

                echo 'Could not connect to the database.';
        } else {

                if(isset($_POST['queryString'])) {
                        $queryString = $db->real_escape_string($_POST['queryString']);

                        if(strlen($queryString) >0) {

                                $query = $db->query("SELECT DISTINCT s_family FROM plants
WHERE s_family LIKE '%$queryString%' LIMIT 10");
                                if($query) {
                                echo '<ul>';
                                        while ($result = $query ->fetch_object()) {
                                        echo '<li onClick="fill3(\".addslashes($result-
>s_family).'\');">'.$result->s_family.'</li>';
                                }
                                echo '</ul>';

                                } else {
                                        echo 'OOPS we had a problem :(';
                                }
                        } else {
                                // do nothing
                        }
                } else {
```

```
                         echo 'There should be no direct access to this script!';
                }
         }
?>
```

contact.php

```php
<?php
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
   die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}

if ($_POST['contact'])
  {
               require_once('recaptchalib.php');
               $privatekey = "privatekey";
               $resp = recaptcha_check_answer ($privatekey,
                 $_SERVER["REMOTE_ADDR"],
                 $_POST["recaptcha_challenge_field"],
                 $_POST["recaptcha_response_field"]);

               if (!$resp->is_valid) {
                // What happens when the CAPTCHA was entered incorrectly
        die ("The reCAPTCHA wasn't entered correctly. Go back and try it again." .
     "(reCAPTCHA said: " . $resp->error . ")");
               } else {
       // Your code here to handle a successful verification
                    $name = $_POST['name'];
                    $email = $_POST['email'];
                    $message = $name . ' writes: ' . "\r\n" . $_POST['message'];
                    $subject = 'Idaho Plants Contact';

                    mail("email@domain.com",$subject,$message,"From: IdahoPlants <no-
reply@idahoplants.sytes.net>" . "\r\n" . 'Reply-To: '.$name.'<'.$email.'>');
                    header("Location: http://idahoplants.sytes.net");
        }
               }
  else
  {
include ('header.php');
?>
```

```
<title>Idaho Plants Home</title>
</head>

<body>
<script>
 (function(i,s,o,g,r,a,m){i['GoogleAnalyticsObject']=r;i[r]=i[r]||function(){
 (i[r].q=i[r].q||[]).push(arguments)},i[r].l=1*new Date();a=s.createElement(o),
 m=s.getElementsByTagName(o)[0];a.async=1;a.src=g;m.parentNode.insertBefore(a,m)
 })(window,document,'script','//www.google-analytics.com/analytics.js','ga');

 ga('create', 'GoogleAnalyticsID', 'auto');
 ga('send', 'pageview');

</script>
<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>
<!-- start menu -->
<div id="navigation" class="clearfix">
<ul class="clearfix">
   <li><a href="index.php"><span>Search Plants</span></a></li>
   <li><a href="about.php"><span>About</span></a></li>
   <li class="menuactive"><a class="menuactive"
href="contact.php"><span>Contact</span></a></li>
</ul>
<a href="#" id="pull">Menu</a>
</div>
<!-- end menu -->
<div class="content">
<form class="pure-form pure-form-aligned" action="<?php echo $_SERVER['PHP_SELF'] ?>"
method="post">
        <fieldset>
                <div class="pure-control-group">
                <label for="name">Name</label>
          <input id="name" type="text" name="name" placeholder="Name" required />
        </div>
        <div class="pure-control-group">
                <label for="email">E-mail</label>
                <input id="email" type="email" name="email"
placeholder="example@host.com" required />
        </div>
        <div class="pure-control-group">
                <label for="description">Message</label>
```

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```
                        <textarea cols="30" rows="5" id="message" name="message"
placeholder="Enter your message here" required ></textarea>
        </div>
    <br/>
    <?php
                        require_once('recaptchalib.php');
                        $publickey = "publickey"; // you got this from the signup page
                        echo recaptcha_get_html($publickey);
                ?>
    <br/>
    <input class="btn" type="submit" name="contact" value="Send">
    </fieldset>
    </form>
</body>
</html>
<?php
}
?>
```

header.php

```
<!DOCTYPE html>
<html>
<head>
<meta charset="utf-8" />
<meta name="viewport" content="width=device-width, initial-scale=1, maximum-scale=1">
<link href="css/menu.css" rel="stylesheet" type="text/css" />
<link href="css/index.css" rel="stylesheet" type="text/css" />
<link href='http://fonts.googleapis.com/css?family=Overlock' rel='stylesheet' type='text/css'>
<link rel="stylesheet" href="//cdn.jsdelivr.net/g/pure@0.5.0(base-min.css+grids-min.css+forms-
min.css+menus-min.css)">
<!--[if lte IE 8]>
    <link rel="stylesheet" href="http://yui.yahooapis.com/pure/0.5.0/grids-responsive-old-ie-
min.css">
<![endif]-->
<!--[if gt IE 8]><!-->
    <link rel="stylesheet" href="http://yui.yahooapis.com/pure/0.5.0/grids-responsive-min.css">
<!--<![endif]-->
<!--[if lt IE 8]>
    <div style=' clear: both; text-align:center; position: relative;'>
```

```html
    <a href="http://windows.microsoft.com/en-US/internet-
explorer/products/ie/home?ocid=ie6_countdown_bannercode">
        <img
src="http://storage.ie6countdown.com/assets/100/images/banners/warning_bar_0000_us.jpg"
border="0" height="42" width="820" alt="You are using an outdated browser. For a faster, safer
browsing experience, upgrade for free today." />
    </a>
  </div>
 <![endif]-->
 <!--[if lt IE 9]>
                <script src="js/html5.js"></script>
                <script src="js/css3-mediaqueries.js"></script>
<![endif]-->
<script src="https://ajax.googleapis.com/ajax/libs/jquery/1.11.1/jquery.min.js"></script>
<script>
                $(function() {
                        var pull        = $('#pull');
                                menu            = $('#navigation ul');
                                menuHeight      = menu.height();

                        $(pull).on('click', function(e) {
                                e.preventDefault();
                                menu.slideToggle();
                        });

                        $(window).resize(function(){
                var w = $(window).width();
                if(w > 320 && menu.is(':hidden')) {
                        menu.removeAttr('style');
                }
                });
                });
        </script>

  <script>
function suggest(inputString){
                if(inputString.length == 0) {
                        $('#suggestions').fadeOut();
                } else {
                $('#name').addClass('load');
                        $.post("autosuggest.php", {queryString: ""+inputString+""},
function(data){
                                if(data.length >0) {
                                        $('#suggestions').fadeIn();
```

```
                                    $('#suggestionsList').html(data);
                                    $('#name').removeClass('load');
                            }
                    });
            }
    }

    function fill(thisValue) {
            $('#name').val(thisValue);
            setTimeout("$('#suggestions').fadeOut();", 600);
    }
</script>

<script>
function suggest1(inputString){
            if(inputString.length == 0) {
                    $('#suggestions1').fadeOut();
            } else {
            $('#sName').addClass('load');
                    $.post("autosuggest1.php", {queryString: ""+inputString+""},
function(data){
                            if(data.length >0) {
                                    $('#suggestions1').fadeIn();
                                    $('#suggestionsList1').html(data);
                                    $('#sName').removeClass('load');
                            }
                    });
            }
    }

    function fill1(thisValue) {
            $('#sName').val(thisValue);
            setTimeout("$('#suggestions1').fadeOut();", 600);
    }
</script>

<script>
function suggest2(inputString){
            if(inputString.length == 0) {
                    $('#suggestions2').fadeOut();
            } else {
            $('#family').addClass('load');
                    $.post("autosuggest2.php", {queryString: ""+inputString+""},
function(data){
```

```
                                        if(data.length >0) {
                                                $('#suggestions2').fadeIn();
                                                $('#suggestionsList2').html(data);
                                                $('#family').removeClass('load');
                                        }
                                });
                        }
                }

        function fill2(thisValue) {
                        $('#family').val(thisValue);
                        setTimeout("$('#suggestions2').fadeOut();", 600);
                }
</script>

<script>
function suggest3(inputString){
                if(inputString.length == 0) {
                        $('#suggestions3').fadeOut();
                } else {
                $('#s_family').addClass('load');
                        $.post("autosuggest3.php", {queryString: ""+inputString+""},
function(data){
                                if(data.length >0) {
                                        $('#suggestions3').fadeIn();
                                        $('#suggestionsList3').html(data);
                                        $('#s_family').removeClass('load');
                                }
                        });
                }
        }

        function fill3(thisValue) {
                        $('#s_family').val(thisValue);
                        setTimeout("$('#suggestions3').fadeOut();", 600);
                }
</script>
<script type="text/javascript">
jQuery(document).ready(function() {
 jQuery(".shcontent").hide();
 jQuery(".shtitle").click(function()
 {
  jQuery(this).next(".shcontent").slideToggle(500);
 });
```

```
});
</script>
```

imageUpload.php

```php
<?php
session_start();
$id = $_SESSION['plantId'];
$pass = $_POST['password'];
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}

if ($pass == "setpassword"){
                //Get the uploaded file information
    /*$name_of_uploaded_file =
    basename($_FILES["fileAttach"]["name"]);

    //get the file extension of the file
    $type_of_uploaded_file =
    substr($name_of_uploaded_file,
    strrpos($name_of_uploaded_file, '.') + 1);


    //Settings
    $allowed_extensions = array("jpg", "jpeg", "gif", "png");

    //------ Validate the file extension -----
    $allowed_ext = false;
    for($i=0; $i<sizeof($allowed_extensions); $i++)
    {
        if(strcasecmp($allowed_extensions[$i],$type_of_uploaded_file) == 0)
        {
         $allowed_ext = true;
        }
    }

    if(!$allowed_ext)
    {
```

```php
        $errors .= "\n The uploaded file is not a supported file type. ".
   " Only the following file types are supported: ".implode(',',$allowed_extensions);
        echo '<h2 style="text-align:center">'.$errors.'<br /><a href="javascript: history.go(-
1)"><u>Go Back</u></a></h2>';
        die();
      }*/
/* ----------------------------------------------------
Begin Picture upload script
---------------------------------------------------- */
        $targetDir = "img/$id/";//Directory for images

        //If directory doesn't exist, create it
                if (!is_dir($targetDir)){
                        $old = umask(0);
                        mkdir($targetDir, 0755);
                        chmod($targetDir, 0755);
                        umask($old);
                }
        $stamp = time();

        //for each uploaded file show error or upload
        $files = $_FILES['files'];
                foreach ($files['error'] as $key => $err) {
                        if ($err == UPLOAD_ERR_OK) {
                                $fn = $files['name'][$key];
                                move_uploaded_file(
                                        $files['tmp_name'][$key],
                                        $targetDir . $fn);
                                mysqli_query($link, "INSERT INTO `plant_images` (`plant_id`,
`location`) VALUES('".$id."','".$targetDir.$fn."')");
                                echo "<p>File $fn uploaded.</p>";
                                echo $targetDir . $fn;
                        }
                }
}
else{
        echo "<h1>Your password is incorrect, No hacking yo!</h1>";
}
/* ----------------------------------------------------
End picture upload script
---------------------------------------------------- */
session_destroy();
?>
```

index.php

```php
<?php
include ('header.php');
?>
<title>Plant Search</title>
</head>

<body>
<script>
  (function(i,s,o,g,r,a,m){i['GoogleAnalyticsObject']=r;i[r]=i[r]||function(){
  (i[r].q=i[r].q||[]).push(arguments)},i[r].l=1*new Date();a=s.createElement(o),
  m=s.getElementsByTagName(o)[0];a.async=1;a.src=g;m.parentNode.insertBefore(a,m)
  })(window,document,'script','//www.google-analytics.com/analytics.js','ga');

  ga('create', 'GoogleAnalyticsID', 'auto');
  ga('send', 'pageview');

</script>

<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>
<!-- start menu -->
<div id="navigation" class="clearfix">
<ul class="clearfix">
        <li class="menuactive"><a class="menuactive" href="index.php"><span>Search
Plants</span></a></li>
  <!--<li><a href="addPlant.php"><span>Add Plants</span></a></li>-->
  <li><a href="about.php"><span>About</span></a></li>
  <li><a href="contact.php"><span>Contact</span></a></li>
</ul>
<a href="#" id="pull">Menu</a>
</div>
<!-- end menu -->
<div id="mainContent">
<p>Welcome to A Digital Flora of Idaho! This in an online multi-entry key and guide for the
native plants of Southeastern Idaho. For information on how to use this search, see the <a
href="about.php">About</a> page. Here are some tips for using the key.<br/>
<ul><h3>Tips</h3>
        <li>guide only covers native plants</li>
        <li>use only 2 or 3 characteristics you are sure of</li>
        <li>using the back button returns to the form with previously selected options</li>
```

```
                <li>clicking 'search plants' in main menu take you to a fresh form</li>
</ul>
<br/>
To search by name, enter the name in the appropriate field and then click 'Search Plant(s)'</p>

<form class="pure-form pure-form-stacked" action="results.php" method="post">
                        <div class="pure-control-group">
                <div id="suggest">
        <label for="name">Common Name: </label><input type="text" name="name"
id="name" onkeyup="suggest(this.value);" onblur="fill();" class="" autocomplete="off" />
            <div class="suggestionsBox" id="suggestions" style="display: none;"> <img
src="img/arrow.png" style="position: relative; top: -12px; left: 30px;" alt="upArrow" />
                <div class="suggestionList" id="suggestionsList"> </div>
                    </div>
                    </div>
                    </div>
        <div class="pure-control-group">
          <div id="suggest">
          <label for="scientific name">Scientific Name: </label><input type="text"
name="sName" id="sName" onkeyup="suggest1(this.value);" onblur="fill1();" class=""
autocomplete="off" />
            <div class="suggestionsBox" id="suggestions1" style="display: none;"> <img
src="img/arrow.png" style="position: relative; top: -12px; left: 30px;" alt="upArrow" />
                <div class="suggestionList" id="suggestionsList1"> </div>
                    </div>
                    </div>
        </div>
        <div class="pure-control-group">
                <div id="suggest">
        <label for="family">Family: </label><input type="text" name="family" id="family"
onkeyup="suggest2(this.value);" onblur="fill2();" class="" autocomplete="off" />
            <div class="suggestionsBox" id="suggestions2" style="display: none;"> <img
src="img/arrow.png" style="position: relative; top: -12px; left: 30px;" alt="upArrow" />
                <div class="suggestionList" id="suggestionsList2"> </div>
                    </div>
                    </div>
                    </div>
        <div class="pure-control-group">
                <div id="suggest">
        <label for="scientific family">Scientific Family:</label> <input type="text"
name="s_family" id="s_family" onkeyup="suggest3(this.value);" onblur="fill3();" class=""
autocomplete="off" />
            <div class="suggestionsBox" id="suggestions3" style="display: none;"> <img
src="img/arrow.png" style="position: relative; top: -12px; left: 30px;" alt="upArrow" />
```

```html
            <div class="suggestionList" id="suggestionsList3"> </div>
                </div>
                </div>
                </div>
    <br/>
    <p>To search by characteristic, click the button to expand the multi-entry key.</p>
    <a style="cursor:pointer;" class="shtitle"><span class="btn">Search by
Characteristic</span></a>
                    <div class="shcontent">
    <br/>
    <div class="pure-control-group">
            <label for="form"><a id="form">Form:</a></label> <select name="form"/>
      <option value="" selected >Select a Form</option>
      <option value="tree" >tree</option>
      <option value="shrub" >shrub</option>
      <option value="forb" >forb</option>
      <option value="grass" >grass</option>
      </select>
    </div>
    <div style="display:block; margin:auto;">
      <a href="#form" class="tooltip"><img src="img/char/Form_tree.jpg"
width="75"/><span>A large woody plant usually with a single stem of main trunk</span></a>
      <a href="#form" class="tooltip"><img src="img/char/Form_shrub.jpg"
width="75"/><span>A woody, plant with several stems, that is shorter than a tree</span></a>
      <a href="#form" class="tooltip"><img src="img/char/Form_forb.jpg"
width="75"/><span>A non-grasslike herbaceous (non-woody) plant</span></a>
      <a href="#form" class="tooltip"><img src="img/char/Form_grass.jpg"
width="75"/><span>An herbaceous plant with parrallel viened leaves growing from a
base</span></a>
    </div>
    <div class="pure-control-group">
            <label for="flower color">Flower Color: </label><select name="flowerColor" />
      <option value="" selected >Select a Color</option>
      <option value="purple" >purple</option>
      <option value="yellow" >yellow</option>
      <option value="blue" >blue</option>
      <option value="white" >white</option>
      <option value="pink" >pink </option>
      <option value="red" >red/orange</option>
      <option value="green" >green</option>
      <option value="brown" >brown</option>
      </select>
    </div>
    <div class="pure-control-group">
```

```html
            <label for="flower type"><a id="flType">Flower Type:</a></label> <select
name="flowerType"/>
        <option value="" selected >Select a Type</option>
        <option value="floret" >floret</option>
        <option value="regular" >regular</option>
        <option value="irregular" >irregular</option>
        <option value="bell" >bell</option>
        <option value="tubular" >tubular</option>
        <option value="non-flowering" >non-flowering</option>
        </select>
    </div>
    <div style="display:block; margin:auto;">
        <a href="#flType" class="tooltip"><img src="img/char/FT_floret.jpg"
width="75"/><span>A small flower in a dense cluster, as in sunflowers and grasses</span></a>
        <a href="#flType" class="tooltip"><img src="img/char/FT_regular.jpg"
width="75"/><span>3-6 petals symmetrically arranged</span></a>
        <a href="#flType" class="tooltip"><img src="img/char/FT_irregular.jpg"
width="75"/><span>Not radially symmetrical leave arrangment, or shape</span></a>
        <a href="#flType" class="tooltip"><img src="img/char/FT_bell.jpg"
width="75"/><span>Bell-shaped</span></a>
        <a href="#flType" class="tooltip"><img src="img/char/FT_tubular.jpg"
width="75"/><span>Fused petals forming a tube</span></a>
    </div>
    <div class="pure-control-group">
            <label for="flower arrangement"><a id="flArran">Flower Arrangement:
</a></label><select name="flowerArran"/>
        <option value="" selected >Select an Arrangement</option>
        <option value="solitary" >solitary</option>
        <option value="head" >head</option>
        <option value="spike" >spike</option>
        <option value="raceme" >raceme</option>
        <option value="panicle" >panicle</option>
        <option value="cyme" >cyme</option>
        <option value="umbel" >umbel</option>
        <option value="corymb" >corymb</option>
        <option value="catkin" >catkin</option>
        </select>
    </div>
    <div style="display:block; margin:auto;">
        <a href="#flArran" class="tooltip"><img src="img/char/FA_solitary.jpg"
width="75"/><span>A single flower on a stem</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_head.jpg"
width="75"/><span>A dense cluster of sessile flowers, typically a combination of disk and ray
florets</span></a>
```

```
        <a href="#flArran" class="tooltip"><img src="img/char/FA_spike.jpg"
width="75"/><span>An unbranched, elongate inflorescences with sessile flowers matureing
bottom up</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_raceme.jpg"
width="75"/><span>An unbranched elongate inflorescence with flower on pedicels, maturing
bottom up</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_panicle.jpg"
width="75"/><span>A branched inflorescence with flowers maturing bottom up</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_cyme.jpg"
width="75"/><span>A determinate panicle where the terminal flowers bloom first</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_umbel.jpg"
width="75"/><span>A flat-topped inflorescence with the pedicels arising from a common
point</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_corymb.jpg"
width="75"/><span>Flat-topped cluster where the flower stalks originate from different
points</span></a>
        <a href="#flArran" class="tooltip"><img src="img/char/FA_catkin.jpg"
width="75"/><span>A spike-like, usually hanging inflorescence that is either male or
female</span></a>
        </div>
        <div class="pure-control-group">
                <label for="Leaf Shape"><a id="lShape">Leaf Shape:</a></label> <select
name="leafShape" />
        <option value="" selected >Select a Shape</option>
        <option value="linear" >linear</option>
        <option value="lanceolate" >lanceolate</option>
        <option value="elliptical" >elliptical</option>
        <option value="ovate" >ovate</option>
        <option value="obovate" >obovate</option>
        <option value="cuneate" >cuneate</option>
        <option value="cordate" >cordate</option>
        <option value="palmate" >palmate</option>
        <option value="pinnate" >pinnate</option>
        <option value="trifoliate" >trifoliate</option>
        <option value="dissected" >dissected</option>
        </select>
      </div>
      <div style="display:block; margin:auto;">
        <a href="#lShape" class="tooltip"><img src="img/char/LS_linear.jpg"
width="75"/><span>Long and narrow with parallel sides</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_lanceolate.jpg"
width="75"/><span>Lance-shaped, longer than it is wide, brouder at the base</span></a>
```

```html
        <a href="#lShape" class="tooltip"><img src="img/char/LS_elliptical.jpg"
width="75"/><span>Narrow oval, broadest in the middle and narrowest at the two equal
ends</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_ovate.jpg"
width="75"/><span>Egg-shaped, attached at the broader end</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_obovate.jpg"
width="75"/><span>Egg-shaped, attached at the narrow end</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_cuneate.jpg"
width="75"/><span>Wedge-shaped, attached at the narrow end</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_cordate.jpg"
width="75"/><span>Heart-shaped, attached between the lobes</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_palmate.jpg"
width="75"/><span>Lobes, viens or divisions radiating from one point</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_pinnate.jpg"
width="75"/><span>Compound leaf with leaflet on opposite sides of an axis, feather-
like</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_trifoliate.jpg"
width="75"/><span>A compound leaf with three segments</span></a>
        <a href="#lShape" class="tooltip"><img src="img/char/LS_dissected.jpg"
width="75"/><span>Cut or divided into numerous and usually narrow segments,
varied</span></a>
    </div>
    <div class="pure-control-group">
            <label for="Leaf Arrangement"><a id="lArran">Leaf Arrangement:</a></label>
<select name="leafArran" />
        <option value="" selected >Select an Arrangement</option>
        <option value="alternate" >alternate</option>
        <option value="opposite" >opposite</option>
        <option value="whorled" >whorled</option>
        <option value="basal" >basal</option>
        </select>
    </div>
    <div style="display:block; margin:auto;">
      <a href="#lArran" class="tooltip"><img src="img/char/LA_alternate.jpg"
width="75"/><span>One at each node, switching sides of the axis</span></a>
        <a href="#lArran" class="tooltip"><img src="img/char/LA_opposite.jpg"
width="75"/><span>2 at a node, across from each other</span></a>
        <a href="#lArran" class="tooltip"><img src="img/char/LA_whorled.jpg"
width="75"/><span>Three or more arising from the same node</span></a>
        <a href="#lArran" class="tooltip"><img src="img/char/LA_basal.jpg"
width="75"/><span>Positioned at or arising from the same node</span></a>
    </div>
    <div class="pure-control-group">
            <label for="fruit color">Fruit Color:</label> <select name="fruitColor" />
```

```
            <option value="" selected >Select a Color</option>
            <option value="red" >red</option>
            <option value="blue" >blue</option>
            <option value="white" >white</option>
            <option value="green" >green</option>
            <option value="brown" >brown</option>
            <option value="orange" >orange</option>
            </select>
        </div>
        <div class="pure-control-group">
                  <label for="fruit type"><a id="frType">Fruit Type:</a></label> <select
name="fruitType" />
            <option value="" selected >Select a Type</option>
            <option value="berry" >berry</option>
            <option value="drupe" >drupe</option>
            <option value="pome" >pome</option>
            <option value="capsule" >capsule</option>
            <option value="follicle" >follicle</option>
            <option value="pod" >pod</option>
            <option value="nutlet" >nutlet</option>
            <option value="achene" >achene</option>
            <option value="caryopsis" >caryopsis</option>
            <option value="samara" >samara</option>
            <option value="schizocarp" >schizocarp</option>
            <option value="cone" >cone</option>
            </select>
        </div>
        <div style="display:block; margin:auto;">
          <a href="#frType" class="tooltip"><img src="img/char/FrT_berry.jpg"
width="75"/><span>A fleshy fruit from a single ovary, with one or many seeds</span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_drupe.jpg"
width="75"/><span>A fleshy fruit with a stony casing around the center seed</span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_pome.jpg"
width="75"/><span>A fleshy fruit with a core, the ovary, that contains seeds</span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_capsule.jpg"
width="75"/><span>A dry fruit made up of carpels that split open in various ways, usually with
definite seams</span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_follicle.jpg"
width="75"/><span>A single ovary that opens along one seam, may be clustered</span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_pod.jpg"
width="75"/><span>A dry dehiscent fruit splitting along two seams, includes legumes: one
carpel, siliques and sillicles: two carpels. </span></a>
            <a href="#frType" class="tooltip"><img src="img/char/FrT_nutlet.jpg"
width="75"/><span>A small, dry, one-seeded fruit with a hard wall</span></a>
```

```
        <a href="#frType" class="tooltip"><img src="img/char/FrT_achene.jpg"
width="75"/><span>A small, dry, indehiscent fruit with a single seed inside a
compartment</span></a>
        <a href="#frType" class="tooltip"><img src="img/char/FrT_caryopsis.jpg"
width="75"/><span>A small, dry, one-seeded fruit where the coat is fused to the
seed</span></a>
        <a href="#frType" class="tooltip"><img src="img/char/FrT_samara.jpg"
width="75"/><span>A winged, one-seed fruit</span></a>
        <a href="#frType" class="tooltip"><img src="img/char/FrT_schizocarp.jpg"
width="75"/><span>A dry fruit that breaks apart into single seed sections, or
carpels</span></a>
        <a href="#frType" class="tooltip"><img src="img/char/FrT_cone.jpg"
width="75"/><span>Seeds are held on woody or fleshy scales around a central axis</span></a>
      </div>
      <!--<li>
            Habitat: <select name="habitat" />
      <option value="" selected >Select a Habitat</option>
      <option value="forest" >forest</option>
      <option value="openDry" >open/dry</option>
      <option value="openMoist" >open/moist</option>
      <option value="riparian" >riparian</option>
      </select>
      </li>
      <li>
            Elevation: <select name="elevation" />
      <option value="" selected >Select an Elevation</option>
      <option value="alpine" >alpine</option>
      <option value="montane" >montane</option>
      <option value="steppe" >steppe</option>
      <option value="lowlands" >lowlands</option>
      </select>
      </li>-->
       <div class="pure-control-group">
            <label for="flowering period">Flowering Period:</label> <select
name="flowerTime" />
      <option value="" selected >Select a Season</option>
      <option value="early spring" >Early Spring</option>
      <option value="spring" >Spring</option>
      <option value="summer" >Summer</option>
      <option value="fall" >Fall</option>
      </select>
      </div>
      <div class="pure-control-group">
            <label for="fruiting period">Fruiting Period:</label> <select name="fruitTime"/>
```

```
            <option value="" selected >Select a Season</option>
            <option value="Spring" >Spring</option>
            <option value="Summer" >Summer</option>
            <option value="Fall" >Fall</option>
            </select>
         </div>
      </div>
      <br/><br/>
      <input type="submit" class="btn" name="FindPlant" value="Find
Plant(s)"/>      
      <input type="reset" class="btn" name="reset" value="Clear"/>
      </form>
</div>

</body>
</html>
```

results.php

```php
<?php
include ('header.php');
?>
<title>Plant Search Results</title>
</head>

<body>
<script>
 (function(i,s,o,g,r,a,m){i['GoogleAnalyticsObject']=r;i[r]=i[r]||function(){
 (i[r].q=i[r].q||[]).push(arguments)},i[r].l=1*new Date();a=s.createElement(o),
 m=s.getElementsByTagName(o)[0];a.async=1;a.src=g;m.parentNode.insertBefore(a,m)
 })(window,document,'script','//www.google-analytics.com/analytics.js','ga');

 ga('create', 'GoogleAnalyticsID', 'auto');
 ga('send', 'pageview');

</script>

<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>
<!-- start menu -->
<div id="navigation" class="clearfix">
```

```html
<ul class="clearfix">
        <li><a href="index.php"><span>Search Plants</span></a></li>
  <!--<li><a href="addPlant.php"><span>Add Plants</span></a></li>-->
  <li><a href="about.php"><span>About</span></a></li>
  <li><a href="contact.php"><span>Contact</span></a></li>
</ul>
<a href="#" id="pull">Menu</a>
</div>
<!-- end menu -->
<div id="mainContent">
```
```php
<?php
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}

if ($_POST['FindPlant'])
  {
            $name = $_POST['name'];
      $sName = $_POST['sName'];
                $family = $_POST['family'];
                $sFamily = $_POST['s_family'];
                $form = $_POST['form'];
                $flColor = $_POST['flowerColor'];
      $flType = $_POST['flowerType'];
                $flArran = $_POST['flowerArran'];
                $leafShape = $_POST['leafShape'];
                $leafArran = $_POST['leafArran'];
                $fruitColor = $_POST['fruitColor'];
      $fruitType = $_POST['fruitType'];
                $flTime = $_POST['flowerTime'];
                $fruitTime = $_POST['fruitTime'];

                //Sanitize inputs before putting in query
                $name = mysqli_real_escape_string($link, $name);
                $sname = mysqli_real_escape_string($link, $sname);
                $family = mysqli_real_escape_string($link, $family);
                $sFamily = mysqli_real_escape_string($link, $sFamily);
```
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```php
$query = "SELECT * FROM `plants`
            WHERE
            (name = '$name' OR '$name' = '') AND
            (s_name = '$sName' OR '$sName' = '') AND
            (family = '$family' OR '$family' = '') AND
            (s_family = '$sFamily' OR '$sFamily' = '') AND
            (form = '$form' OR '$form' = '') AND
            (fl_arran = '$flArran' OR '$flArran' ='') AND
            (leaf_shape = '$leafShape' OR '$leafShape' = '') AND
            (leaf_arran = '$leafArran' OR '$leafArran' = '') AND
            (fruit_color = '$fruitColor' OR '$fruitColor' = '') AND
            (fruit_type = '$fruitType' OR '$fruitType' = '') AND
            (fl_time = '$flTime' OR '$flTime' = '') AND
            (fruit_time = '$fruitTime' OR '$fruitTime' = '') AND ";
            if ($flColor == "blue" OR $flColor == "purple")
                {
                        $query = $query."fl_color = 'blue' OR fl_color =
'purple'";
                }
            else{
                        $query = $query."(fl_color = '$flColor' OR '$flColor'
= '')";
                }
    $result = mysqli_query($link,$query);
    $num_plants = mysqli_num_rows($result);

    if (!$name && !$sName && !$family && !$sFamily && !$flColor && !$flType &&
!$flArran && !$leafShape && !$leafArran && !$fruitColor && !$fruitType && !$flTime
&& !$fruitTime && !$form)
    {
            echo "<h1>You must select at least one characteristic!</h1>";
    }
    else if (!$num_plants)
                {
                        echo "<h1>No plants found with given
characteristics!</h1>";
                }
    else
    {
    echo'<h1>Found '. $num_plants .' results</h1>';
```

```php
        echo'<div class="pure-g">
                        <div class="pure-u-1-3"><span style="padding:1%; font-weight:bold;">Thumbnail</span></div>
                        <div class="pure-u-1-3"><span style="padding:1%; font-weight:bold;">Name</span></div>
                        <div class="pure-u-1-3"><span style="padding:1%; font-weight:bold;">Family</span></div>
            </div>
            <hr style="color:#410b4c;" />';

            for($i=0; $i<$num_plants; $i++) {
              $plantinfo = mysqli_fetch_assoc($result);    // get all the fields from the query
            if ($plantinfo['thumb']==""){
                                            echo '
                                            <div class="pure-g">
                                            <div class="pure-u-1-3"><div style="padding:1%;"><a style="text-decoration:none;" href="species.php?id='.$plantinfo['id'].'">No Picture Available</a></div></div>
                                            <div class="pure-u-1-3"><div style="padding:1%;"><a href="species.php?id='.$plantinfo['id'].'">'.$plantinfo['name'].'<br/><span class="italics">('.$plantinfo['s_name'].')</span></a></div></div>
                                            <div class="pure-u-1-3"><div style="padding:1%;">'.$plantinfo['family'].'</div></div>
                                            </div>
            ';
                                            }
                                            else{
                                            echo '
                                            <div class="pure-g">
                                            <div class="pure-u-1-3"><div style="padding:1%;"><a style="text-decoration:none;" href="species.php?id='.$plantinfo['id'].'"><img style="max-width:100px; padding:.5%;" src="slir/w100/'.$plantinfo['thumb'].'"></a></div></div>
                                            <div class="pure-u-1-3"><div style="padding:1%;"><a href="species.php?id='.$plantinfo['id'].'">'.$plantinfo['name'].'<br/><span class="italics">('.$plantinfo['s_name'].')</span></a></div></div>
                                            <div class="pure-u-1-3"><div style="padding:1%;">'.$plantinfo['family'].'</div></div>
```

```
                                    </div>
            ';
                                    }
                                    }
                                    //echo '</tbody></table>';
              }
      }
?>
</div>
</body>
</html>
```

species.php

```php
<?php
session_start();
//connect to database
$link = mysqli_connect('localhost', 'user', 'password', 'database');

if (!$link) {
   die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}

$id = $_GET['id']; //Get plant id from previous link
$_SESSION['plantId'] = $_GET['id'];
//Get all info from plant with the given id
$query = "SELECT * FROM `plants` WHERE id='".$id."'";
$result = mysqli_query($link,$query);
$plantinfo = mysqli_fetch_assoc($result);

//Get images of plant
$imgQuery = "SELECT * FROM `plant_images` WHERE plant_id='".$id."'";
$imgresult = mysqli_query($link,$imgQuery);
$num_imgs = mysqli_num_rows($imgresult);

include ('header.php');
?>


<div class="header">
<img id="header" src="img/header.jpg" alt="Floral Header" width="100%" />
</div>
```

```html
<!-- start menu -->
<div id="navigation" class="clearfix">
<ul class="clearfix">
        <li><a href="index.php"><span>Search Plants</span></a></li>
  <!--<li><a href="addPlant.php"><span>Add Plants</span></a></li>-->
  <li><a href="about.php"><span>About</span></a></li>
  <li><a href="contact.php"><span>Contact</span></a></li>
</ul>
<a href="#" id="pull">Menu</a>
</div>
<!-- end menu -->

<title>PlantCommonName-<?php echo $plantinfo['name']; ?></title>
<link href="css/species.css" rel="stylesheet" type="text/css" />
<link href='http://fonts.googleapis.com/css?family=Overlock' rel='stylesheet' type='text/css'>
<link href="css/photoswipe.css" type="text/css" rel="stylesheet" />
<link href="css/jquery-mobile.css" type="text/css" rel="stylesheet" />
        <script type="text/javascript" src="js/klass.min.js"></script>
        <script type="text/javascript"
src="//ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js"></script>
        <script type="text/javascript" src="js/code.photoswipe.jquery-3.0.5.min.js"></script>


  <script type="text/javascript">
                (function(window, $, PhotoSwipe){
                        $(document).ready(function(){
                                var options = {};
                                $("#Gallery a").photoSwipe(options);
                        });
                }(window, window.jQuery, window.Code.PhotoSwipe));
        </script>

</head>

<body>
<script>
 (function(i,s,o,g,r,a,m){i['GoogleAnalyticsObject']=r;i[r]=i[r]||function(){
 (i[r].q=i[r].q||[]).push(arguments)},i[r].l=1*new Date();a=s.createElement(o),
 m=s.getElementsByTagName(o)[0];a.async=1;a.src=g;m.parentNode.insertBefore(a,m)
 })(window,document,'script','//www.google-analytics.com/analytics.js','ga');

 ga('create', 'GoogleAnalyticsID', 'auto');
 ga('send', 'pageview');

</script>
```

```html
<div id="mainContent">
<h1><?php echo $plantinfo['name']; ?></h1>

<h3 class="italics"><?php echo $plantinfo['s_name']; ?></h3>
<p> <?php echo $plantinfo['family']; ?> (<?php echo $plantinfo['s_family']; ?>) </p>
<p><span style="font-weight:bold;">Size and Form:</span> <?php echo $plantinfo['size'];
?><br/><span style="font-weight:bold;">Flower:</span> <?php echo $plantinfo['flower'];
?><br/><span style="font-weight:bold;">Fruit:</span> <?php echo $plantinfo['fruit'];
?><br/><span style="font-weight:bold;">Leaves:</span> <?php echo $plantinfo['leaves'];
?><br/><span style="font-weight:bold;">Found:</span> <?php echo $plantinfo['found'];
?><br/><span style="font-weight:bold;">Other:</span> <?php echo $plantinfo['Notes']; ?></p>

<div class="imgHolder">
<ul id="Gallery" class="gallery">
        <?php for($i=0; $i<$num_imgs; $i++) {
                $imgplantinfo = mysqli_fetch_assoc($imgresult);
                echo '<li><a href="'.$imgplantinfo['location'].'"><img
src="/slir/w300/'.$imgplantinfo['location'].'" alt="'.$plantinfo['s_name'].'" /></a></li>';
        }
        ?>
</ul>
</div>
<!--
<form action="imageUpload.php" method="post" enctype="multipart/form-data">
<label for="file">Picture(s):</label>
<input name="files[]" type="file" multiple />
<input name="upload" type="submit" value="Upload" /><br/>
<label for="password">Password:</label>
<input name="password" type="password" />
</form>
-->
</div>
</body>
</html>
```

CSS (Cascading Style Sheet)

index.css

```css
@charset "utf-8";
/* CSS Document */

body
```

```css
{       font-family: 'Overlock', serif;
background-color: #9e947a;
}

#header
{
        max-width:840px;
        max-height:245px;
        width:100%;
        display:block;
        margin:auto;
}

#mainContent
{
        display:block;
        margin:auto;
        padding:2%;
}

.imgHolder
{
        max-width:840px;
        display:block;
        margin:auto;
}

.header
{
        background-color:#410b4c;
        margin:0 2% 0 2%;
}

.content
{
        /*TRBL*/
        margin:0 2% 0 2%;
        padding: 1%;
        background-color:#ddd9c3;
}

.italics
{
        font-style:italic;
```

```css
}

.left
{
        float:left;
        padding: 0 1% 1% 0;
}

.right
{
        float:right;
        padding:0 0 1% 1%;
}

.btn {
 -webkit-border-radius: 28;
 -moz-border-radius: 28;
 border-radius: 28px;
 text-shadow: 1px 1px 3px #666666;
 font-family: Arial;
 color: #ffffff;
 font-size: 20px;
 background: #342a38;
 padding: 10px 20px 10px 20px;
 text-decoration: none;
}

.btn:hover {
 background: #410b4c;
 text-decoration: none;
}

h1
{
        color:#410b4c;
}
h2
{
        color:#342a38;
}
p
{
        color:#000000;
}
```

```
/* ------------------------------------------------------------------------------------------
Begin CSS3 Tooltip using span tags
-------------------------------------------------------------------------------------- */
.tooltip
{
  position: relative;
  /*background: #1f2857;*/
  cursor: help;
  display: inline-block;
  text-decoration: none;
  color: black;
  outline: none;
}

.tooltip span
{
  visibility: hidden;
  opacity:0;
  filter:Alpha(opacity=0) /* for IE 8 and earlier */
  transition:opacity 1s linear;
  -webkit-transition:opacity 1s linear;
  -moz-transition:opacity 1s linear;
  -o-transition:opacity 1s linear;
  color: white;
  position: absolute;
  bottom: 30px;
  left: 50%;
  z-index: 999;
  width: 75px;
  margin-left: -48px;
  padding: 10px;
  border: 2px solid #342a38;
  /*opacity: .9;*/
  background-color: #410b4c;
  /*background-image: -webkit-linear-gradient(rgba(52,42,56,1), rgba(65,11,76,1));
  background-image: -moz-linear-gradient(rgba(52,42,56,1), rgba(65,11,76,1));
  background-image: -ms-linear-gradient(rgba(52,42,56,1), rgba(65,11,76,1));
  background-image: -o-linear-gradient(rgba(52,42,56,1), rgba(65,11,76,1));
  background-image: linear-gradient(rgba(52,42,56,1), rgba(65,11,76,1));*/
  -moz-border-radius: 4px;
  border-radius: 4px;
  -moz-box-shadow: 0 1px 2px rgba(134,12,24,.4), 0 1px 0 rgba(134,12,24,.5) inset;
  -webkit-box-shadow: 0 1px 2px rgba(134,12,24,.4), 0 1px 0 rgba(134,12,24,.5) inset;
```

```css
  box-shadow: 0 1px 2px rgba(134,12,24,.4), 0 1px 0 rgba(134,12,24,.5) inset;
  text-shadow: 0 1px 0 rgba(134,12,24,.4);
}

.tooltip:hover
{
  border: 0; /* IE6 fix */
}

.tooltip:hover span
{
  visibility: visible;
  opacity:.9;
  filter:Alpha(opacity=90) /* for IE 8 and earlier */
}

.tooltip span:before,
.tooltip span:after
{
  content: "";
  position: absolute;
  z-index: 1000;
  bottom: -7px;
  left: 50%;
  margin-left: -8px;
  border-top: 8px solid #342a38;
  border-left: 8px solid transparent;
  border-right: 8px solid transparent;
  border-bottom: 0;
}

.tooltip span:before
{
  border-top-color: #ccc;
  bottom: -8px;
}

/* -----------------------------------------------------------------------------------------
End CSS3 Tooltip using span tags
------------------------------------------------------------------------------------------- */


/* -----------------------------------------------------------------------------------------
End predictive text suggestion style
------------------------------------------------------------------------------------------- */
```

```css
#result {
        padding:5px;
        margin-bottom:10px;
        background-color:#FFFF99;
}
#name{
        padding:3px;
        border:1px #CCC solid;
}
.suggestionsBox {
        position: absolute;
        left: 0px;
        top:40px;
        margin: 10px 0px 0px 0px;
        width: 200px;
        padding:0px;
        background-color: #410b4c;
        border-top: 3px solid #410b4c;
        color: #fff;
        z-index:100;
}
.suggestionList {
        margin: 0px;
        padding: 0px;
}
.suggestionList ul li {
        list-style:none;
        margin: 0px;
        padding: 6px;
        border-bottom:1px dotted #666;
        cursor: pointer;
}
.suggestionList ul li:hover {
        background-color: #cd55ff;
        color:#000;
}

.load{
background-image:url(img/loader.gif);
background-position:right;
background-repeat:no-repeat;
}
```

```css
#suggest {
        position:relative;
}
/* ----------------------------------------------------------------------------------------
End predictive text suggestion style
---------------------------------------------------------------------------------------- */
```

menu.css

```css
@charset "utf-8";
/* CSS Document */
/* This is the Menu bar */
/* { padding: 0; margin: 0; }*/
/* Clearfix */
.clearfix:before,
.clearfix:after {
  content: " ";
  display: table;
}
.clearfix:after {
  clear: both;
}
.clearfix {
  *zoom: 1;
}

#navigation
{
  font-size:.938em;
        height: 40px;
        /*width: 100%;*/
        background: #342a38;
        font-weight: bold;
        position: relative;
        border-bottom: 2px solid #342a38;
        margin:0 2% 0 2%;
}

#navigation ul
{
        padding: 0;
        margin: 0 auto;
        width: 600px;
```

```css
        height: 40px;
}

#navigation li
{
        display: inline;
        float: left;
}

#navigation a
{
        color: #ddd9c3;
        display: inline-block;
        width: 100px;
        text-align: center;
        text-decoration: none;
        line-height: 40px;
        text-shadow: 1px 1px 0px #000;
}

#navigation li a {
        border-right: 1px solid #410B4C;
        box-sizing:border-box;
        -moz-box-sizing:border-box;
        -webkit-box-sizing:border-box;
}
#navigation li:last-child a {
        border-right: 0;
}
#navigation a:hover, #navigation a.menuactive {
        background-color: #410B4C;
}
#navigation a#pull {
        display: none;
}

/*Styles for screen 600px and lower*/
@media screen and (max-width: 600px) {
        #navigation {
                height: auto;
        }
        #navigation ul {
                width: 100%;
                display: block;
```

```css
                height: auto;
        }
        #navigation li {
                width: 50%;
                float: left;
                position: relative;
        }
        #navigation li a {
                border-bottom: 1px solid #342a38;
                border-right: 1px solid #342a38;
        }
        #navigation a {
                text-align: left;
                width: 100%;
                text-indent: 25px;
        }
}

/*Styles for screen 515px and lower*/
@media only screen and (max-width : 480px) {
        #navigation {
                border-bottom: 0;
        }
        #navigation ul {
                display: none;
                height: auto;
        }
        #navigation a#pull {
                display: block;
                background-color: #410B4C;
                width: 100%;
                position: relative;
        }
        #navigation a#pull:after {
                content:"";
                background: url('/img/nav-icon.png') no-repeat;
                width: 30px;
                height: 30px;
                display: inline-block;
                position: absolute;
                right: 15px;
                top: 10px;
        }
}
```

```
/*Smartphone*/
@media only screen and (max-width : 320px) {
        #navigation li {
                display: block;
                float: none;
                width: 100%;
        }
        #navigation li a {
                border-bottom: 1px solid #342a38;
        }
}

/* End Menu bar */
```

External Pages/Projects

- jQuery (http://jquery.com/)
- jQuery Mobile (http://jquerymobile.com/)
- Photoswipe (http://photoswipe.com/)
- PureCSS (http://purecss.io/)
- SLIR [Smart Lexicon Image Resizer] (https://github.com/lencioni/SLIR)
- Recaptcha (https://www.google.com/recaptcha/intro/index.html)
- Google Analytics (http://www.google.com/analytics)

*Usernames, Passwords, Database, IDs & Key values have all been changed to provide security. If using/testing this code, replace with your own environment details.