

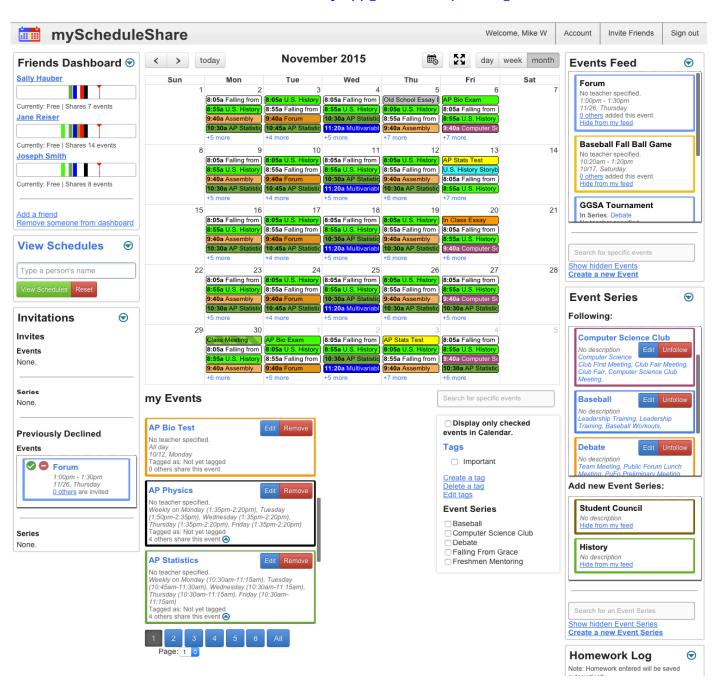
# myScheduleShare

# By: Michael Wornow

An original website for students to share schedules and stay organized, with more functionality than Google Calendar & Microsoft Outlook!

Live Demo: <a href="https://myScheduleShare.com/register.php">https://myScheduleShare.com/register.php</a>

Code on Github: <a href="https://github.com/Miking98">https://github.com/Miking98</a>



# 1. Inspiration

There is no central repository of students' schedules at my school, and it is frustrating not being able to see who will be in my classes over the summer, or who has what periods free. Additionally, commonly used scheduling systems like **Google Calendar and Microsoft Outlook are not suited for school usage** – for example, they are unable to support the "bell schedules" that most schools use for classes. In a bell schedule, classes repeat at different times on different days for different durations (e.g. a Physics class might meet on Monday and Friday before lunch, but on Tuesday, Wednesday, and Thursday after lunch), and neither widely used calendar supports this feature.

I started development of myScheduleShare at the beginning of 11th grade, and finished my first Beta version of the site a year later.

I wrote every line of code of the website by myself, a total of over 40,000 lines of code.

# 2. Programming Languages, Libraries, and Databases

The website is written in PHP, SQL, Javascript, HTML, and CSS, with a mySQL database using the InnoDB storage engine.

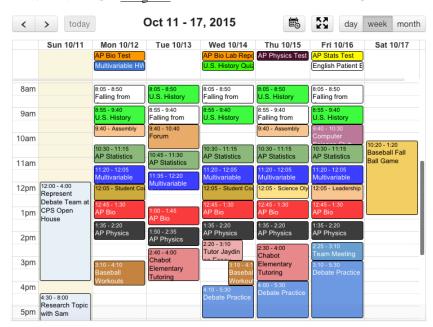
It uses several Javascript libraries, including **jQuery**, **FullCalendar**, **MomentJS** (for times and dates), and **Twix** (for date ranges). On the PHP side, the libraries used are **Carbon** (an API extension for PHP's DateTime class) and the **FacebookSDK** (for logging in users with Facebook).

Almost every client-side feature of the website utilizes **AJAX** to ensure quick load times and responsiveness, using the *refresh\_ajaxelements()* function in *functions.js*.

# 3. Core Challenge: Building a Calendar Engine from Scratch with More Features than Google Calendar & Microsoft Outlook

The "brains" behind myScheduleShare's Calendar, the storing, manipulating, and rendering of Calendar Events (basically, the entire back-end), was extremely difficult to create, since I had to build the back-end entirely from scratch with PHP and SQL.

Below is an image of the Calendar's Week View. See Image #1 at the end of the document for the Calendar's Month and Day Views.



I modeled myScheduleShare's Calendar after Google Calendar and Microsoft Outlook, and tried to reverse engineer as many features as possible. I modified, removed, and added features to fit the "school-centric" theme of myScheduleShare - for example, I added inputs for "Homework" and "Teacher of Class" for each event, fields that make sense on myScheduleShare but not on Google Calendar or Microsoft Outlook.

There were many areas where I improved upon Google Calendar and/or Microsoft Outlook, and these features are detailed in the next few pages.

# A) Superior Core Scheduling Model: myScheduleShare "Events" vs. Google Calendar "Calendars"

myScheduleShare is based on the concept of "Events".

Google Calendar is built around "Calendars".

With Google Calendar, all events are grouped into "Calendars." Thus, Events are basically LEGO bricks that, when pieced together, make up a Calendar. An Event can only belong to one Calendar with Google Calendar.

A major feature of Google Calendar is its collaborative nature. Google Calendar allows a user to add a co-worker's Calendar to his/her personal Calendar. However, Google Calendar does not let you manipulate and add specific Events to your Calendar; instead, you must add a colleague's entire Calendar if you want to "share" it with yourself. For example, if I want to add the Event "Math Class" to my schedule, and "Math Class" is located on Sarah's Calendar, I have to add Sarah's entire Calendar to my own Calendar to "share" the Event "Math Class" with myself. (NOTE: The only workaround for this problem on Google Calendar is for a user to "copy" a specific Event to his/her own Calendar, which will allow the user to edit that Event. However, this action will 1) delink that Event from the original Event it was copied from, so that future changes to the original Event won't get pushed to the user's personal Event and 2) end in the creation of two Events for the same event. These two consequences defeat the purpose of having a centralized calendar).

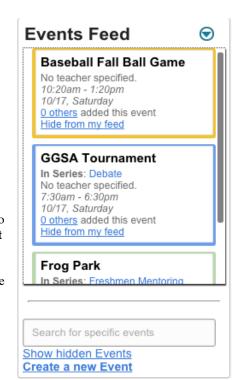
myScheduleShare, however, is based around Events, not Calendars. In myScheduleShare, Events themselves can be manipulated, added, and customized, because Events are stored independently of Calendars. Going back to Sarah's example, myScheduleShare would allow you to click on "Math Class" and add only that Event to your schedule.

In summary: myScheduleShare, unlike Google Calendar, allows you to choose specific Events to add, giving you precise control over your Calendar. This is clearly shown in the "Events Feed" Dashboard above, which shows all public Events that have been created by students at your school that you haven't already added to your schedule. It also allows the user to search for a specific Event, and to hide Events that the user doesn't want to see anymore.

Another added benefit to using myScheduleShare is the ability to customize the color of an Event you didn't create. In Google Calendar, you can only customize the color of an entire Calendar. Try it out, and you'll see that you can't customize the colors of Events that belong to the same Google Calendar.

But wait, there's more!

myScheduleShare gives you the best of both worlds, since it also has features that mimic the properties of a Google Calendar "Calendar." In myScheduleShare, these are called





No description Hide from my feed "Event Series." An Event Series is a group of Events that can be added simultaneously. An Event can belong to many Event Series (in Google Calendar, an Event can only belong to one Calendar), and an Event Series can have many Events.

myScheduleShare, by breaking a user's schedule down to the "Event" itself, allows for more flexibility and customization, while preserving the benefits and simplicity of Google Calendar "Calendars" in the form of myScheduleShare "Event Series."

The "Event Series Dashboard" shows which Event Series the user is following, and allows the user to add other Event Series that other members of that user's school have created.

## B) An In-depth View of a myScheduleShare Event

The hardest part of building a fully functional Calendar from scratch was adding logic for storing and rendering Events.

The most basic property of an Event, what time it occurs, was implemented using UNIX timestamps. Many hours were spent learning the intricacies (and suffering from the unanticipated effects!) of time zones, locales, UTC, GMT, UNIX, cron scheduling, and other concepts/methods involving the storage of time.

Properties of Events (represented by the scheduleevent class in secureclasses.php) in myScheduleShare include:

- Unique ID
- Name
- When Event Occurs
  - o If it only occurs once: UNIX start and end date/time
  - o If it is an "All Day" event: UNIX start and end date
  - It is is a "Recurring" event: Uses a RecursObj Object to store complex recurring information
- Color (user can choose any color imaginable)
- Tag
- Teacher Name
- Homework
- Description

- Event Series it Belongs to
  - The relationship between Event and Event Series can be Many-to-Many
- Visibility (Private or Public)
  - If Private, the user can invite specific people to see this Event
  - o If Public, anyone can add this Event to his/her schedule
- Other people who share Event
- Other people invited to Event
- Current user's editing permissions
- Date Created (UNIX)
- Date Last modified (UNIX)
- User ID of Creator of Event
- School ID of School that Event belongs to

See <u>Image #2</u> to view the "Edit Event" page, and <u>Image #3</u> to view the "Event View" page (for users without editing permission).

# C) Recurring Events, with More Options than Google Calendar & Microsoft Outlook

The biggest challenge, by far, around building myScheduleShare's Calendar from scratch was adding logic for Events that recur more than once. For example, a class might repeat every 2 weeks from 8:00-8:45am on Monday, Tuesday, and Friday, but from 9:00-10:30am on Wednesday and Thursday. Or, a club might meet on the third Sunday every two months, but end after meeting 18 times. As you can probably tell, there is a lot of complexity when it comes to dealing with recurring events. But these are especially important for a "school-centric" scheduling application like myScheduleShare - classes often repeat at different times on different days, and a Calendar that can't handle this simple fact isn't fully functional.

Unfortunately, I couldn't just reverse engineer Google Calendar to solve this issue of repeating events. Google Calendar, it turns out, can't handle Events that repeat at different times on different days! Try it out for yourself. If your school has a bell schedule that has classes occurring at different times on different days (like most schools have), Google Calendar won't be able to have your Math class repeat every week from 8-9 on Monday, Wednesday, and Friday, but from 9-10 on Tuesday and Thursday. To solve this, I had to be a bit more creative when coming up with a database design to store myScheduleShare's Calendar Events, and write PHP

code that could quickly handle the many ways in which events can repeat and determine whether an Event fell within the time range that the user's Calendar was showing.

myScheduleShare can handle every type of Event Google Calendar and Microsoft Outlook can handle, plus more complex types of events (like ones that repeat at different times on different days).

See Image #4 for a visualization of these features, created with Javascript.

### D) Flexible Privacy Controls

Privacy is critical to any sharing application. Students' willingness to use myScheduleShare depends on their confidence in having control over their information.

Being able to make an Event private, then Invite certain people to that Event and prohibit everyone else from viewing that Event, was surprisingly hard to program. Every time an Event was fetched from the database, it had to have its "visibility" checked, to ensure that the Privacy Controls put on that Event were being followed.

The most difficult implementation of Privacy Controls was in the "Compare Schedules" feature of the website, which allows a user to compare multiple peoples' schedules (including his/her own) side-by-side. Accurately checking the Privacy Controls on each user's Events, then crosschecking that with the user who was currently using the "Compare Schedules" feature, was hard to comprehensively implement. Diagramming my thought process on paper was extremely helpful in resolving this issue.

A convenient feature of myScheduleShare is the ability to create "Groups" of people at your school. For example, the image to the right shows Groups for members of the Baseball team, of Computer Science Club, and of the school in general. Clicking on a Group's link will automatically fill the Invitations with people in that Group.

#### **Invited People**



#### Groups

Baseball
Comp Sci Club Members
Everyone

#### Create a new group

#### Visibility

Make this event private. ?

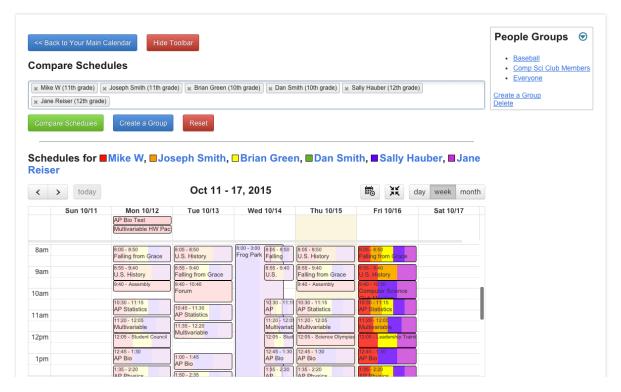
NOTE: Uninvited people who already added this event won't be able to see it on their calendars anymore.

# E) Compare Schedules of Multiple Users, Side-By-Side

Another uniquely powerful feature of myScheduleShare is its ability to compare many users' schedules side-by-side, enabling a user to see when his/her friends are free, what classes others share, and what the best time to schedule a meeting would be.

It was challenging to implement code that efficiently fetched dozens of users' schedules at a time, then determined which Events they shared and color-coded those Events appropriately. To accomplish this, PHP sends a compressed JSON string to the user's browser, then Javascript color-codes the Events and displays them with the help of a lot of arrays and some HTML and CSS tricks.

Below is the Compare Schedules Week View, with the names of the people whose schedules you are viewing shown in the Top Toolbar. myScheduleShare allows you to compare an unlimited number of peoples' schedules simultaneously. See <a href="Image#5">Image #5</a> for the Compare Schedules Month View.



# 4. Powerful Dashboards

A series of user-friendly Dashboards add unique functionality to the myScheduleShare experience.

## A) Daily Snapshot of Friends' Schedules

The "Friends Dashboard" allows a user to see his/her friends' schedules for today. **Neither Microsoft Outlook nor Google Calendar has anything comparable.** 

Interesting features to note:

- 1. The Dashboard displays a red current time cursor that updates throughout the day the image to the right was taken at 11:40pm, so the red arrow is at the far right of the image.
- 2. The Events are color-coded like usual, and hovering over an event will cause a tooltip to pop up and show the name and time of the Event. Clicking the Event brings the user to the "Event View" page, which is depicted in <a href="Image#3">Image #3</a>.
- 3. The current status of each friend, "Busy" or "Free", is displayed under that person's schedule, as well as the number of Events that friend shares with the current user.

The main programming challenge of generating a small "snapshot" of a user's daily schedules was deciding how to handle Events that overlapped – For example, if "Lunch" was from 11-12, but "Meet with Teacher" was from 11:30-11:45, the "Lunch" event would completely hide the "Meet with Teacher" event, or the "Meet with Teacher" event would land right in the middle of "Lunch," which looked ugly and made "Lunch" seem like it was composed of two distinct events that occurred right before and after "Meet with Teacher."

To solve this, I created an algorithm that "stacked" overlapping Events into separate rows, so that no two Events in the same row occupied the same interval of time. To minimize the screen space that this stacking process took, I optimized the algorithm to utilize as few rows as possible in displaying all of a user's Events so that they did not overlap.

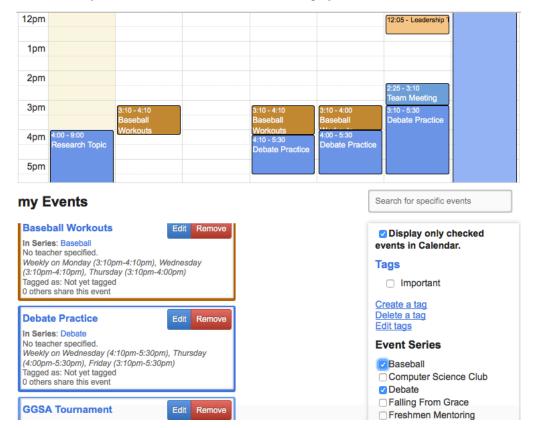


### B) myEvents Dashboard

The myEvents Dashboard contains a sortable, searchable, paginated, and tagged list of every Event the user has added to his/her Calendar. Neither Google Calendar nor Microsoft Outlook has anything comparable.

The most powerful feature of the myEvents Dashboard, and one of the coolest features of myScheduleShare that Google Calendar and Microsoft Outlook lack, is the ability for users to limit the Events displayed on their main Calendar to only Events with a certain tag or which belong to a certain Event Series.

In the example below, the "Display only checked events in Calendar" checkbox has been selected. Since the Baseball and Debate Event Series have been selected, only Events in those Event Series will be displayed in the user's main Calendar.



# 5. Security

Building myScheduleShare was an interesting way to learn in-depth about website security. Following OWASP guidelines and advice on StackOverflow, I've tried making myScheduleShare follow as many standard security procedures as possible.

Some security specs:

- Passwords on myScheduleShare are salted and hashed using sha-256. Plain text passwords are never stored.
- Facebook Authentication is built into the login form for user convenience.
- .htaccess will always redirect users to the https:// version of myScheduleShare.
- XSS and SQL injection prevention techniques, like parameterized queries and htmlspecialchars().

# 6. Selected Code

# Viewable at: <a href="https://github.com/Miking98/myScheduleShare">https://github.com/Miking98/myScheduleShare</a>

#### Javascript

- functions.js The front-end backbone of myScheduleShare. Contains most of the functions and objects used in other Javascript scripts.
- o toggleable.js Allows HTML elements to have custom "togglewith" attribute, which points to another HTML element that will either show or hide when this element is clicked.
- o emptyfieldvalidation.js Makes sure every field is filled out before a form is submitted.
- o *editevent.js* Javascript that makes the Edit Event page work (colorpickers, tooltips with recurring information, dropdowns that use AJAX like the teacher name dropdown).
- compareschedules.js Javascript for Compare Schedule page. Contains code for coloring, sorting, and keeping track of events that multiple users share.

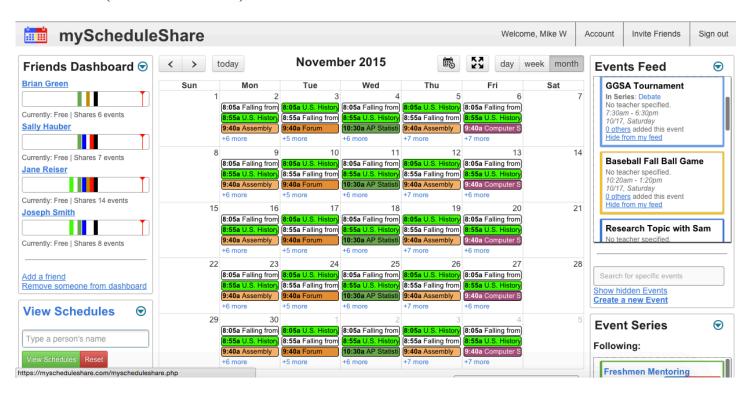
#### PHP

- o *cleanfunctions.php* The back-end backbone of myScheduleShare. Contains most of the functions used in other PHP scripts. Has been trimmed significantly to contain only the Event Rendering logic and simpler utility functions.
- o secure classes.php Contains all the PHP classes used in the website, including:
  - JSONEncodable Base class for JSON encoding arrays and objects.
  - IDname Basic object containing an Integer ID, a String Name, and an Array of extra Info.
  - *Person* A member of myScheduleShare.
  - PersonGroup A group of Person objects. Contains meta information about the Group.
  - EventTag A tag for an event. Has Name, Color, ColorEvents (if this is set to 1, every event with this tag will have this tag's Color), and ScheduleEvents (array of event IDs it has tagged) properties.
  - EventSeries An EventSeries, which is used to link a set of Events (ScheduleEvent objects) under one common "series" of events. If "Baseball" were an EventSeries, it would have "Game on Wednesday", "Game on Thursday", and "Practice" as Events.
  - *ScheduleEvent* An Event. The largest and most used class, with dozens of properties.
  - RecursObj An object storing the recurring information of a ScheduleEvent object. Used for Events that occur more than once, e.g. once every two months on a Friday, or weekly on Thursday and Saturday.
  - Paginator Used to create Pagination below the "myEvents Dashboard".

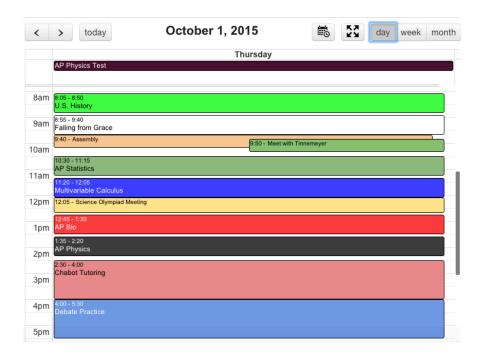
# 7. Extra Images

#### 1. Main Calendar

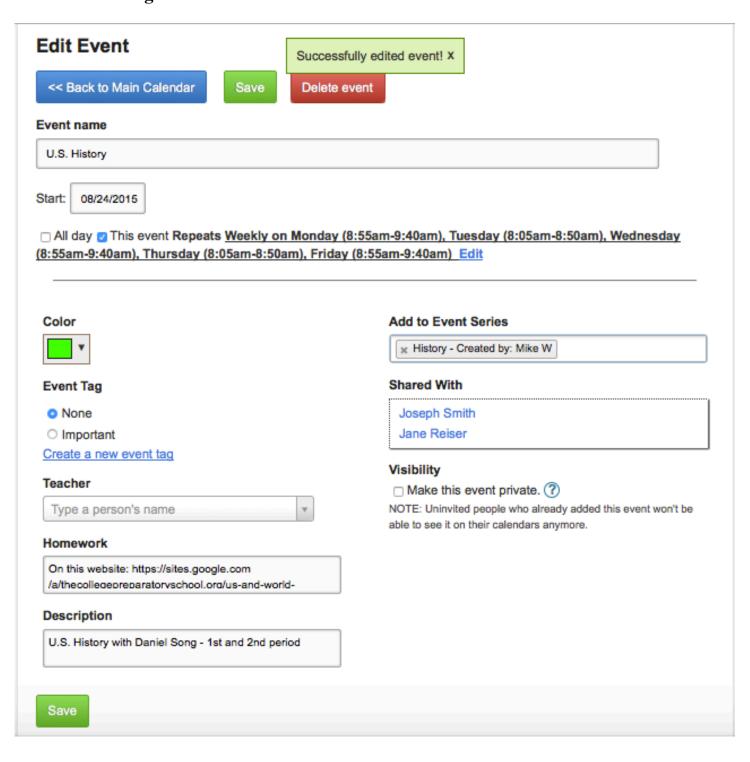
Month View (Dashboards shown)



#### Day View (Dashboards hidden)



# 2. Edit Event Page

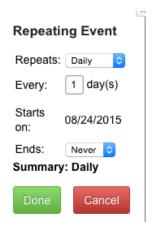


# 3. Event View Page

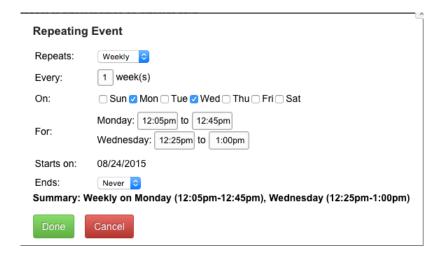
Weekly on Monday (8:05am-8:50am), Tuesday (8:55am-9:40am), Wednesday (8:05am-8:50am), Thursday (8:55am-9:40am), Friday (8:05am-8:50am)  Color  In Event Series  Falling From Grace  Tag None.  Teacher None.  Homework Read pages 60-95 Description None.  Visibility This event is public.  Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By	<< Back to Main Calendar	Remove from My Schedule	Edit	
(8:55am-9:40am), Friday (8:05am-8:50am)  Color  In Event Series  Fallling From Grace  Tag  None.  Teacher  None.  Homework  Read pages 60-95  Description  None.  Visibility  This event is public.  Shared With  Joseph Smith  Brian Green  Sally Hauber  Jane Reiser  Created By  Mike W	Falling from Grace  Weekly on Monday (8:05am-8:50am), Tuesday (8:55am-9:40am), Wednesday (8:05am-8:50am), Thursday (8:55am-9:40am), Friday (8:05am-8:50am)			
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Falling From Grace  Tag None. Teacher None. Homework Read pages 60-95 Description None. Visibility This event is public. Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By Mike W	Color			
Falling From Grace  Tag None. Teacher None. Homework Read pages 60-95 Description None. Visibility This event is public. Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By Mike W	Ψ			
None. Teacher None. Homework Read pages 60-95 Description None. Visibility This event is public. Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By Mike W	In Event Series			
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Description None. Visibility This event is public. Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By Mike W	Homework			
None.  Visibility This event is public.  Shared With  Joseph Smith  Brian Green  Sally Hauber  Jane Reiser  Created By  Mike W	Read pages 60-95			
This event is public.  Shared With  Joseph Smith  Brian Green  Sally Hauber  Jane Reiser  Created By  Mike W	Description			
This event is public.  Shared With  Joseph Smith  Brian Green  Sally Hauber  Jane Reiser  Created By  Mike W	None.			
Shared With  Joseph Smith Brian Green Sally Hauber Jane Reiser  Created By Mike W	Visibility			
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Brian Green Sally Hauber Jane Reiser  Created By Mike W	Shared With			
Sally Hauber Jane Reiser  Created By  Mike W	Joseph Smith			
Jane Reiser  Created By  Mike W	Brian Green			
Created By Mike W	Sally Hauber			
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# 4. Recurring Events

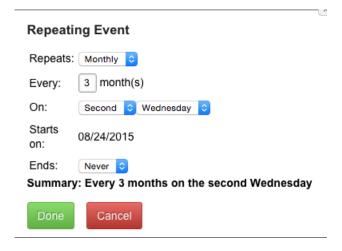
### **Daily Repeat Options**



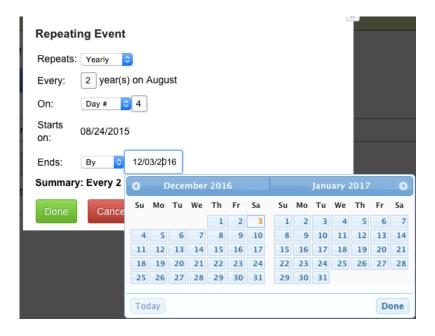
## **Weekly Repeat Options**



#### **Monthly Repeat Options**



# **Yearly Repeat Options**



# **5.** Compare Schedules

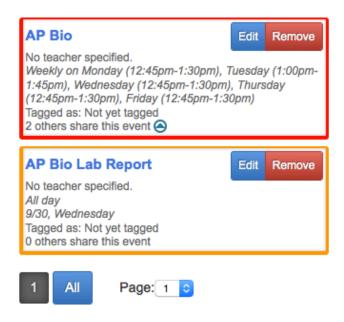
## **Month View (top Toolbar hidden)**

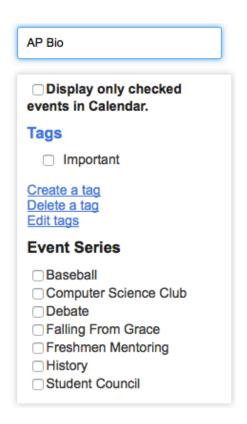


## 6. myEvents Dashboard

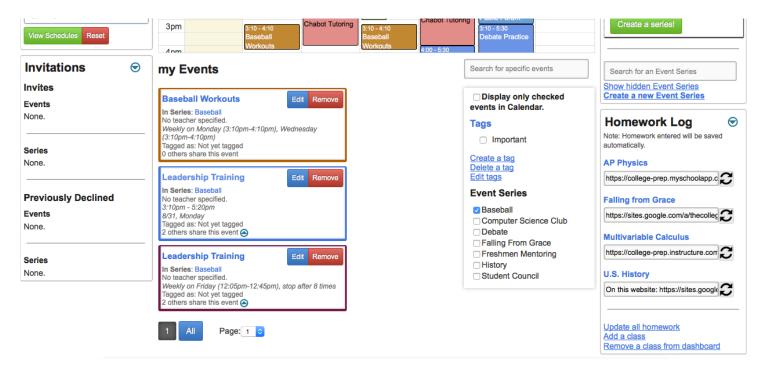
#### **Search Feature**

# my Events

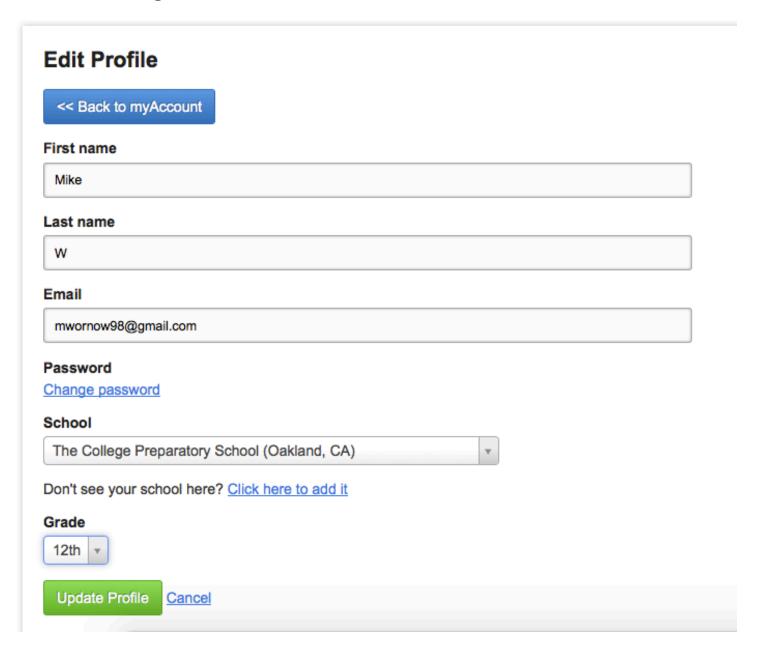




#### **Dashboard in Context of Entire Webpage**



# 7. Edit Profile Page



# 8. Sign Up Page

