



Part 1: Registration

Created: 06/03/2018 • Last updated: 06/10/2018

Please complete this form to register as an official nominee of the 2018 Broadcom MASTERS competition. The content in Part 1 is not used in evaluation. Please note that this section contains a second page.

Student/Parent Information

STUDENT INFORMATION

* Required Field

Student First Name*	Nathaniel
Student Middle Name	Matthew Fish
Student Last Name*	Waterman
Student Preferred Name/Nickname	Nathaniel
Student Email Address*	nmfwaterman@gmail.com
Student Phone Number (xxx-xxx-xxxx)	(No response)
Date of Birth (mm/dd/yyyy)*	07/19/2004
Sex	Male
Ethnicity	(No response)
Race	(No response)
T-shirt Size (adult sizes)*	Large
If you are selected as one of the Top 300 MASTERS or 30 finalists, do we have permission to share your contact information with your members of Congress?*	Yes

Mailing Address

Street Address 1*	40 Tolman Street
Street Address 2	(No response)
City*	Sharon
State*	MA
Zip Code*	02067

PARENT/GUARDIAN INFORMATION

This information will be used after the application has closed. You may enter the same adult listed in the Designated Adult section, or you may choose a different parent or guardian.

Parent/Guardian First Name*	Jennifer
Parent/Guardian Last Name*	Waterman
Parent/Guardian Relationship to Entrant	Mother
Parent/Guardian cell phone number (xxx-xxx-xxxx)*	339-364-9932
Parent/Guardian home phone number (xxx-xxx-xxxx)	(No response)
Parent/Guardian Email Address*	jenniferwaterman1@comcast.net
*If you are applying from one of our DOD fairs, please enter a US phone number above and your international phone number here	(No response)

Teacher/Science Fair Information

SCHOOL INFORMATION

Name of Current School (2017/2018 academic year)*

*If your school is not listed, please email masters@societyforscience.org with the name and address of your school and we will add it to the list. You can search for your school by typing in the name or the zip code. Home schooled students should select "Home School."

Sharon Middle School, Sharon, MA, 02067

Type of School*

Public

School Address

Street Address 1*	75 Mountain Street
Street Address 2	(No response)
City*	Sharon
State*	MA
Zip Code*	02067

Identify the teacher who has most supported your science or engineering project. This teacher MUST be a middle school teacher, a middle school informal science program educator, or a middle school homeschooling instructor. Your teacher receives application reminders and notifications from The Society, and receives notification if you are selected as one of the 30 finalists or Top 300 MASTERS. This teacher will receive awards if you advance to the Top 300 MASTERS or finalist level. You will not be permitted to change the teacher listed here after the application deadline.

Teacher Information

Teacher Prefix	(No response)
Teacher First Name*	Gregory
Teacher Last Name*	Warren
Teacher Email Address*	g_warren@sharon.k12.ma.us

Principal Information

Title	Principal
Principal First Name*	Kevin
Principal Last Name*	O'Rourke
Principal Email Address*	k_orourke@sharon.k12.ma.us

SCIENCE FAIR INFORMATION

You were nominated for the Broadcom MASTERS by USMA01.
Did you receive a second nomination from another science fair?*

No

Is this a team project?*

No

Just a friendly reminder: each member of a team project needs to submit his/her own independent application in his/her own words.

If you worked on a team, please list the name(s) of your team member(s). If you did not work on a team, please leave this question blank.

	First Name	Last Name
Team Member #1		

	First Name	Last Name
Team Member #2		

Are you an alumnus of the Broadcom MASTERS program?*

This is my first year receiving a nomination! (Awesome!)



Part 2: Project Information

Created: 06/03/2018 • Last updated: 06/10/2018

This is your chance to tell us about your awesome science or engineering project in your own words. If you are feeling stumped, take a look at your science fair board for inspiration. This section is designed to feel like a judging interview at your science fair.

Project Title/Team info

Select a category that best describes your project*:

These categories might differ from the categories at your local science fair. Here's a helpful hint to help you choose: think about what type of scientist or educator would best understand your project.

Computer Science & Software Engineering

Project Title*

HFatch: A User-Friendly API Client for the Schoology LMS

This is how your project title will appear in our materials if you are select to the top 300 or top 30.

What is your current grade (2017/2018 academic year)*?

8th

Remind us, is this a team project*?

No

Just a reminder that each member of a team must submit his/her own application in his/her own words.

What was the inspiration for your science or engineering project? Please describe if there was a personal experience, challenge or individual(s) that inspired your choice of this project.* (max. 100 words)

The challenge to remember homework was my inspiration.

Project Reflections

TELL US ABOUT YOUR SCIENCE FAIR PROJECT

What was your research question? For engineering projects: what was the human need or problem you wanted to solve?* (max. 50 words)

Problem: Students forget to check for homework posted on Schoology, and blind/disabled kids may not be able to.

What was your scientific hypothesis or engineering design criteria?* (max. 125 words)

Design Criteria: The design must

- 1) Retrieve homework assignments from Schoology
- 2) Be able to be integrated into other programs easily
- 3) Be able to run on MacOS (The OS that I use and the OS of the computers at school, which are distributed to each student)

Explain your methodology and procedures for carrying out your project in detail, addressing the questions below. *

For engineering projects, explain your methods and procedures for building your design, addressing the questions below (max. 400 words).

- 1) How did you collect your data? For engineering projects, how did you build your design?
- 2) What were your testing procedures? For engineering projects, how did you test your design?
- 3) Discuss your control group and variables tested. For engineering projects, discuss the controls and variables tested in your design.

Before beginning to develop HFetch (HomeworkFetch), I did some research. Since I hadn't programmed anything quite at this scale or complexity before, I had to learn about JSON, one format in which the Schoology servers send their messages; jq, a utility for deciphering JSON; OAuth, the system that the servers use to authenticate and secure their communications; APIs and RESTfulness, the details of communication with the server. While researching I also found a Java library of functions for the API on GitHub, but I didn't find any implementations.

While writing HFetch, I tested the basic functionality by frequently running and troubleshooting it and the integrability by incorporating it into my pre-existing reminder systems. I tested the program on varying operating systems, such as MacOS and Debian; amounts of assignments, and assignment titles.

FLOWCHART

The program's normal course of operation is along the left side of the chart.

First, the program sets itself up and checks if any options were specified, such as whether it's being run from a GUI or not.

The first deviation occurs if the application jq is not installed. HFetch uses jq to decipher the messages from Schoology's servers. If jq isn't installed, the program installs it with the user's permission or tells the GUI to handle installation.

Next, HFetch reads the user's API credentials (like a valet key for their Schoology account) from some files on the disk. If it is found that they don't exist, the program creates them, or exits if it takes too long to receive the credentials.

If the program has continued to this point, it means that the credentials have been successfully read and jq is installed. The program will stop after this if the option to do so was specified at the start. If not, it continues.

Next, the HFetch asks Schoology which classes its user is enrolled in. Once it has this information, it uses jq to extract just the IDs of each class, and goes through each one, retrying the request if there was an error. If five or more errors occur, it gives up.

Once it has information as to assignments for each class, the program uses jq to extract just the information needed, in this case, the assignment name, due date, and if it's being run from a GUI, the URL to send the user to if they request to view the details of an assignment.

How did you analyze and interpret your data?* (max. 300 words)

Use this section to write about the process of analyzing and interpreting your data. You will have an opportunity to share charts, tables, graphs, photos, etc. containing your data in a ONE (1) page PDF document later in this application. For engineering projects, this question still applies. Tell us HOW you formed your conclusions through observation and any special analysis used.

A few lessons were learned while designing HFetch:

When testing the shell script, I discovered that OAuth is incredibly uncompromising: requests to the server must be sent with increments between their timestamps of at least 1 second, as the PHP time() function returns the time in seconds, not milliseconds. The errors from the server were getting passed along as JSON to jq, and this was breaking jq as the errors were not in valid JSON format. The program was adjusted such that it retries a request if it fails and waits one second between requests.

Also, one time, the API credentials on the disk became corrupted and jq failed to parse the server's responses due to them being error messages instead of JSON. It took much troubleshooting to find that the root of the problem was not jq, but a credential issue – I had to trace the error back through all the steps of processing by running each step separately to figure this out. The program was then adapted to easily handle such issues.

The shell script, written in bash, uses jq to parse the JSON from the API, but since jq is not installed by default on MacOS, it had to be installed during setup. However, as MacOS does not have a package manager, the package manager Homebrew had to be installed in order to install jq – my dependency had a dependency! The program was modified and the GUI application now attempts to install Homebrew.

As this is a computer program, there wasn't much useful quantitative data to collect, but the qualitative data of user friendliness most certainly increased as the program went from unreliable and unusably ugly (it had a terrible UI) when the first working iteration was completed, to idiot-proof after weeks of improvement.

What conclusions did you reach? Why? How does your data support this conclusion?* (max. 250 words)

The frequency of uncaught exceptions has decreased to zero, showing that the end result definitely works, and the GUI, written in AppleScript, is quite user-friendly. More importantly, it is easy to integrate into other programs, as demonstrated by its successful cooperation with programs such as a reminder program and to-do list I made, and use by me and my friends. I am also exploring the possibility of installing HFetch on every one-to-one student computer at my school.

TELL US WHAT YOU LEARNED FROM YOUR PROJECT

Did questions or problems arise that you were not expecting? How would you adjust your experimental design or your engineering design process to address these problems?* (max. 150 words)

I encountered and overcame quite a few problems, such as:

- Duplicate timestamps
- Confusing errors
- Dependencies with dependencies

Please see "How did you analyze and interpret your data?" above for details.

Where did you conduct your experimentation?*	Home
	School

Please select all that apply.

A science or engineering project is never a solitary activity. Tell us who contributed to your research and what resources did they bring to your project:* (max. 250 words)

- Where and how did you conduct your research? What special equipment did you use?
- Who supervised and/or collaborated with you on your research (i.e. parents, teachers, mentors, peers?) What were their contributions?
- Were there others who helped you perform your research who you wish to tell the evaluators about?

My parents helped me brainstorm the idea, but nobody I know knows bash, so no-one else particularly contributed to the development except my friend who tested the app by trying to install it on his school computer. He could not, as our school computers are incredibly locked down, such that students cannot access the command line. After trying many approaches to an automated installation of Homebrew, I resorted to creating a version with jq built in, eliminating the necessity for a command-line installation through Homebrew. This new program, pHFetch (portable HomeworkFetch) is three times the size of its predecessor, but I downloaded it onto a school computer, and it works!

What did you learn from conducting and presenting your science fair project?* (200 word maximum)

Please consider addressing the following points in your answer:

- What lessons did you learn from doing your project?
- What lessons did you learn from presenting your project?
- What question would you ask next or engineering project would you pursue if you chose to continue exploring this topic?

Through my research, I learned about what a RESTful API is, and how HTTPS works in general.

When presenting HFetch at fairs, I learned that experienced programmers are frighteningly proficient at discovering logic and flowchart errors, notebook guidelines are things that should be read, and talking about mistakes and their solutions is an excellent way to demonstrate redesign.

In the future, a user interface should be created for Linux as the current one is written in AppleScript, new versions of this program should be created for Windows and iOS, and a similar client for the Powerschool API (used to store and manage grades) should be created or added as a part of HFetch.

While looking around at the state fair, I noticed many world-saving styled projects. This caused me to realize that HFetch could be used in assistive technology for disabled children, as my current setup uses MacOS dictation commands to activate the app, and could be easily modified such that it reads the assignments and their respective due dates aloud – no visual or physical interaction with the computer is required, so anyone who can talk can check their homework with HFetch. Due to its versatility and integrability, HFetch could be used for other assistive applications quite easily.

If you were a member of a team project, please explain your role in researching, developing and presenting your project. Describe how work was divided among your team. (max. 150 words)

I was not a member of a team project.



Part 3: Essay Questions

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This section provides you with an opportunity to tell us more about you and your thoughts about science, technology, engineering and math (STEM) as they relate to your project and in general.

Select one (1) question in each of the three sections: About My Project, About Me, and Solve a Problem, then compose your answers in the resulting text boxes.

About My Project (please select ONE question, then answer in the text box below): Submit an abstract for your project (250 words or less).

About My Project:

Schoology, a popular learning management system, is useful and powerful, but it takes time to check for homework posted there. This was the reason for designing HFetch, which uses a RESTful API to fetch, display, and provide details about assignments from Schoology in two clicks, or none if it is launched automatically or by voice commands. This could easily be used in assistive technology, as the program can automatically check for homework on behalf of its user.

About Me (please select ONE question, then answer in the text box below): What things do you do everyday that you wish were automated? Tell us about a device you might invent to tackle one of these issues and why it would be helpful. (max. 250 words)

About Me:

Each day, I try to remember to check for homework that my teachers have posted on Schoology. Occasionally, I forget. When this happens, my grades suffer needlessly. It would be really nice if I had some sort of computer program that would automatically check it for me...

Solve a Problem (please select ONE question, then answer in the text box below): In a 2012 report, the National Oceanic and Atmospheric Administration (NOAA) predicated that by 2100 sea levels will have risen somewhere between 8 inches and 6.6 feet. What are some challenges you can foresee being created if sea levels rise by 3 feet? What would you suggest to combat these issues? (max. 300 words)

Solve a Problem:

If sea levels rise by even 3 feet, there will be terrible consequences. Not only will most beaches be reduced to thin strips of seaside sand, other coastal areas will flood, destroying habitats for animals and humans. The humans will be able to move, but relocation is expensive, especially when entire coastal cities are doing so. The permeation of land with rising saltwater will also cause increased erosion, contaminate aquifers and soil, making farming in coastal areas impossible. To stop this from occurring, we must switch completely from fossil fuels to green energy and plant more plants in order to convert the carbon dioxide in the atmosphere back to oxygen.



Part 4: Personal Interests

Created: 06/04/2018 • Last updated: 06/10/2018

Tell us a about yourself as an individual, apart from your science fair project and your thoughts on science or engineering. Share information that will help us get to know you better.

Check activities in which you are currently or have been involved:

Check all that apply

Computer Club

Music (instrument or choir)

Robotics

Community Service (where?): Acolyte at St. Jonhs, Sharon

Science/Math Olympiad

Science or Engineering Summer Camp (list name of camp):
College Academy & ID Tech

Student Council

Foreign Language studies (list language): French

Other: Travel (Switzerland, Italy & Greece), Skiing, 5ks,
Running, Fishing, Hiking, Rocketry, Baking

Which instrument? (select all that apply)

Piano

What hobbies or extra-curricular activities do you most enjoy and why? (max. 100 words)

I particularly enjoy automating various annoying tasks on my MacBook using bash. It's satisfying to create something that's functional and useful.

Tell us about a time you worked in a team. In your opinion, what is the most important trait of a successful team? (max. 150 words)

Last Friday, I worked with a team to build circuits in a sort of collaborative science quiz. There was argument, but when we trusted the kid who was trying to do something with the circuit, though we thought it was pointless, we figured out a way (with no small amount of MacGyvering) to make it work. By this anecdote, it is demonstrated that trust is the most important attribute of a team – if team members don't trust each other, they can't work with any semblance of harmony.

Is there additional information that you wish to share with the judges to help them better know you as an individual and what is personally important to you? Future goals, favorite topics, accomplishment of which you are most proud, etc.-- this is your chance to share anything (max. 100 words)

I'm quite proud of all the bash I've learned and the things that I've made with it, including HFetch.

I hope to someday fly a plane, and to make the world slightly better by way of something like HFetch.

Which one of the following STEM careers are you most interested in pursuing? Computer Scientist

Please note-- careers will display below in random order. To find a specific career, click inside the box and type the name. If it's included in the list, the career will appear in blue.

Why does this career interest you? (max. 100 words)

I enjoy programming and solving interesting problems.



Science Fair Paperwork Wizard

Last updated: 06/04/2018

Where did you conduct your lab work? (check all that apply)

Home

School

Check all aspects among the following that were used in your research (must select at least one):

None of the above

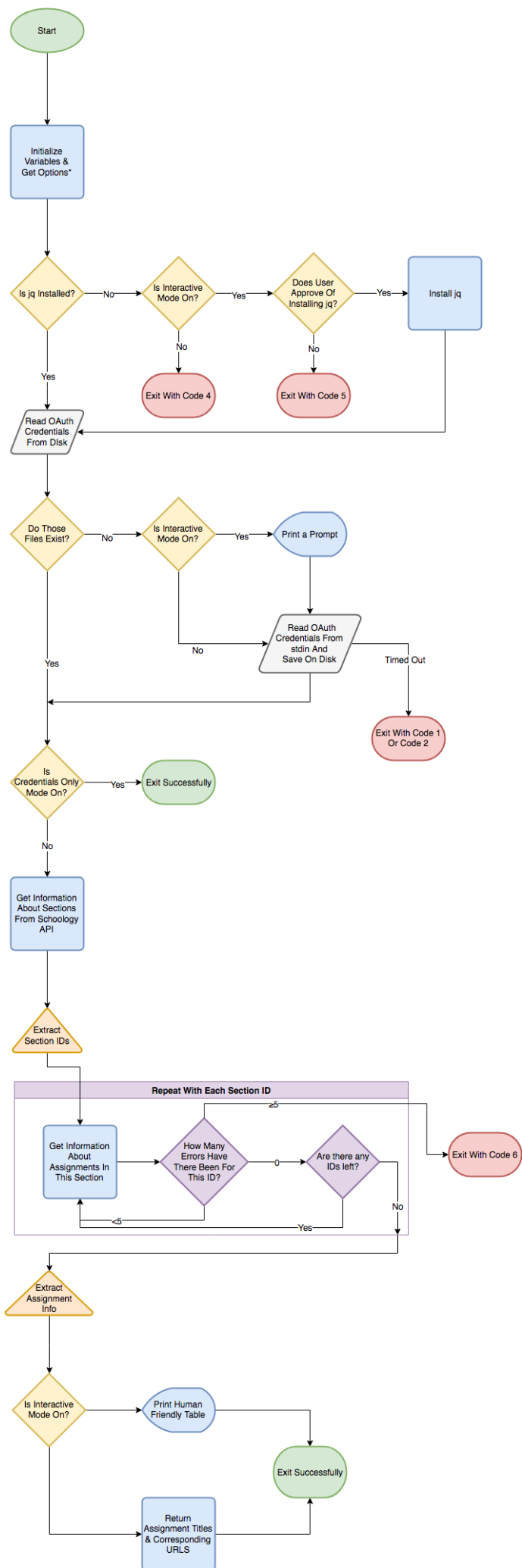
If you have checked any of the aspects above, EXCEPT the last option "None of the above," your project may have required pre-approval by a Scientific Review Committee (SRC) or Institutional Review Board (IRB). Please upload copies of any forms your science fair or school required to approve your research, and answer the questions below.

Many fairs use the Intel ISEF approval forms (Form 1A, 1B and other supplemental forms); however some fairs have their own local equivalent. Please see the Intel ISEF Rules for clarification: <https://student.societyforscience.org/international-rules-pre-college-science-research>

If you checked "None of the above," you do not need to submit any forms.

Please do not upload supplemental essays, abstracts, links, or documents about your project, as only the written information in your application will be reviewed

Thank you! You do not need to submit any paperwork to Broadcom MASTERS for additional review. We recommend that you save copies of any paperwork you may have completed for your personal records.





Broadcom MASTERS®

Signature Page and Parent Permission Form

Student Last Name: Waterman
Student First Name: Nathaniel
Fair Password: USMA01
(If Fair Password unknown, please list fair name, city and state)

Student Certification

I certify that all of the information given in the entry form is correct and has been completed by me. The project I have submitted is my own work, and has not been plagiarized, forged or fabricated from another researcher or source. I understand that fraudulent projects will fail to qualify for the Broadcom MASTERS competition.

I understand that the answers I am submitting may be used in any way by Society for Science & the Public and will not be returned to me. I certify that I have read and fully understand the eligibility requirements as outlined in this packet and that I satisfy all of them.

Nathaniel Waterman
Signature of Student

6-9-2018
Date

Parent/Guardian Certification and Release

I consent to my child participating in the Broadcom MASTERS program. If my child is chosen as a finalist, I consent to his/her participation in an all-expense-paid trip to Washington, DC, from October 18 to 24, 2018 to be accompanied by one parent or guardian. I have read the eligibility requirements as outlined in this packet and I certify that my child has satisfied all of them and has worked independently on his/her submission.

I also hereby grant to Society for Science & the Public and their subsidiaries, affiliates and advertising, promotion and production agencies, and their respective assigns, permission to use my child's name, image and biographical information in advertising and promotional materials for purposes of advertising or promoting the Broadcom MASTERS program. I acknowledge and agree that I will have no right of approval, no claim to any compensation, and no claim arising out of the use of my child's submission, name, image or biographical information in connection with the exercise of the rights granted to Society for Science & the Public under this certification.

Jennifer L F Waterman
Signature of Parent/Guardian

06/09/18
Date

This signature page **MUST** be included in the online Broadcom MASTERS Student Application in the upload section. To access the application, go to broadcommasters.fluidreview.com.

Questions? Contact MASTERS@SOCIETYFORSCIENCE.ORG