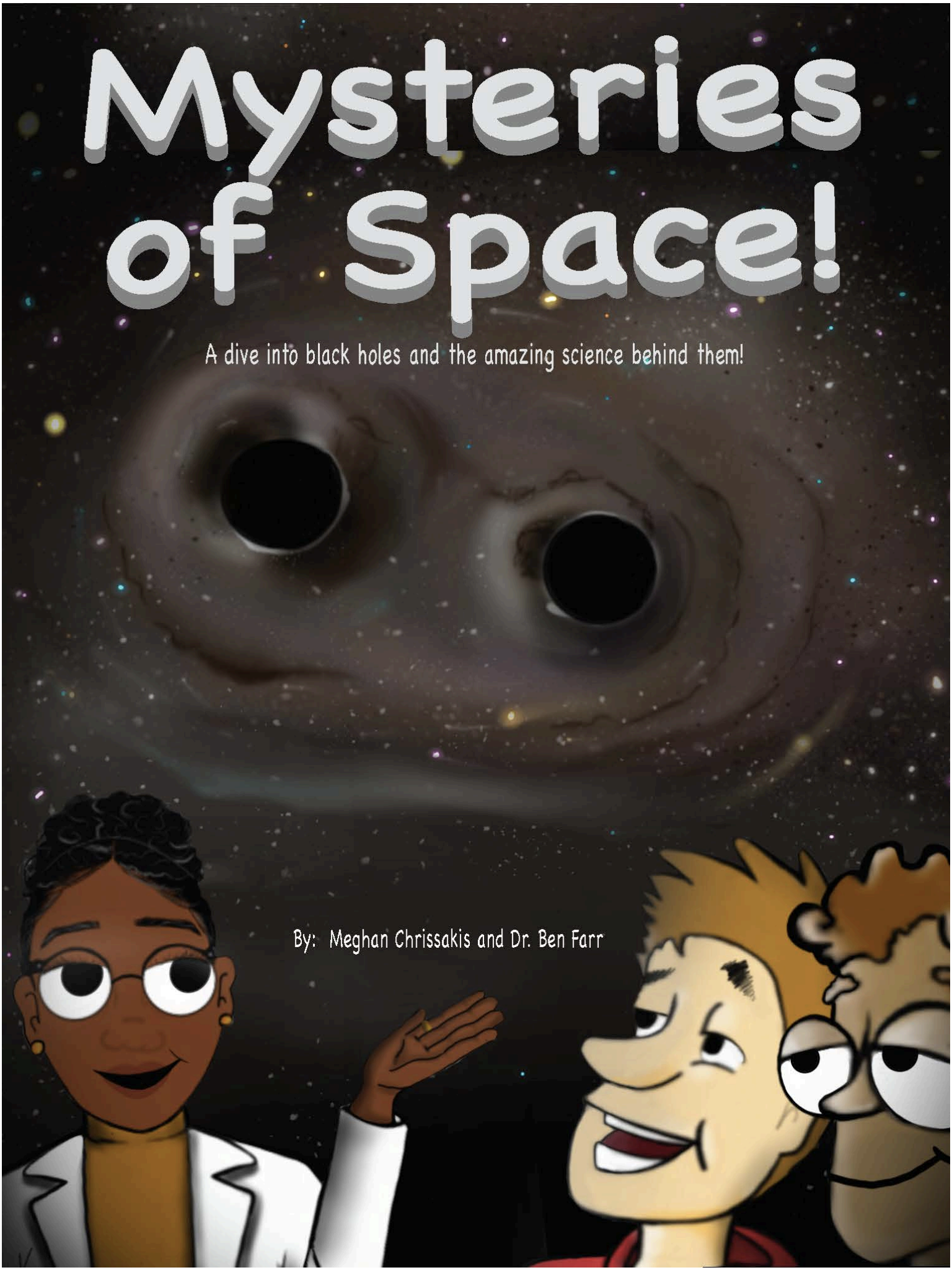
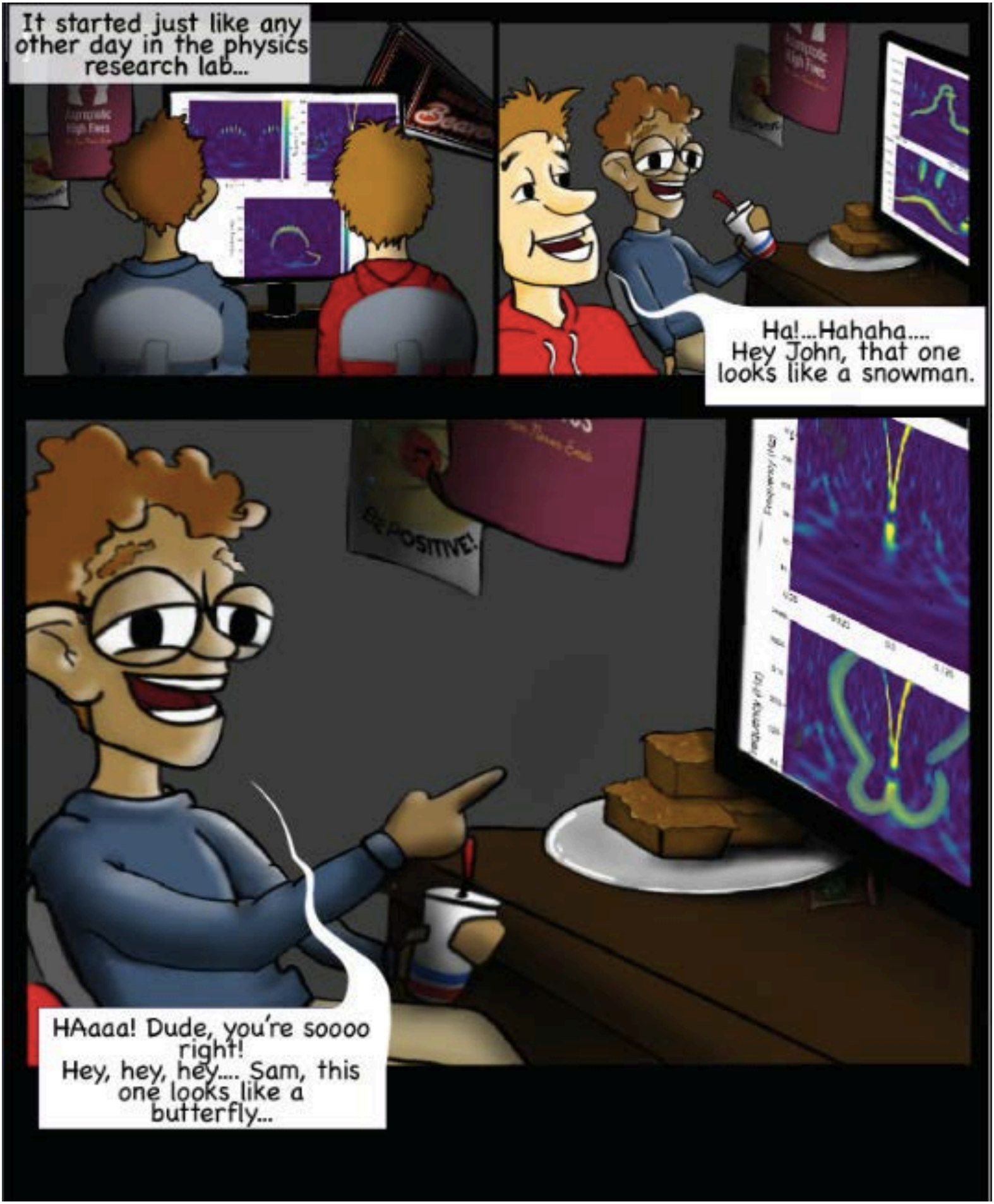
Mysteries of Space!

A dive into black holes and the amazing science behind them!



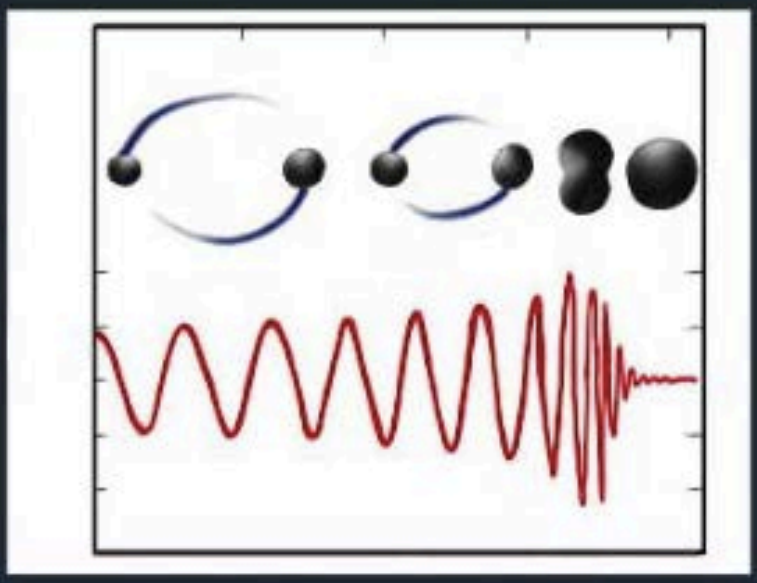
By: Meghan Chrissakis and Dr. Ben Farr


It started just like any other day in the physics research lab...
Ha!...Hahaha.... Hey John, that one looks like a snowman.
BE POSITIVE!
HAaaa! Dude, you're soooo right! Hey, hey, hey.... Sam, this one looks like a butterfly...

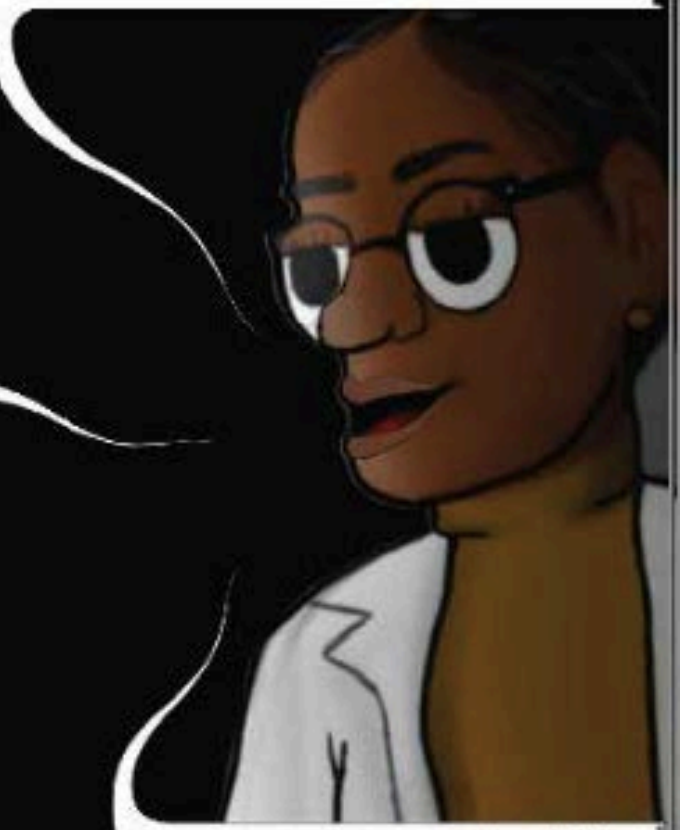

Ha!... Bro, this job is sooo great. We get to eat snacks, look at some crazy graphs and hang out all day bro!
You're so right dude... hey look at this one, it is most definetly a duck!
Hahahahaaa... lets find one that looks like a butt...
Ahhhhh.... it does look like a duck!!
Oh my gosh, duudee. We found it!
Ha ha ha haaa!!!


Excuse me gentlemen, what are you doing? In this lab we don't make fun of data that is incredibly important to the scientific community!
But professor, these are just stupid graphs that kinda look like funny things... They don't mean anything.
Actually John and Sam, these are.....
Gravitational Wave Spectrograms!
...they are derived from some of the most precise measurements humans have ever made, and help in the search for black hole collisions in outer space

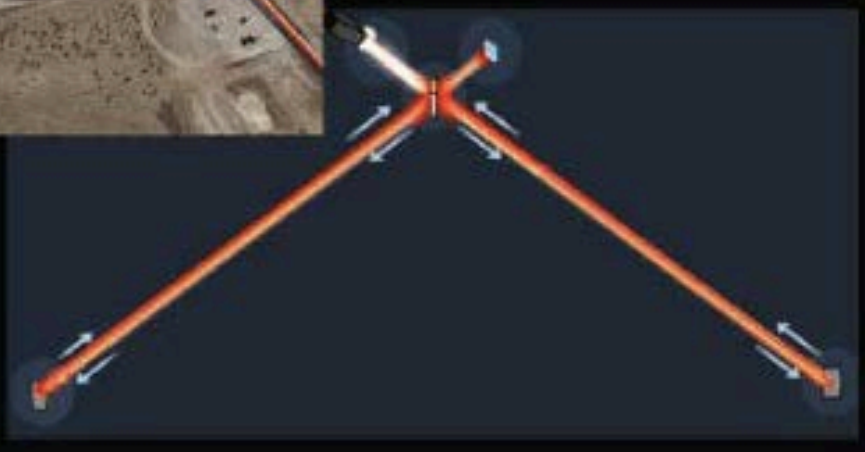
As two black holes orbit one another they radiate gravitational waves, increasing their orbital speed and decreasing their orbital separation, until they collide to form one BIG black hole!



These gravitational waves are ripples in spacetime that travel through the Universe carrying information about their origins...

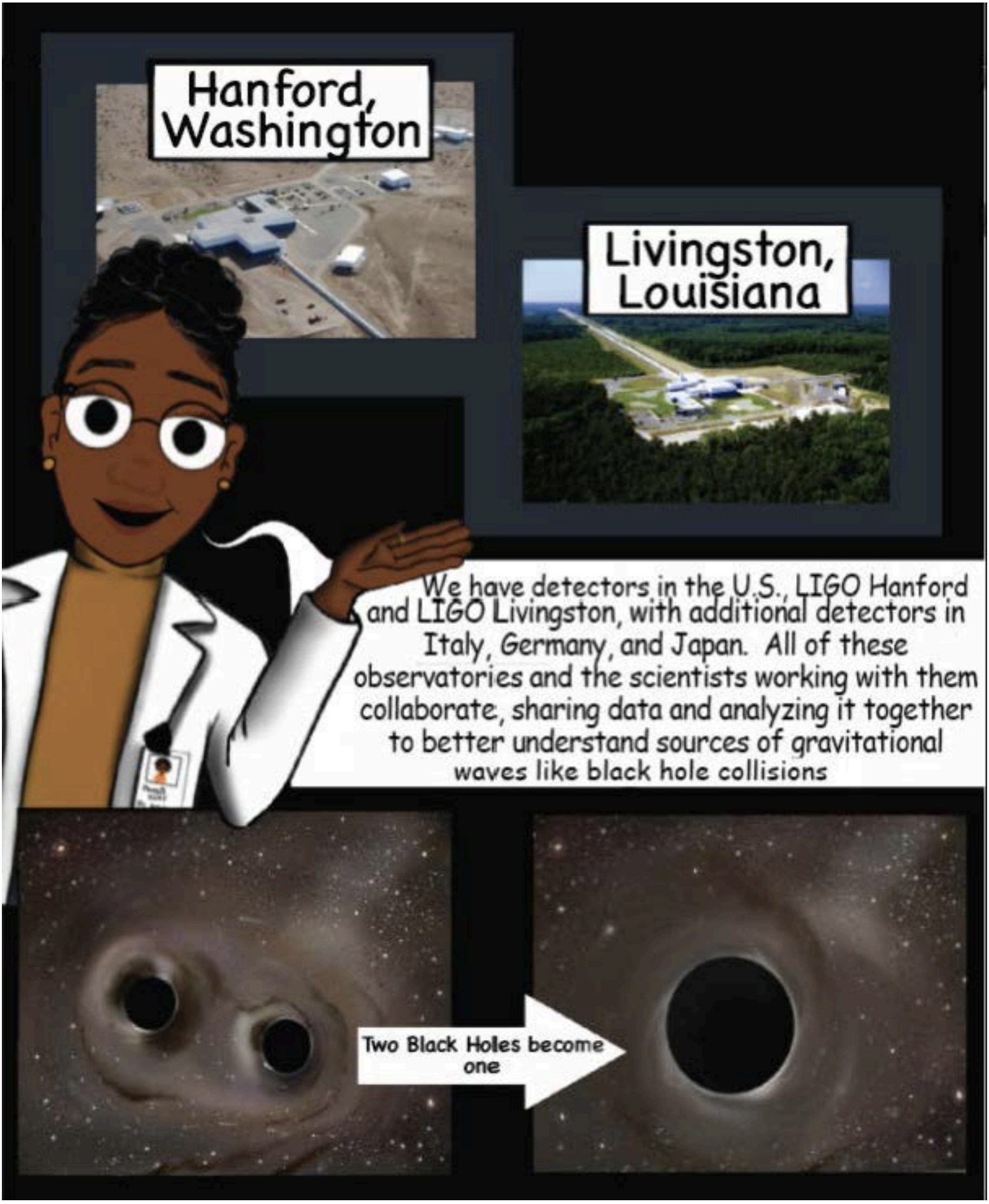


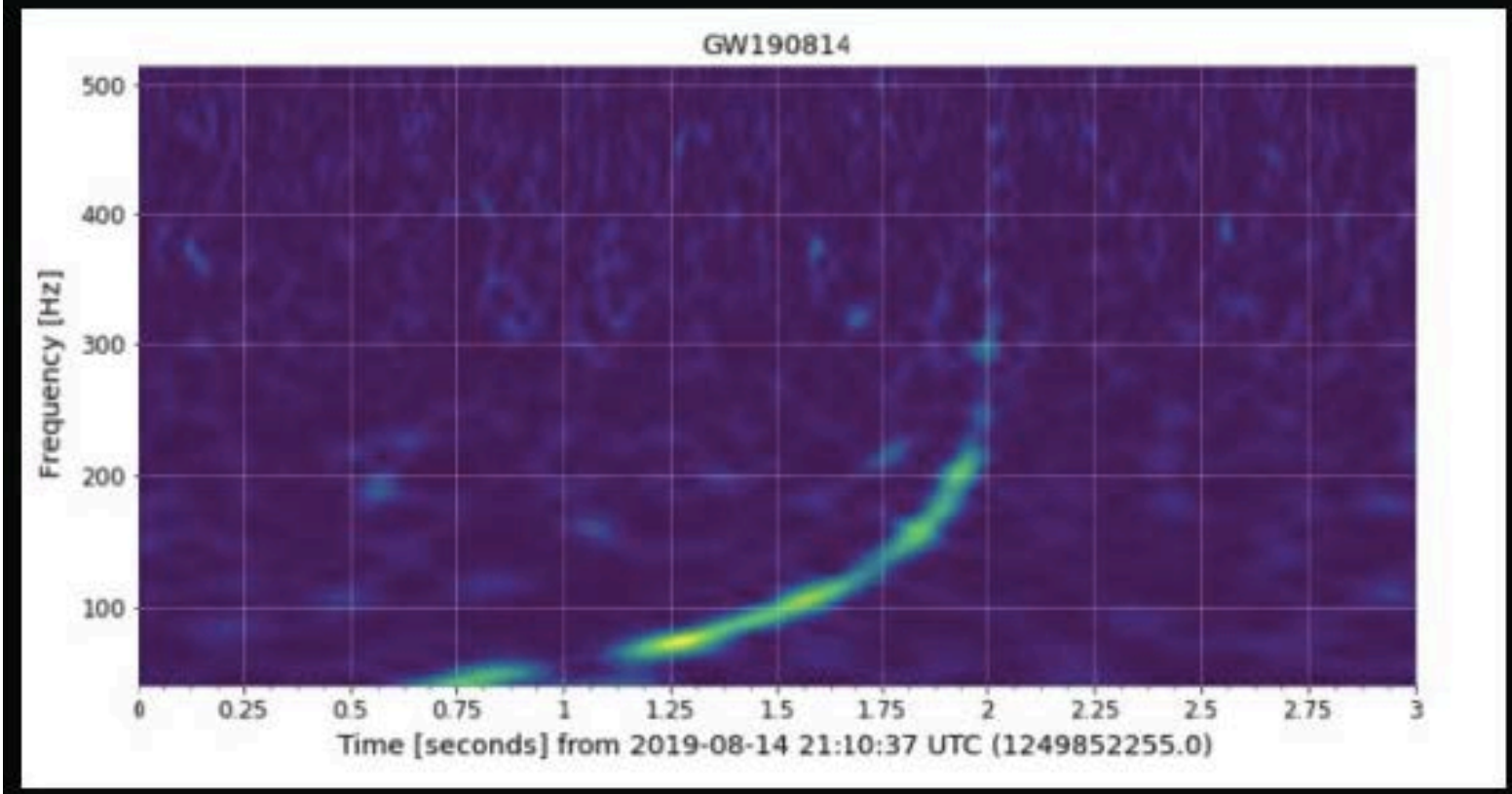
Eventually these ripples come in contact with detectors here on Earth, like the Laser Interferometer Gravitational Wave Observatory (LIGO). Like a microphone for sound, these observatories are sensitive to gravitational waves coming from any direction, causing the path traveled by laser light in these detectors to grow and shrink. We can use this information to generate graphs like the ones you're looking at, these are called spectrograms!



we can also convert the data to audio files and "listen" to our observations

Look for these QR codes and scan them inorder to hear the sounds of differnet black holes merging!!


Hanford, Washington
Livingston, Louisiana
We have detectors in the U.S., LIGO Hanford and LIGO Livingston, with additional detectors in Italy, Germany, and Japan. All of these observatories and the scientists working with them collaborate, sharing data and analyzing it together to better understand sources of gravitational waves like black hole collisions
Two Black Holes become one

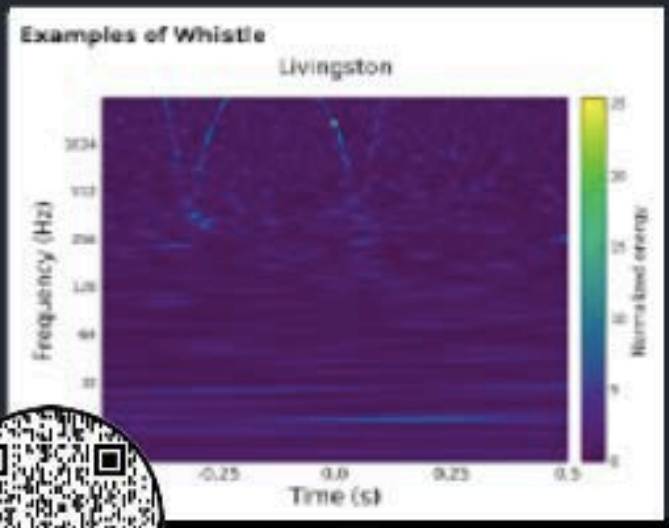


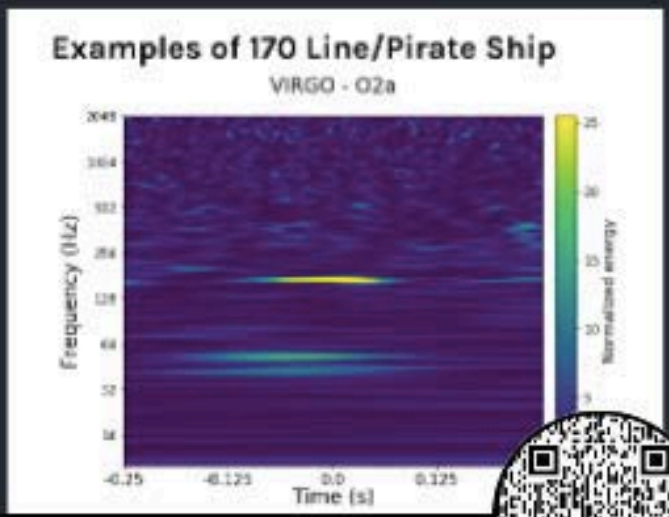
Lower frequency

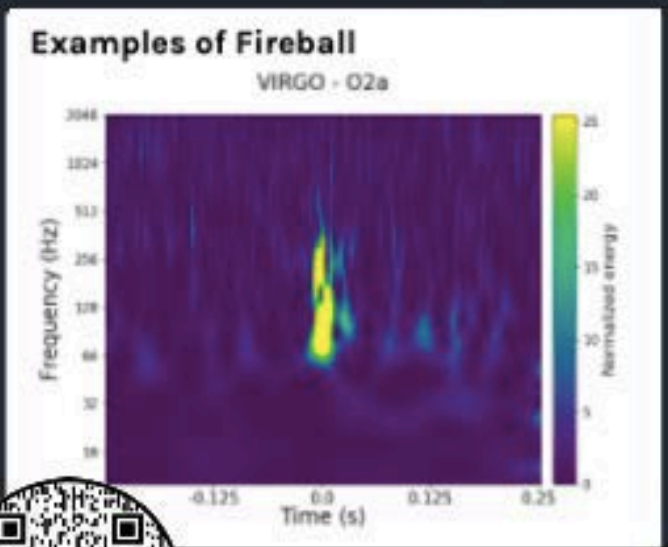
Higher frequency

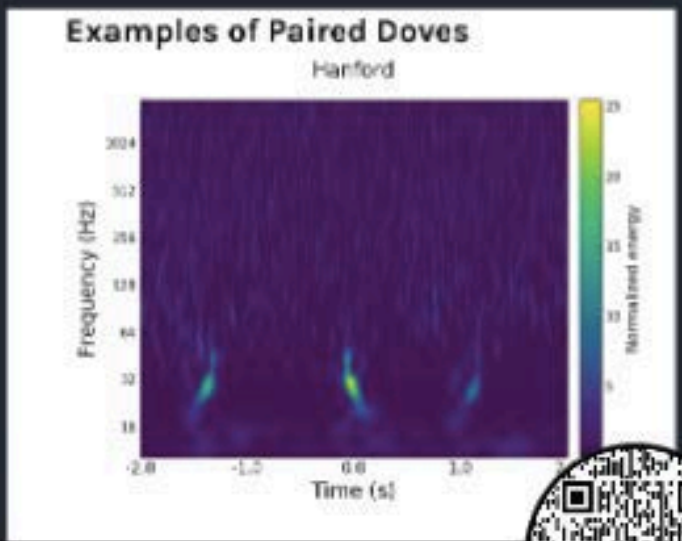
Here is an example of the gravitational wave "chirp" of the binary black hole merger GW190814. As the black hole's orbit shrinks the frequency of the orbit and the signal increases until the black holes finally collide. We can hear this chirp in the data! Its low frequency makes it hard to hear on some speakers, so raising the pitch can make it even clearer

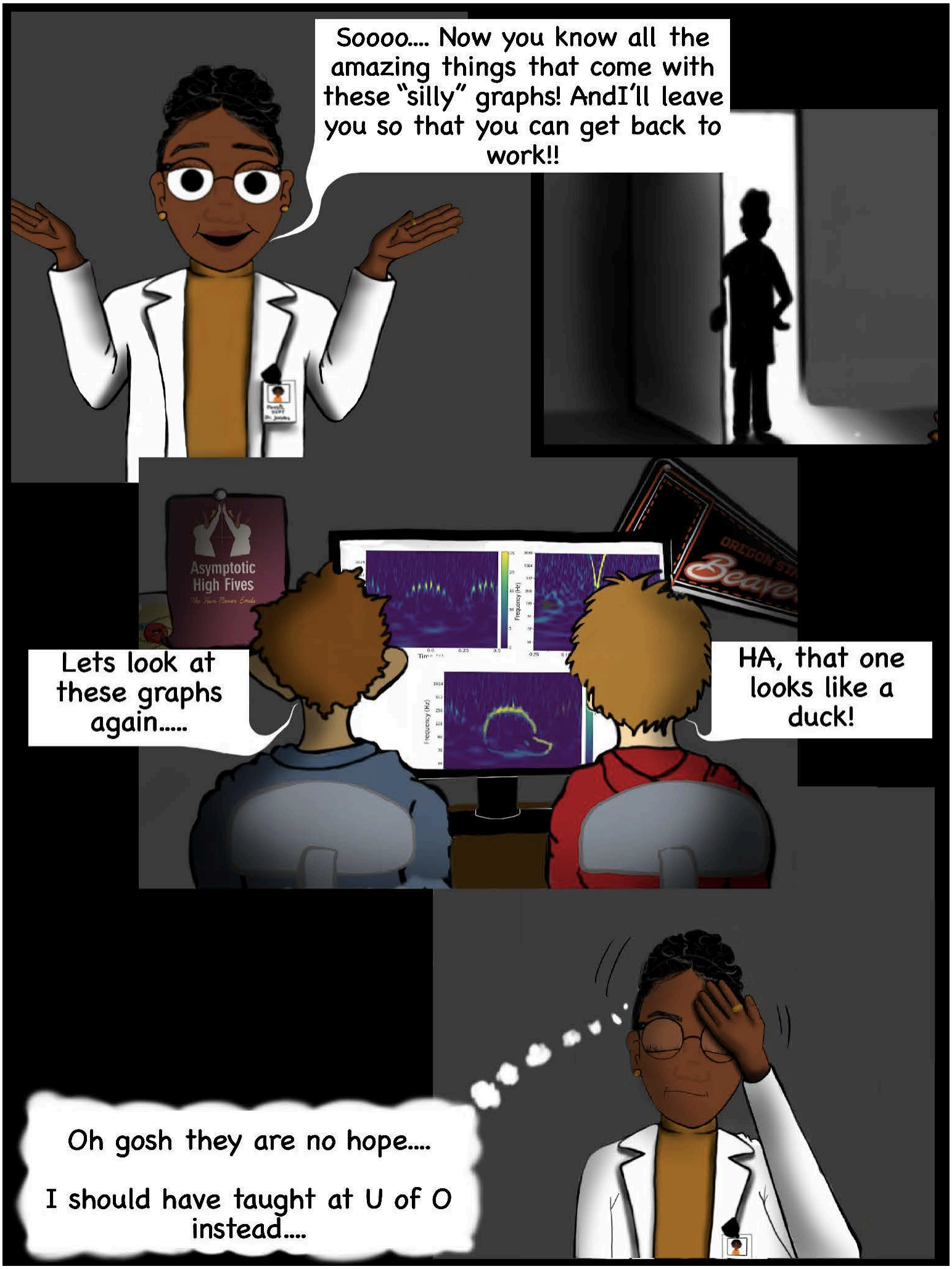
Here are some examples of noise events in the data that aren't gravitational waves, which complicate our search for true astrophysical events. Some are easy to identify, like Whistles, while others can be hard to tell apart from astrophysical signals!










Soooo.... Now you know all the amazing things that come with these "silly" graphs! AndI'll leave you so that you can get back to work!!
Asymptotic High Fives
Lets look at these graphs again.....
HA, that one looks like a duck!
Oh gosh they are no hope....
I should have taught at U of O instead....