Using cybersecurity as a context to explain how digital signals encode and transmit personal information

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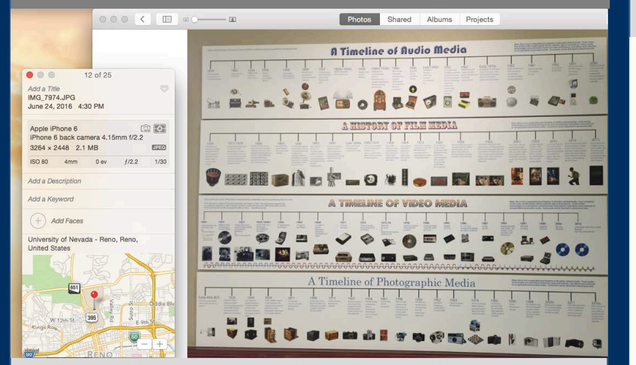
Curriculum and Assessment

Using authentic learning tasks can motivate students to become aware of the value of science and scientific thinking as it applies to their world. Integrated 8th grade science is a year long course. Each week there are three-50 minute classes and one-90 minute block class. The integration of cybersecurity lessons will be two-fold: General lessons related to the guiding theoretical frameworks and specific lessons related to disciplinary core idea MS-PS4 Waves and their Applications in Technologies for Information Transfer.
Each of these learning activities are tied to the essential question, written below in student friendly language, so that students can record their response before, during, and after each learning activity to establish a timeline of learning. The learning activities will include simulations, lab experiments, reading materials with discussion and writing code. These qualitative responses will be quantified using a rubric and should show increasing sophistication of ideas. There are additional assessments unique to each task, illustrating desired student outcomes.

How did we historically share information?

Students will compare scientific and technological data about analog and digitized signals to discover the advantages of each, and how both are used today to send information. Students will then conduct a shared inquiry debate on whether there should be an Internet fast lane in the near future.

How much information are we sharing?



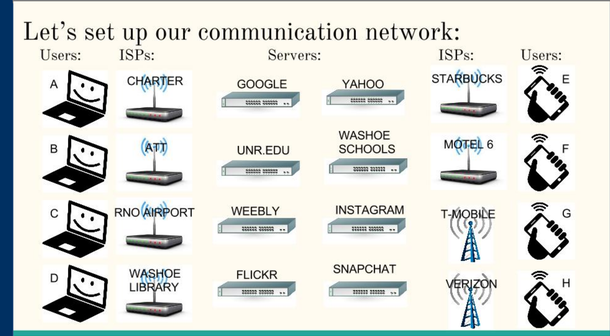
Students will examine metadata of images from various sources, including photos posted to social media, and discuss privacy in regards to their own personal safety.

How do we secure our information?

Students will learn how to create a password schema which will have various characteristics that cannot be hacked in a timely manner via free software. Several simple passwords will be hacked so that the data could be compiled to illustrate the exponential increase in time required to hack more complex passwords. Students will also discuss the benefits and problems of using biometric measures to secure data.

Image Credits : Finger Print by Chadmiller at Creative Commons/Flickr

How do we share information using digitized signals on the Internet?

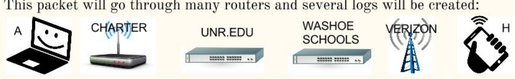


The diagram above illustrates an electronic message simulation using students to represent elements in a network and index cards to make packets. After sending get to know you messages, students will demonstrate how information could be encrypted using rotational ciphers. They will then send compromised messages, simulate IP spoofing, use multiple relays to hide sender/receiver information inside envelopes, and discuss how to balance security with privacy when sending digital information.

PACKET:

Source	Destination	Sequence	Time	Error	Message
Alice@UNR.EDU	Heather@WashoeSchools.net	First	9:03am	None	Hi Heather!

Let's send our first packet:
This packet will go through many routers and several logs will be created:



LOG: CHARTER

Source	Destination	Sequence	Time	Error
Alice@UNR.EDU	Heather@WashoeSchools.net	First	9:03am	None

LOG: UNR.EDU

Source	Destination	Sequence	Time	Error
Alice@UNR.EDU	Heather@WashoeSchools.net	First	9:03am	None

LOG: WASHOESCHOOLS.NET

Source	Destination	Sequence	Time	Error
Alice@UNR.EDU	Heather@WashoeSchools.net	First	9:03am	None

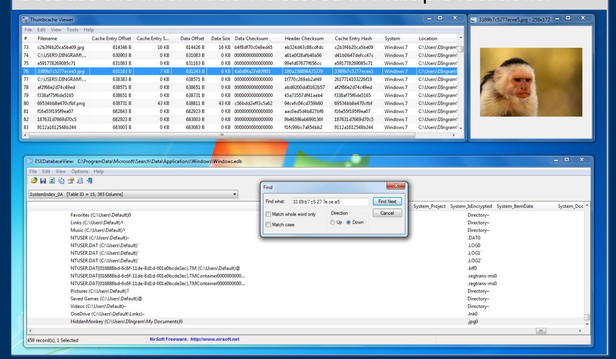
LOG: VERIZON

Source	Destination	Sequence	Time	Error
Alice@UNR.EDU	Heather@WashoeSchools.net	First	9:03am	None

Since the message arrived in it's entirety and no data was lost or ruined, it was sent successfully and there are no errors.

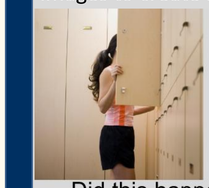
Can we delete our information?

Students will use a Thumbcache viewer and ESEDatabase View to illustrate how deleted images can still be viewed, because the information is stored in multiple locations.

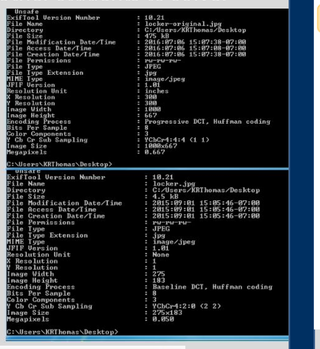


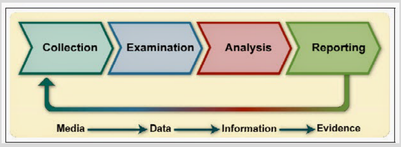
Who else can see our information?

Students will use Exiftool to modify or delete metadata on images to create a mystery for other students to solve.



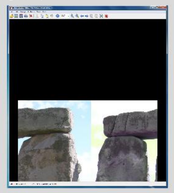
Did this happen in 2016?
Or...2015?
Using IMGonline.com.ua to alter the metadata and create a puzzle for students



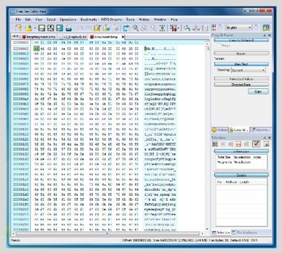


Students will use the digital forensics process to investigate a case as though they were a detective using various forensic tools, including using a hex editor to manually file carve previously deleted files.

There is so much data to be searched though, that in the interest of time, knowing the gist of an image will allow the viewer to make decisions about its importance relative to a investigatory case.

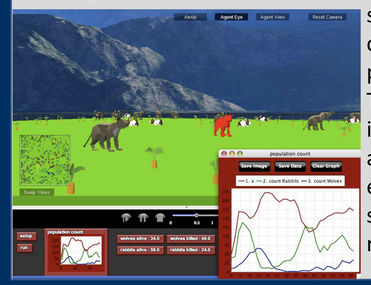


File Carving Fragments

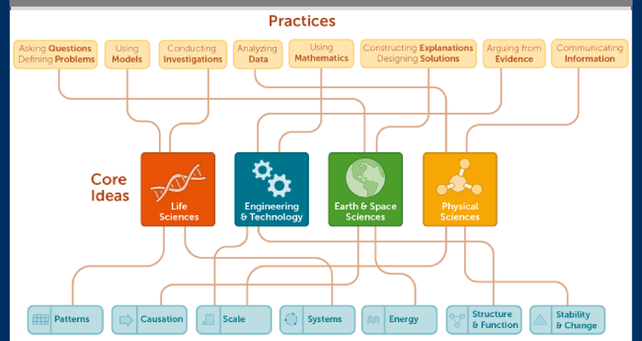


How can we use computers to model dynamic scientific processes?

Students will acquire programming skills using drag-and-drop blocks in the program StarLogo Nova from Project Growing Up Thinking Scientifically (GUTS) to model simulations of complex scientific processes.
These include investigations of: water as a shared resource, ecosystems as complex systems, and chemical reactions.



Guiding Theoretical Frameworks



Life Science	Physical Science
LS1: From Molecules to Organisms Structures and Processes	PS1: Matter and Its Interactions
LS2: Ecosystems: Interactions, Energy, and Dynamics	PS2: Motion and Stability: Forces and Interactions
LS3: Heredity: Inheritance and Variation of Traits	PS3: Energy
LS4: Biological Evolution: Unity and Diversity	PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth's Place in the Universe	ETS1: Engineering Design
ESS2: Earth's Systems	ETS2: Links Among Engineering, Technology, Science, and Society
ESS3: Earth and Human Activity	

Website References

csint.unr.edu
nextgenscience.org
projectguts.org
code.org/curriculum/science
wcsd21.com
http://web.mit.edu/jhawk/mnt/cgs/Image-ExifTool-6.99/html/
https://thumbcacheviewer.github.io
http://www.hhdsoftware.com/free-hex-editor
http://www.imgonline.com.ua/eng/hdr-jpg.php

"This work is supported by the National Science Foundation under Grant #1542465."