This is an example of what we mean by Source Content for a CLOVER Activity. It is the first document that the Originating LGU creates for our development workflow, and undergoes feedback (like that below in comments) for approval prior to becoming a Storyboard.

Cloud Computing

Cloud computing is the delivery of computing services over the Internet.

About the Activity

You will learn how cloud computing has altered where we store our digital data.
In this activity, you will explore the advantages and disadvantages of the cloud.

Objectives

1) Learn about cloud computing.
2) Find out what a server farm is and how it relates to cloud computing.
3) Discover the pros and cons of using cloud services, versus having the physical data on our devices.
4) Investigate how our families use cloud computing in our daily lives.
5) Explore the costs and offerings that different types of cloud services offer.

Grades: 3rd – 8th grade
Topic: Computer Science
Estimated Time:

Attribution: Brought to you by Mark Light, Ohio State University

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Commented [1]: Also, all the content aligns well with the learning objectives. I didn't find any holes or extra content. Nicely done.

Supplies

These simple supplies are
all you'll need for this activity.

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- Web browser

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- Digital devices in your home
- Paper and Pencil or pen

Activity Steps

Jerome: Why are you on this plane?

Chris: I am looking for my pictures.

Jerome: Did you lose them on the plane?

Chris: No, someone told me they were stored in the cloud, so I decided to look for them.

Jerome: They are not actually in the clouds, that is just a computer term. Let me help you learn more.

1. What is the cloud?

In activities 1 and 2 we learned about the computer and the hardware and software that allow us to perform tasks and operations. Computer files and software were often stored on a portable disk drive or on a computer hard drive. Files had to be backed up, where a second copy of the files was stored in an alternate location. If something happened to the original file, there was a backup copy that could restore the file. This way pictures, videos, letters, and data were not lost if something happened. If you were at work or school and you wanted to work on a file later at home, you made a physical copy on a portable file storage device to take it home. Another method was to email it to yourself.

In the early 2000s, the term "cloud computing" as we know it today was coined. Essentially, the cloud is a virtual space where users can access shared resources such as storage, computing power, and software applications on demand. The cloud offers many benefits to users, including the ability to add more storage, cost savings, and flexibility. It also allows users to access data and applications from anywhere if they have an internet connection.

Since then, cloud computing has become increasingly popular and has revolutionized the way businesses and individuals use technology. Today, cloud computing is an integral part of the tech industry, powering everything from online storage and collaboration tools to artificial intelligence and machine learning applications.

The greatest example of cloud computing would be how education was delivered during the pandemic in the spring of 2020. You were in one location and your classmates and teachers were in other locations. Your teacher provided lessons shared with you over the Internet. You uploaded your assignments to the cloud when you submitted them to your teacher.

On a piece of paper, draw out the path that your schoolwork took during the pandemic when you were learning remotely. Draw paths

1) From your teacher to the students
2) From the students to the teacher
3) From one student to another student

Share your drawing with someone in your family and explain the path that the files traveled.

Did You Know? Cloud computing has its roots in the 1960s when computer scientist John McCarthy proposed the idea of "utility computing" - a model of computing where computing resources could be sold in the same way as a utility like water or electricity. Cloud computing, however, did not gain popularity until 2006 when Amazon Web Services (AWS) launched its Elastic Compute Cloud (EC2) platform, which provided users with scalable computing resources in the cloud.

1. The Farms

Did the information for your school assignments go directly to the teacher or was there a location in between? When we send a file to the cloud, it is not really in the sky like real clouds. Instead, we are sending files across the Internet to be stored and accessed later. These files are stored in a server farm. Does this farm have a barn and animals?

Server farms, also known as data centers, are large facilities that house multiple computer servers and other computing equipment used to support the delivery of cloud services and other internet-based applications. These facilities are designed to provide reliable and scalable computing resources, such as a large scale power source, file storage, and strong network connectivity to the Internet, to support the growing demand for cloud services.

A typical server farm consists of multiple racks of computers called servers, each of which can contain dozens or even hundreds of individual servers. The servers are typically housed in climate-controlled rooms with back up power supplies to ensure uninterrupted operation and cooling systems due to the heat generated from hundreds of computers. Data centers also have advanced security measures in place to protect against physical and cyber threats.

Server farms are a critical component of cloud computing infrastructure, providing the backbone for the delivery of cloud services to users around the world. They are often located in remote areas where the cost of real estate and electricity is lower, and where there is access to reliable power and network connectivity.

There are many companies that have data centers all over the world. Just because you have a data center close to you, does not mean that that is where your data is stored. It is often based on what type of data it is, whether it is public or private, and if you have paid a specific company for online storage.

Check out this worldwide map of Google Data Centers. What is the closest one to you?
https://www.google.com/about/datacenters/locations/

Here are pictures of what it is like to work in a data center.

https://www.google.com/about/datacenters/gallery/

Did You Know? The United States has the highest number of data centers in the world, with an estimated 2.5 million data centers as of 2021.

Data centers generate a significant amount of heat, and cooling equipment accounts for up to 40% of their energy consumption.

In the United States, data centers use an estimated 90 billion kilowatt-hours of electricity per year, which is equivalent to the energy consumed by 34 coal-fired power plants.

3. My Daily Cloud

While you may realize that you can store data in the cloud, you may not realize all the ways you and your family might use the cloud on a daily basis.

Most schools are probably using the cloud to post assignments on the Internet. Since the pandemic, your may have more content that is provided through the cloud, than through a physical textbook. This content may be hosted on Google Drive, Apple iCloud, or Microsoft One Drive. These companies offer online storage for our files, photos, and videos. Sometimes a portion of this storage might be free and then after a few Gigabytes, you might have to pay a monthly or yearly fee.

How do you listen to music? Do you buy a record, tape, or other physical copy of your favorite artist? Most likely you are streaming the music through a service like Spotify or Apple Music. Here you do not own the music, but instead, access the music through an online service. Even if you listen to the radio, there may not be a local DJ, but instead, a larger company is providing the music from a distant location and streamed to a location radio station, like iHeartMedia.

Do you go to the movies in a theatre? While you might visit a theatre occasionally to see a new movie release, you are probably watching most of the movies on a cloud platform. Here the movie is not in your house, but instead, the video content is coming through an Internet feed. You are watching the video in your home, but the video is physically at a data center that houses the movie that you can watch on your TV, computer, or phone. Netflix, Amazon Prime, and YouTube are examples of paid and unpaid services that allow us to watch video content. YouTube allows us to also create content to put on the web for others to see.

No longer do we have to be in a single physical space to access digital content. Now we can access files and data from anywhere. Other examples of digital cloud-based content include apps, multiplayer video games, eBooks, online shopping, video conferencing, and websites. All of these activities still require physical computers that store the data and programs that allow us to access these items from anywhere.

Write down the cloud-based services mentioned above that you and your family use on a regular basis. With the help of an adult find out the costs of these online and streaming services. If you do not currently use streaming and cloud services, investigate some of the services you would like to try someday. Record your data in a chart like this one.

Company or service	Free or Paid	Monthly cost	Pros	Cons	Are we using this service	Is there a cheaper alternative?

Dig deep. Sometimes adults sign up for services that we forget about. Are there services that you are paying for that you do not use regularly? Could you cancel those and then restart them if you need to? Is there a free or cheaper alternative you can switch to? While cloud-based services are helpful, the costs can add up quickly. As a family, talk about how you could save money by reducing the services you subscribe to.

> **Did You Know?** The average amount that households spend per month on cloud-based and streaming services can vary widely depending on a number of factors, such as the number of services used, the pricing model of each service, and the geographic location of the household. However, according to a survey conducted by the consulting firm Deloitte in 2021, the average US household spent $80 per month on subscription streaming and other digital media services. This includes video streaming services like Netflix and Hulu, music

streaming services like Spotify and Apple Music, and cloud storage services like Dropbox and Google Drive.

Bonus Activity: One way your family can save money on your cloud storage is to divide up your storage into different buckets. For example, you can use Google Photo for your pictures and get up to 15 GB for free. Amazon Prime members get unlimited photo backup. Upload videos to YouTube and select private or unlisted and you would not have to publish the video for public viewing. Plans and services change all the time, so be aware that it is not just a free trial and then it starts charging you. Discuss file storage needs as a family and make decisions about what services might be the best for each type of file so that the whole family has access. Make sure to get an adult involved before signing up for any service.

Test Your Knowledge

See how much you've learned about cloud computing

Another name for a data center is _____

1. Computer Farm
2. Server Farm
3. Sea of Servers

Data centers in the US use over ____ billion kW hours per year.

5. 90
6. 900
7. 9000

The benefit of using cloud computing is (select all that apply):

9. scalability
10. cost savings
11. flexibility

Which one are cloud-based products (select all that apply):

13. Movie Streaming
14. Online file storage
15. Music streaming
16. Buying a video game from a store

17. Uploading videos to the Internet

The first major cloud service was called

18. Elastic Compute Cloud
19. Floating on the Cloud
20. Cloud Nine

Reflection Questions

1. Do you remember switching to online learning in during the pandemic? What has changed and what went back to normal?
2. Were you surprised at how much money can be spent in a month on cloud-based products?
3. Did you know where the nearest data center was?

Bonus questions to inspire wonder.

1. Did you know that your local library offers digital books and other products you can borrow for free?
2. We often think about physical clutter in our bedroom. Have you thought about how digital clutter can also take up space and cause electricity and other resources to be used up?
3. One benefit of cloud storage and digital content is that future generations will know a lot more about how we lived life than past generations did when there were fewer pictures and videos that were accessible. Can you ask a grandparent or a parent how family history was documented before digital photos?

Investigate and Explore

There seem to be a lot of positives about having data in the cloud, but there are also some disadvantages.

1. Dependency: We become reliant on the cloud provider for their computing resources, which can be a disadvantage if the provider experiences downtime or other issues.
2. Connectivity: Cloud computing requires a reliable internet connection, and if the connection is lost or slow, users may experience delays or be unable to access their data or applications.

3. Data privacy: There are concerns about data privacy in the cloud, as we have now handed more personal information over to companies that manage the cloud service.
4. Data breaches: Cloud computing providers may be targeted by hackers, leading to data breaches and other security issues.
5. Unlimited choice: When the content online seems endless, we can binge-watch and lose track of our time.

Have you ever felt the need to take a break from technology? We call that being unplugged or going analog. Analog is the opposite of digital. It can mean listening to music through a record player or radio where there is less distraction or tracking of what we are listening to. Ask an adult what they did before the cloud or the Internet was available.

Career Connections

Data centers require a diverse range of professionals with various skill sets to keep operations running smoothly. Some of the common job roles found in data centers include:

1. Data center technicians: These professionals are responsible for the physical maintenance and upkeep of the data center, including hardware installation, equipment configuration, and troubleshooting.

2. Network engineers: Network engineers are responsible for designing, implementing, and maintaining the network infrastructure of the data center, ensuring that data flows smoothly between servers, storage devices, and other equipment.

3. Security specialists: Security specialists are responsible for monitoring and securing the data center against physical and cyber threats, including firewalls, intrusion detection systems, and access control systems.

4. Systems administrators: Systems administrators are responsible for configuring and maintaining the operating systems and software applications used in the data center.

5. Electrical and mechanical engineers: These professionals are responsible for designing and maintaining the power and cooling systems used in the data center, ensuring that the equipment stays operational and does not overheat.

These are just a few examples of the many job roles found in a data center. Data centers require a diverse range of professionals with specialized skills to ensure that they can deliver reliable and secure cloud services to their customers. Explore some of the profiles of Google staff that work at a data center.

https://www.google.com/about/datacenters/life/