Cybersecurity in Food and Agriculture, Advanced

8075 36 weeks

Table of Contents

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Course Description

Suggested Grade Level: 10 or 11 or 12
Prerequisites: 8074

This advanced course continues to focus on threats and security practices in the food and agriculture industries, while specifically addressing cryptology, threats associated with precision agriculture (PA) and vulnerabilities in livestock, flock, and crop production. The students will research future trends in cybersecurity and the use of artificial intelligence (AI), along with cybersecurity concerns related to agricultural marketing, distribution, business management, and financing. Additionally, students will explore careers related to cybersecurity in various agriculture, food, and natural resource industries.

Task Essentials Table

8075	Tasks/Competencies
⊕	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.
⊕	Participate in an SAE.
⊕	Identify the benefits and responsibilities of FFA membership.
⊕	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
○	Apply for an FFA degree and/or an agricultural proficiency award.

⊕	Explain the steps required for logical problem solving.	
⊕	Develop a graphic or concept map for the logical flow of information among devices within a network.	
⊕	Explain the communication processes on a machine and across networks.	
⊕	Compare wired and wireless networks.	
⊕	Create wired networks.	
⊕	Create wireless networks.	
⊕	Compare networking conceptual models.	
⊕	Explain connection-oriented and connectionless protocols.	
⊕	Explain services, their relationship to the OSI model, and potential vulnerabilities.	
⊕	Explain how confidentiality is achieved through cryptology.	
⊕	Generate key pairs for data encryption.	
⊕	Use key pairs to encrypt/decrypt data.	
⊕	Explain how to generate a symmetric key.	
⊕	Explain certificates and public keys.	
⊕	Identify groups affected by the use or misuse of PA.	
⊕	Explain the confidentiality, integrity, and availability (CIA) triad model of information security.	
⊕	Identify key threats to confidentiality.	
⊕	Identify key threats to integrity.	
⊕	Identify key threats to availability.	
⊕	Explain methods for strengthening the CIA triad as it applies to security in food and agriculture.	
⊕	Identify information management and cyber threats facing embedded and digital tools used by PA.	
⊕	Identify baseline security controls necessary to mitigate threats in PA.	
⊕	Explain agricultural industry standards related to cybersecurity.	
⊕	Develop best practices to protect and build resilience into PA.	
⊕	Identify the Center for Internet Security's (CIS) top 20 critical security controls.	

⊕	Explain methods of building resilience into rural navigation, communication, and embedded tool applications.	
⊕	Explain the technologies used in PA and precision agronomics.	
⊕	Describe technologies used in greenhouse production.	
⊕	Describe the technologies used in precision livestock farming (PLF).	
⊕	Explain threats to PA technologies used in crop and livestock production.	
⊕	Explain the vulnerabilities of the technologies used in livestock production.	
⊕	Explain how PLF improves animal welfare and minimizes negative environmental effects.	
⊕	Identify vulnerabilities in PA technologies used in crop production.	
⊕	Explain how in-situ monitoring and data collection technologies are used in production agriculture.	
⊕	Explain how PA technologies are used on agricultural machinery and equipment.	
○	Identify how ML algorithms can be integrated into decision-support tools in PA.	
⊕	Explain how DSS are used in agriculture.	
⊕	Explain the advantages and disadvantages of the Internet of Things (IoT).	
⊕	Research AI-driven technologies in agriculture and how they help increase food production with fewer resources.	
⊕	Explain threats to food and animal feed processing and manufacturing.	
⊕	Explain how facilities engaged in the manufacture of food and feed for animals are vulnerable to cyberattack.	
⊕	Develop a mitigation plan to address cybersecurity threats related to agricultural production or processing facilities.	
⊕	Explain how to mitigate cybersecurity threats related to agricultural equipment and machinery.	
⊕	Propose methods to ensure agricultural equipment and machinery are resistant to cyberattack.	
⊕	Explain the importance of accuracy of information derived from sensor-based systems.	
⊕	Explain how social engineering can promote cybersecurity intrusion.	
○	Evaluate animal, plant, soil, and/or mechanical test results to identify cybersecurity intrusion.	
⊕	Explain threat vectors in the wholesale and retail distribution sectors of agricultural and food products industries.	

⊕	Explain methods of distribution disruption.	
⊕	Create a mitigation plan for threat vectors in the agricultural product transportation systems.	
⊕	Explain how cyber intrusion might affect an agricultural enterprise.	
⊕	Design a plan to use management controls to secure information and operations and prevent security breaches.	
⊕	Create a secure customer relationship management (CRM) database.	
⊕	Identify cybersecurity threats facing financial institutions and the effect on the agricultural business sectors.	
⊕	Develop a cyber plan to safeguard data.	
⊕	Explain how to protect a business against online scams and fraud.	
⊕	Research the implications of intellectual property (IP) theft.	
⊕	Explain key threats perpetrated by threat actors to manipulate the commodities market.	
⊕	Explain national and international cybersecurity laws and policies related to agricultural enterprises.	
⊕	Explain the importance of securing a company's network.	
⊕	Explain the costs associated with a data breach, security incident, privacy violation, or phishing/skimming incident.	
⊕	Research careers associated with cybersecurity in agriculture.	
⊕	Research educational requirements for cybersecurity jobs in agriculture.	
⊕	Conduct research on cybersecurity in the food, agriculture, and natural resource industries.	
⊕	Conduct an oral presentation on a subject related to cybersecurity in the food and agriculture industries.	

Legend: ⊕Essential ○Non-essential ⊖Omitted

Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf). All inquiries may be sent to cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).

Curriculum Framework

Task Number 39

Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

Definition

Identification should include

- defining an SAE program as *an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment*
- researching the Foundational SAE
    - career exploration and planning
    - personal financial planning and management
    - workplace safety
    - employability skills for college and career readiness
    - agricultural literacy
- researching the Immersion SAE
    - entrepreneurship/ownership
    - placement/internships
    - research (experimental, analytical, invention)
    - school business enterprises
    - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: SAE Resources, National Council for Agricultural Education

Process/Skill Questions

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?
- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student's Career Plan of Study?
- How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
- What are the four types of SAEs?
- What are the advantages of participating in work-based learning experiences and projects?

- How does one choose an appropriate SAE in which to participate?

Task Number 40

Participate in an SAE.

Definition

Participation should include

- developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
- documenting experience, connections, positions held, and competencies attained, using the *Virginia SAE Record Book*
- researching available awards and degrees, based on SAE participation.

Teacher resources:
FFA SAE
The Agricultural Experience Tracker

Process/Skill Questions

- What are the advantages of participating in work-based learning experiences and projects?
- How do SAEs help prepare students for the workforce?
- What are some examples of SAEs in AFNR?

Exploring Leadership Opportunities through FFA

Task Number 41

Identify the benefits and responsibilities of FFA membership.

Definition

Identification should include

- benefits
    - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
    - exploring leadership development opportunities

- responsibilities

- researching the responsibilities of FFA officers, committees, and members
- locating resources that guide participation in FFA activities
- explaining the FFA Creed, Motto, Salute, and mission statement
- explaining the meaning of the FFA emblem, colors, and symbols
- explaining significant events and the history of the organization.

Process/Skill Questions

- How does one become an FFA member?
- What is the FFA's mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

Task Number 42

Describe leadership characteristics and opportunities as they relate to agriculture and FFA.

Definition

Description should include

- examples of successful leaders
- types of leadership
  - autocratic
  - participative
  - laissez-faire
  - servant
  - followership
- positive leadership qualities and traits of successful leaders
- opportunities for participating in leadership activities in FFA
- demonstrating methods for conducting an effective meeting.

Process/Skill Questions

- Who are some successful leaders in the agriculture industry?
- What qualities make a successful leader?
- What are leadership traits?
- What is the difference between positive and negative leadership?

Task Number 43

Apply for an FFA degree and/or an agricultural proficiency award.

Definition

Application should include

- identifying types of FFA degrees
    - Greenhand
    - Chapter
    - State
    - American
- identifying proficiency award areas
    - entrepreneurship
    - placement
    - combined
    - agriscience research
- exploring CDEs and LDEs related to this course
- identifying all SAE criteria to be eligible for the award
- identifying the type of award
- applying for an FFA award.

Teacher resource: FFA Agricultural Proficiency Awards

Process/Skill Questions

- Where are the awards and their application criteria located?
- What are the benefits of winning an FFA award?
- What are the benefits and requirements of an FFA degree?
- What FFA awards are available?
- How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
- What is the highest degree that can be conferred upon an FFA member at the national level?
- What are the requirements for a Greenhand FFA degree?

Identifying the Necessary Skills to Understand Cybersecurity Concerns

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Task Number 44

Explain the steps required for logical problem solving.

Definition

Explanation should include

- how a computer runs a program
- the function of an algorithm (i.e., a series of steps)
    - sequence
    - iteration
    - selection
- components of processes (e.g., input/output)
- a basic problem-solving process
    - analyze the problem
    - design a solution
    - implement the solution
    - test
    - refine.

Process/Skill Questions

- How does cybersecurity operate as part of a larger system using a systems-thinking approach?
- How does a computer turn bits into a comprehensive data set?
- What is the purpose of using computers instead of humans to execute algorithms?
- How do computers have an advantage over humans when solving specific types of problems?
- How does putting computers together into networks improve the ability to solve certain problems?

Task Number 45

Develop a graphic or concept map for the logical flow of information among devices within a network.

Definition

Development should include

- computers
- processes
- network adapters/connections
- humans
- input/output (I/O) devices
- hierarchy (i.e., how they are related and arranged).

Process/Skill Questions

- What happens when one clicks on a link?
- How does the data flow in a client-server computing environment?
- What types of devices may be on a network?

Task Number 46

Explain the communication processes on a machine and across networks.

Definition

Explanation should include

- interprocess communication (IPC)
- specific subsets of programs vulnerable to attack (e.g., browsers, web daemons)
- methods of attack (e.g., man-in-the-middle, address resolution protocol [ARP] poisoning, domain name system [DNS] hijacking).

Process/Skill Questions

- What types of networks are unique to the food and agriculture sectors?
- How might a network in a food and agriculture setting differ from a standard office network?
- How could a man-in-the-middle attack threaten secure communications on a network?

Task Number 47

Compare wired and wireless networks.

Definition

Comparison should include

- network speed
- network reliability
- network security
- streaming/block encryption
- frequency hopping.

Process/Skill Questions

- How do security concerns differ between wired and wireless networks?
- When might a wired network be more effective than a wireless one?
- What type of network is one more likely to see in an agricultural setting?

Task Number 48

Create wired networks.

Definition

Creation should include

- understanding
    - wiring order (e.g., 568 A/B)
    - the use of tools
        - crimping
        - wire cutters
        - cable testers
        - multimeter
- administering settings, such as
    - Internet protocol (IP) address
    - gateway
    - netmask
    - DNS server
    - dynamic host configuration protocol (DHCP) server vs. static (i.e., manual application of the settings).

Process/Skill Questions

- What is the difference between DHCP and the manual assignment of IP addresses?
- What benefits does DHCP provide?
- What is the role of a gateway server?
- What situations might require use of static IP addresses vs. DHCP addresses? When does one need an IP to remain constant?
- What is the role of a DNS server in a network?

Task Number 49

Create wireless networks.

Definition

Creation should include

- administering settings to the client (e.g., personal computer (PC), such as
    - IP address
    - gateway
    - netmask
    - DNS server
    - dynamic vs. static
- administering settings to the small office, home office (SOHO)
    - security
    - enabling media access control (MAC) filtering
    - setting the encryption
    - explaining what a network address translation (NAT) does.

Process/Skill Questions

- What security options are available when connecting to a wireless network?
- Why do most home computers share the same IP address?

- How does NAT help protect devices from hackers in a SOHO network?
- Why should a consumer change the password on a wireless access point after purchase?
- How can a wireless network be vulnerable to cyberattack?
- How can one secure a user-built system?
- How can one secure a system that has been built by others?
- Where might one look for weaknesses or vulnerabilities in a network?

Task Number 50

Compare networking conceptual models.

Definition

Comparison should include the following models:

- Open systems interconnect (OSI)–a seven-layer model that describes communication between systems; the seven layers include the following:
    - Application
    - Presentation
    - Session
    - Transport
    - Network
    - Data link
    - Physical
- Internet transmission control protocol/Internet protocol (TCP/IP)–a four-layer model that describes communication between systems; the four layers include the following:
    - Application
    - Transport (transport/TCP)
    - Network (Internet/IP)
    - Network Access (link, physical)

Process/Skill Questions

- What layers of the OSI model are important to the app developer?
- What is the benefit of a layered model for representing network communication systems?
- What does TCP provide which IP does not?
- What is an example of software at the application layer of the TCP/IP model?

Task Number 51

Explain connection-oriented and connectionless protocols.

Definition

Explanation should include

- TCP

- user datagram protocol (UDP).

Process/Skill Questions

- What guarantees does TCP provide that UDP does not?
- What apps would use UDP instead of TCP, and why would they do so?
- What purpose might a connectionless protocol serve?

Task Number 52

Explain services, their relationship to the OSI model, and potential vulnerabilities.

Definition

Explanation should include

- identifying the protocols used and the level of the OSI model
- defining the term *service* as an app running on a computer
- understanding
    - DNS
    - email services
    - printing services
    - file distribution systems and services
    - directory services
    - web services
    - wireless sensor network.

Process/Skill Questions

- What is the definition of *service* as it applies to computer information systems?
- What are the potential vulnerabilities in services?
- What is the TCP, and how is it related to network services?
- What is the purpose of a DNS service?
- What services provide file transmission?

Examining Cryptology

Task Number 53

Explain how confidentiality is achieved through cryptology.

Definition

Explanation should include

- the two fundamental types of encryption
    - symmetric/private key
        - advanced encryption standard (AES)
        - data encryption standard (DES)
    - asymmetric/public key
        - Diffie-Hellman (DH)
        - Rivest-Shamir-Adleman (RSA)
- certificate authorities (CA)
- chain of trust.

Process/Skill Questions

- Why do businesses still use both symmetric and asymmetric encryption?
- What fundamental encryption-related problem does asymmetric encryption solve?
- How can exhaustive key space search and frequency analysis be used to break encryption?
- How does key length affect the level of security provided by encryption?

Task Number 54

Generate key pairs for data encryption.

Definition

Generation should include identifying software packages such as

- the open-source version of the secure shell (OpenSSH)
- pretty good privacy (PGP).

Process/Skill Questions

- What is a key pair? Why is key length important?
- How does one generate key pairs and extract the private key?

Task Number 55

Use key pairs to encrypt/decrypt data.

Definition

Use should include explaining how software packages are used to encrypt/decrypt.

Process/Skill Questions

- How does one encrypt with a public key?
- Why is encryption with a private key generally referred to as signing?

- What are the risks involved with publishing public keys?

Task Number 56

Explain how to generate a symmetric key.

Definition

Explanation should include discussion on

- AES
- DES.

Process/Skill Questions

- How does one use open Secure Sockets Layer (SSL) to generate an AES key?
- Why are different key lengths possible with AES but not with DES?
- What is the key length for DES?

Task Number 57

Explain certificates and public keys.

Definition

Explanation should include

- a mapping of the processes of encrypting communication between client/server
- X.509
- the public/private key pair
- the certificate request
- the certification authority
- the certificate
- the certificate revocation list
- individual's public key used for encryption
- individual's public key used for signature verification
- certificate services role.

Teacher resource: Certificates and Public Keys, Microsoft Development Center

Process/Skill Questions

- What is the difference between http: and https:?
- What is the purpose of web server certificates?
- What information is stored in a certificate?
- What is the relationship between a public and a private key?

- How do public key infrastructure (PKI) cryptographic algorithms use the public key of the receiver of an encrypted message to encrypt data?
- How is it possible for the related private key and only the related private key to decrypt the encrypted message?

Identifying Threats in Precision Agriculture (PA)

Task Number 58

Identify groups affected by the use or misuse of PA.

Definition

Identification should include

- farmers
- livestock producers
- farm laborers
- consumers
- organizations and industries that generate new information for advancing agriculture through research and innovation (e.g., academic research institutions, United States Department of Agriculture [USDA] Agricultural Research Service)
- industries that support agriculture (e.g., fertilizer and pesticide suppliers, seed companies, equipment providers, consulting firms, feed suppliers, financial institutions)
- organizations that support agriculture (e.g., extension offices, secondary and postsecondary education, government agencies, transportation services companies [e.g., trucking], energy companies, communication companies [e.g., wireless, remote, telephone, satellite])
- industries that generate data through distribution/sales to end users/consumers, other retail, tourism
- industries that rely on outputs or data from agriculture (e.g., food processors, grain dealers, commodity brokers, energy producers, manufacturers, crop insurers)
- animal health and safety.

Process/Skill Questions

- What is the definition of *precision agriculture* (PA)?
- How does a group use PA?
- What are the various threats associated with the use of PA?
- How might a technology related to PA be misused?
- What are some examples of PA software applications?

Task Number 59

Explain the confidentiality, integrity, and availability (CIA) triad model of information security.

Definition

Explanation should include the

- definition of the *CIA triad* as a model designed to guide policies for information security within an organization
    - *confidentiality*–a set of rules that limits access to information
    - *integrity*–the assurance that the information is trustworthy and accurate
    - *availability*–a guarantee of reliable access to the information by authorized people
- effects on CIA of
    - cyberattacks
    - natural disasters
    - terrorist attacks
    - equipment breakdowns
    - insider threats.

Process/Skill Questions

- Why is CIA important in PA?
- Which component of the CIA triad model is affected by a denial-of-service (DoS) attack?
- What does the term *integrity* mean as it relates to computer security?
- How would a cyberattack (e.g., modification of a computer program/algorithm) that controls a food processing critical control point (e.g., fluid milk pasteurization temperature/time) affect food safety and influence consumer perception of the safety of the broader food supply?

Task Number 60

Identify key threats to confidentiality.

Definition

Identification should include

- intentional theft of data collected through decision support systems (DSS) or the unintentional leakage of data to third parties
- intentional publishing of confidential information from within the industry, such as from a supplier, to damage the company or cause chaos
- foreign access to unmanned aerial systems (UAS) data
- unscrupulous sale of confidential data.

Process/Skill Questions

- What are brute force attacks?
- What is social engineering?

- How might dumpster diving affect confidentiality if records or data are discarded improperly?
- What is a keylogger?
- How does wiretapping work?
- How might phishing and pharming affect the confidentiality of data in PA?
- What sorts of data should be kept confidential in an agribusiness network?
- How might confidential data be threatened?

Task Number 61

Identify key threats to integrity.

Definition

Identification should include

- intentional falsification of data to disrupt crop, livestock, or poultry sectors
- introduction of rogue data into a sensor network, which damages a crop, herd, flock, or process
- insufficiently vetted machine learning (ML) modeling.

Process/Skill Questions

- What are man-in-the-middle, data-diddling, trust-relationship, and session-hijacking attacks?
- How could falsified data harm an agriculture business?
- How might a computer criminal attempt to falsely modify digital data?
- How might a farmer/producer be affected if a variable-rate application (VRA) sensor network for fertilizer was secretly programmed to deliver at a rate higher than appropriate?

Task Number 62

Identify key threats to availability.

Definition

Identification should include

- potential for human error (e.g., accidental deletion of data)
- physical access vulnerabilities (e.g., disrupting/damaging data delivery)
- distributed denial-of-service (DDoS)
- timing of equipment availability
- space-based and ground-based disruption to positioning, navigation, and timing (PNT)
- disruption to communication networks
- foreign supply chain access to equipment used in PA
- smart livestock production facility failure.

Process/Skill Questions

- What safeguards need to be in place in case of a natural disaster and the destruction of data or resources?

- How can a DDoS attack on equipment affect PA?
- How might an attack on the power grid cause a disruption in data availability?
- What type of nonmalicious event might have a negative effect on data availability?
- What is a DoS attack?
- What are criteria for identifying key personnel who should have access to data?
- How should businesses validate the chain of transfer of data among authorized personnel?
- What would be the appropriate computer, technical, management, and policy/regulatory positions to include in the chain of transfer?

Task Number 63

Explain methods for strengthening the CIA triad as it applies to security in food and agriculture.

Definition

Explanation should include the importance of

- industry efforts to expand and improve upon the standards critical for equipment interoperability
    - controller area network (CANBUS)
    - tractors and machinery for agriculture and forestry—serial control and communications data network (ISOBUS)
- industry and nonprofit efforts to build standards for exchange of digital information and file integrity monitoring (FIM) programs
- organizations like Ag Data Coalition and Open Ag Data Alliance to build best practices for data use and privacy.

Process/Skill Questions

- What are standard practices for strengthening CIA? How might those standard practices need to be modified for use in PA?
- Which component of CIA is most important?
- What is CANBUS?

Task Number 64

Identify information management and cyber threats facing embedded and digital tools used by PA.

Definition

Identification should include

- data theft
- illegal capture of resources
- reputation loss

- destruction of equipment
- improper financial advantage over competitors.

Process/Skill Questions

- What are the best practices for information management?
- How can information management be affected by cyber threats?
- What is an embedded system?
- How can loss of reputation negatively affect a business?
- Who should own the infield, yield, and other data generated by PA technology?
- What threats can be embedded in digital tools, and what are the ways to keep them more secure?

Task Number 65

Identify baseline security controls necessary to mitigate threats in PA.

Definition

Identification should include best practices such as the following:

- Implement email and web browser protections (e.g., antivirus programs).
- Limit and control network ports, protocols, and services (e.g., network- and host-based firewalls).
- Inventory and control hardware assets.
- Inventory and control software assets (e.g., patch management, updates, service packs).
- Establish account monitoring and control.
- Separate operational technologies and business operations.

Identification may also include

- data security controls
    - data recovery capabilities
    - data protection
    - understanding data ownership
- incident response and physical security
    - incident response and management
    - implementation of physical controls.

Teacher resource: Center for Internet Security (CIS)

Process/Skill Questions

- How are baseline (i.e., minimal) security controls identified?
- Who might set the standards for baseline security controls in PA?
- How does a host-based firewall improve security in a PA scenario?
- How should a farmer/producer, who has one Internet-linked computer for both personal use and agricultural data/business management, protect the business data from potential corruption or inadvertent loss?

- What practices are included in a comprehensive best management practices (BMP) program for an agribusiness?

Task Number 66

Explain agricultural industry standards related to cybersecurity.

Definition

Explanation should include

- International Organization for Standardization (ISO) technical standards for data and equipment
- privacy/use standards for data generated by PA applications
- transparency standards on how information is generated, used, stored, and shared.

Process/Skill Questions

- What ISO standards apply to the agriculture industry information technology (IT) systems?
- What privacy requirements apply to agriculture IT systems?
- Who defines and regulates cybersecurity standards for the small agricultural business owner?

Task Number 67

Develop best practices to protect and build resilience into PA.

Definition

Development should include

- definition of *resilience*
- critical information security controls (e.g., following state and industry guidelines)
- agricultural industry standards
    - technical ISO standards for data and equipment
    - privacy/use standards for data generated by PA applications
- multiple communication and computer processing paths (e.g., 5G, Wi-Fi, satellite cloud services, edge computing).

Process/Skill Questions

- What does *resilience* mean as it relates to systems that support PA?
- How can resilience be integrated into PA?
- What implications does lack of high-speed Internet in rural areas of the United States have on PA and cybersecurity?

Task Number 68

Identify the Center for Internet Security's (CIS) top 20 critical security controls.

Definition

Identification includes

1. Inventory and control of hardware assets
2. Inventory and control of software assets
3. Continuous vulnerability management
4. Controlled use of administrative privileges
5. Secure configuration for hardware and software on mobile devices, laptops, workstations, and servers
6. Maintenance, monitoring, and analysis of audit logs
7. Email and web browser protections
8. Malware defenses
9. Limitation and control of network ports, protocols, and services
10. Data recovery capabilities
11. Secure configuration for network devices, such as firewalls, routers, and switches
12. Boundary defense
13. Data protection
14. Controlled access based on the need to know
15. Wireless access control
16. Account monitoring and control
17. Implement a security awareness and training program
18. Application software security
19. Incident response and management
20. Penetration tests and red team exercises

Process/Skill Questions

- What benefit do these controls offer to cybersecurity as it relates to PA?
- Why is it important to identify hardware assets in the network?
- Why is it important to limit the use of administrative logins to a system?
- Who is responsible for training a small agribusiness owner to understand, characterize, interpret, and apply the CIS critical security controls?

Task Number 69

Explain methods of building resilience into rural navigation, communication, and embedded tool applications.

Definition

Explanation should include how resiliency manifests in each of the following technologies:

- 5G
- Wi-Fi

- Satellite
- Cloud service
- Edge computing

Process/Skill Questions

- How might the implementation of 5G change the cybersecurity infrastructure in PA?
- How could a malicious actor fool the Global Positioning System (GPS)?
- How could a malicious actor eavesdrop on cellular signals?
- What navigation tools might be available in 10 or 20 years, and how might they be used in agriculture?

Researching Cybersecurity Vulnerabilities in Livestock and Crop Production

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Task Number 70

Explain the technologies used in PA and precision agronomics.

Definition

Explanation should include

- high-precision positioning systems, such as
    - Differential Global Positioning System (DGPS)
    - geographic information system (GIS)
- sensors and remote sensing (e.g., drones)
- automated steering systems
- geomapping (e.g., yield, soil, scouting)
- variable-rate technology (VRT)
- integrated electronic communications.

Teacher Resource: AGFUNDER NEWS: What is Precision Agriculture?

Process/Skill Questions

- How is the GPS used in PA? How is this technology susceptible to cyber threats?
- What level of accuracy is needed in GPS equipment for agricultural applications?
- What types of data are collected from remote-sensing equipment? How is the data used?
- What is the difference between agriculture and agronomics?
- What type of equipment would utilize automated steering systems?
- How can VRT affect the environment?
- What are examples of technology used in agribusiness?
- What is the purpose of GPS?

- What technological advances could benefit agribusiness in the future?
- How have technologies increased efficiency in agribusiness?

Task Number 71

Describe technologies used in greenhouse production.

Definition

Description should include

- irrigation control
- temperature control
- fertilizer injection system
- humidity control
- lighting system
- air exchange
- integrated pest monitoring and control.

Process/Skill Questions

- How could sensor-controlled water, temperature, and lighting systems be used to create a biological or chemical threat for the landscape and nursery industries? What influence might that have on the perception of safety to the public?

Task Number 72

Describe the technologies used in precision livestock farming (PLF).

Definition

Description should include

- high-precision positioning systems (e.g., DGPS, GIS)
- sensors and remote sensing (e.g., drones)
- geomapping (e.g., livestock location)
- VRT
- integrated electronic communications
- water and feed supply
- temperature control
- humidity control
- lighting systems
- air exchanges
- integrated pest monitoring and control.

Process/Skill Questions

- What new technologies monitor the health and well-being of livestock?
- What livestock information might be collected as part of PLF?

Task Number 73

Explain threats to PA technologies used in crop and livestock production.

Definition

Explanation should include

- embedded and connected technologies used to generate data to enhance agricultural and livestock management (e.g., microchipping, tattooing, electronic ear tags, electronic collars)
- PA vulnerabilities to access sensitive data, steal resources, and destroy equipment
- threats to livestock health and safety (e.g., theft, introduction of disease, human or animal attack).

Process/Skill Questions

- How could manipulation of real time kinematic (RTK) positioning affect crop health or production?
- What efficiencies in practice do such technologies introduce? What are the risks of such technologies in terms of additional management and nontraditional, undeveloped skills?

Task Number 74

Explain the vulnerabilities of the technologies used in livestock production.

Definition

Explanation should include vulnerabilities connected to

- technology used to decrease production costs and increase outputs
- technology used to improve input efficiency and collect output data to facilitate future production decisions
- technology used to maximize crop yield and reduce labor costs and time
- data collected at the animal level to recognize sick animals, increase feed efficiency, and save on labor, feed costs, and time
    - automated milking systems
    - electronic feeding
    - health monitoring
        - mechanisms for early detection of health incidents
        - biosurveillance
- infrastructure.

Process/Skill Questions

- What are some vulnerabilities associated with electronic health monitoring systems?
- How can technology improve input efficiency and output efficiency?
- How can technology maximize crop yields and reduce labor costs and time?
- What is biosurveillance, and why is it important to the safety of the U.S. population?

Task Number 75

Explain how PLF improves animal welfare and minimizes negative environmental effects.

Definition

Explanation should include

- the definition of *PLF*
- the importance of collecting relevant information frequently and cost effectively
- identification of current technologies
    - robotic milkers
    - wearable sensors
    - biosensors
    - microphones
    - radio frequency identification (RFID) ear tags
    - feed sensors
- factors and conditions that can be monitored with minimal human intervention
    - individual animal feed consumption
    - feedlot movement
    - temperature
    - lameness
    - animal health status
    - milk production
    - meat composition and quality
    - antibiotic use
    - weight gain
    - livestock waste management
    - environmental data.

Process/Skill Questions

- How can PLF improve milk production among dairy cows?
- How could data be used to influence public perception of animal welfare?

Task Number 76

Identify vulnerabilities in PA technologies used in crop production.

Definition

Identification should include describing how PA technologies can be exploited to cause catastrophic damage to crop and production goals. These technologies include

- GPS
- DGPS
- satellites
- continuously operating reference stations (CORS)
- RTK
- overhead imagery (i.e., multispectral imagery from satellites, planes, and UAS)
- VRT/VRA
- ground-based sensor collection.

Process/Skill Questions

- How could the interaction of electromagnetic radiation with soil and plant material captured as images with sensors mounted on various platforms such as satellites, aircraft, or UAS, be infiltrated, used by a bad actor, and/or exploited?
- How are UAS used to deliver scouting services as part of integrated pest management (IPM)?
- How can sensors, including multispectral, hyperspectral, radar, Light Detection and Ranging (LiDAR), and thermal imaging, provide added value in crop scouting?

Task Number 77

Explain how in-situ monitoring and data collection technologies are used in production agriculture.

Definition

Explanation should include

- precision soil sampling
    - how grid soil sampling and proximal sensors are used in PA to measure or estimate various soil parameters and characteristics at precise locations
    - how the results are used to create maps for activities such as variable-rate applications of fertilizer, variable-planting rates, and other technology that is dependent on soil types
- how proximal sensors are used to determine soil and plant status
- electromagnetic induction (EMI) mapping of apparent electrical conductivity (EC)
- soil-moisture sensors
- visible and near-infrared reflectance spectroscopy (VNIRS).

Process/Skill Questions

- What is needed to develop sensors that are responsive to the variety of conditions but resilient to the challenges of the natural and managed environment of an agricultural or natural resource setting?
- How is EMI used?

Task Number 78

Explain how PA technologies are used on agricultural machinery and equipment.

Definition

Explanation should include

- automatic steering and guidance
- section control
- VRT
    - prescription-based
    - sensor-based
- yield monitors
- section and row technologies
- telematics machinery operating information
- LiDAR technology
- crop sensors.

Process/Skill Questions

- How are PA technologies used on agricultural machinery and equipment?
- What are recommended practices for configuring and managing remote access for control systems?
- What are telematics systems, and how can the use of telematics increase productivity and maximize efficiency?

Researching Future Trends in Cybersecurity and the Use of Artificial Intelligence (AI) in Food and Agriculture

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Task Number 79

Identify how ML algorithms can be integrated into decision-support tools in PA.

Definition

Identification should include how neural networks, related software tools, and other related technologies can be applied.

Process/Skill Questions

- What are ML algorithms?
- How is ML related to AI?
- What are the benefits and drawbacks in relation to ML algorithms?
- What biological or environmental conditions contribute to variability that might obscure the signals needed for interpretation and decision-making?

Task Number 80

Explain how DSS are used in agriculture.

Definition

Explanation should include

- sensors
- cameras
- phones
- tablets
- in-cab virtual terminals.

Process/Skill Questions

- What DSS is typically used in food and agriculture industries?
- How are sensors used to collect data?

Task Number 81

Explain the advantages and disadvantages of the Internet of Things (IoT).

Definition

Explanation should include advantages (e.g., convenience, instant information, increased connectivity, feeling of safety) and disadvantages (e.g., increased vulnerability to hacking).

Process/Skill Questions

- How does the IoT increase vulnerability?
- How could the IoT disrupt life?
- How will the IoT affect agriculture?

Task Number 82

Research AI-driven technologies in agriculture and how they help increase food production with fewer resources.

Definition

Research should include

- harvest prediction
- pest detection
- resource sustainability
- production efficiency.

Process/Skill Questions

- How will the agricultural production industry be transformed by data science and AI?
- How can one use a smart phone to control what happens to a crop in the field?

Researching Potential Threats and Risks in Food and Agriculture

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Task Number 83

Explain threats to food and animal feed processing and manufacturing.

Definition

Explanation should include

- lack of proper supply chain management (SCM) for livestock feed products
- computer tracking system failures
- feed ingredients from countries with a high threat of disease agents.

Process/Skill Questions

- How could disruption of agricultural exports threaten economic security?
- How could someone utilize the dependence on unscreened seasonal workers to gain access to the food supply?
- What is nonrepudiation, and how does it help secure chain of custody?
- How could disruption of computer tracking systems lead to distribution failure?
- How is a fresh produce supply chain currently monitored? Where are the gaps in the system?

Task Number 84

Explain how facilities engaged in the manufacture of food and feed for animals are vulnerable to cyberattack.

Definition

Explanation should include vulnerabilities in

- the manufacture of feed for livestock, dairy, poultry, and specialty animals
- the manufacture of grain and meat feed, supplements, concentrates, mixes, and other animal feed
- the manufacture of pet food
- on-site feed mills
- off-site feed mills
- how hackers could infiltrate supply chains to disrupt the transportation of supplies/goods to locations
- how hackers could manipulate programmable controllers and introduce harmful chemicals into the food supply or alter mineral balances in animal feedstuffs.

Process/Skill Questions

- What are the risks to animal food and feed manufacturing facilities?
- What are the vulnerabilities of animal food and feed manufacturing facilities?
- What are the assets affected?
- What effect would a cyberattack have on facilities engaged in the manufacture of feeds for livestock, dairy, poultry, and specialty animals?
- What is the difference between an on-site feed mill and an off-site feed mill?
- What is the benefit of an on-site feed mill?
- What are the cyberattack risks to these facilities?

Task Number 85

Develop a mitigation plan to address cybersecurity threats related to agricultural production or processing facilities.

Definition

Development should include

- using mitigation standards (e.g., Consumer Technology Association (CTA), Common Criteria)
- using a risk management framework
- securing access to facilities
- acknowledging the effects of control system manipulation
    - heating, ventilation, and air conditioning (HVAC)
    - water circulation
    - lighting
- following security systems and protocols
- recognizing routes of contamination.

Teacher Resource: [The Stuxnet Attack on Iran's Nuclear Plant, Business Insider]

Process/Skill Questions

- What are the weaknesses in various agricultural facilities?
- How can security in agricultural facilities be improved to decrease the threat of cyberterrorism?
- What is concentrated animal feeding operation (CAFO)? What are the potential vulnerabilities in their support systems?
- What are some recent innovations to use system controls?

Task Number 86

Explain how to mitigate cybersecurity threats related to agricultural equipment and machinery.

Definition

Explanation should include

- equipment vulnerable to attack
    - pumps
    - irrigation systems
    - drones
    - automated equipment
    - ventilation
- methods of mitigation
    - physical security
        - fences
        - proximity badges
        - restricted access
        - principle of least privilege
    - passwords
    - biometric access.

Process/Skill Questions

- What types of farms utilize irrigation systems?
- What purpose could drones serve in the agricultural production community?
- What are current Federal Aviation Administration (FAA) rules for drone use?

Task Number 87

Propose methods to ensure agricultural equipment and machinery are resistant to cyberattack.

Definition

Proposal should include

- analysis of the current platform safeguards
- discussion of the platform's ability to upgrade
- presentation showing the steps required for the upgrade
- advantages and disadvantages of upgrading.

Process/Skill Questions

- How can drones be made resistant to cyberattacks?
- What security system is in place with standard drones?
- Who should have access and control over high-value, next-generation machinery?
- What are the advantages and disadvantages of completely automating an agricultural system?

Task Number 88

Explain the importance of accuracy of information derived from sensor-based systems.

Definition

Explanation should include

- testing sensors for accurate feedback
- using secure physical sensors
    - self-destruction
    - cryptographically secure sensor-based system Federal Information Processing Standard (FIPS) 140-2
- inspecting sensors
- identifying common causes for faulty readings
- describing production decision outcomes based on information derived from sensor-based systems
- describing how a farm management information system (FMIS) is used to collect, process, store, and disseminate data to support production management.

Process/Skill Questions

- What is an example of a sensor-based system?
- How can farmers use sensor-based systems to make production decisions?
- What are the benefits of using a FMIS?

Task Number 89

Explain how social engineering can promote cybersecurity intrusion.

Definition

Explanation should include

- shoulder surfing
- backdoor trojans
- masquerading
- dumpster diving
- familiarity exploit
- phishing
- the need for email and browser protections
- the importance of controlling network ports and hardware/software assets.

Process/Skill Questions

- What is social engineering?
- What are ways to protect an organization against phishing attacks on employees?
- How does phishing trick people into giving away data?
- Why are personalized user credentials and permissions essential in preventing cyberattacks?
- Why is it dangerous to open attachments in emails from senders not known by the company or representative?
- How do piggybacking and tailgating depend on human decency and/or common manners (e.g., holding a door open for someone carrying a large package) to circumvent restricted access controlled by electronic devices?

Task Number 90

Evaluate animal, plant, soil, and/or mechanical test results to identify cybersecurity intrusion.

Definition

Evaluation should include

- examining data before, during, and after the test
- identifying anomalies in the data collected
- explaining the chain of custody for the physical material and the data
- identifying the value of the data to an intruder
- identifying at what point the data is at risk during the testing.

Process/Skill Questions

- What are the risks?
- What are the vulnerabilities?
- What are the assets affected?
- How would an animal, plant, soil, and/or mechanical test reveal a cyber intrusion?

Researching Cybersecurity in Agricultural Marketing and Distribution

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Task Number 91

Explain threat vectors in the wholesale and retail distribution sectors of agricultural and food products industries.

Definition

Explanation should include

- describing chain of custody threat vectors
- describing threat vectors in the tracking of commodities
- identifying responsible parties on the receiving end.

Process/Skill Questions

- What are the risks to distribution of agricultural and food products?
- What are the vulnerabilities in the chain of custody?
- What are the vulnerabilities of the distribution of agricultural and food products? What are the assets affected?
- What is the effect of trade policies on growing and producing agricultural products?
- Where do various wholesalers buy their products, and to whom do they sell?
- What is the difference between wholesale and retail distribution?

Task Number 92

Explain methods of distribution disruption.

Definition

Explanation should include

- methods of distribution (i.e., transportation)
- methods of disruption
    - DoS
    - viruses
    - worms
    - malware
    - system hacking and data manipulation
    - hacking into supply routes and logistics management

- potential miscommunication issues in international trade
- false advertising.

Teacher resource: Vulnerabilities in the Food Supply Chain, the New Hidden Systemic Risk, World News

Process/Skill Questions

- How are agricultural food products transported?
- How would false advertising pose a potential threat to the distribution sector?
- How is the transportation network susceptible to cyberattack?
- Why is it important to protect against false trade numbers?

Task Number 93

Create a mitigation plan for threat vectors in the agricultural product transportation systems.

Definition

Creation of a mitigation plan should include identification of threat vectors in the following areas:

- Road transport, including trucks, truck terminals, truck wash and disinfection facilities, highways, bridges, and tunnels
- Rail transport, including rail tank cars, rail car loading/unloading terminals, rail car wash and disinfection facilities, rail rights-of-way, railroad bridges, and railroad tunnels
- Maritime transport, including barges, loading/unloading piers, waterways, canals, and ports
- Air transport, including aircraft and airports

Process/Skill Questions

- What are the risks to agricultural product transportation systems?
- What are the vulnerabilities of agricultural product transportation systems?
- What are the assets affected?
- What type of products require maritime transport?
- How would disruption of maritime transport affect the food supply sector?
- What regulations are in place to ensure security while transporting goods via air?
- How might the risk of cyberattacks be elevated in global transportation vs. domestic transportation?

Maintaining Cybersecurity in Agricultural Business Management and Financing

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Task Number 94

Explain how cyber intrusion might affect an agricultural enterprise.

Definition

Explanation could include describing

- how the theft of data through DSS could affect the reputation of a business
- the result of foreign access to UAS data
- how falsified data can disrupt the crop or livestock sectors
- how integrating rogue data into a network can damage a crop or herd
- timing equipment availability.

Process/Skill Questions

- How could rogue data damage a crop or herd?
- How could foreign access to UAS data present problems?

Task Number 95

Design a plan to use management controls to secure information and operations and prevent security breaches.

Definition

Design should include setting a security policy to

- ensure individual accountability
    - user authentication
    - auditing account services
        - internal
        - external
- ensure separation of duty
    - user authorization
    - access control mechanisms.

Process/Skill Questions

- What are the assets that could be affected by a security breach?
- Why are password protocols critical in preventing security breaches?
- Why is it important to secure information?
- What are some consequences of failure to develop policies and controls to ensure the availability and security of computer-based systems?

Task Number 96

Create a secure customer relationship management (CRM) database.

Definition

Creation should include

- the CIA triad
- case studies
    - Target (2013)
    - Equifax (2017).

Process/Skill Questions

- Why is it essential for businesses to ensure customer data confidentiality?
- What were the weaknesses in the Target (2013) and Equifax (2017) cyberattacks?
- How does one create a secure CRM database?

Task Number 97

Identify cybersecurity threats facing financial institutions and the effect on the agricultural business sectors.

Definition

Identification should include

- threat vectors
    - identity theft
    - account takeover
    - synthetic fraud
    - ransomware
    - social engineering
- management tools to mitigate cybersecurity threats
    - identification verification
    - biometrics and liveness detection
    - anomaly detection
    - simulated attacks
    - backup and disaster recovery as a service (DRaaS)
    - employee training.

Process/Skill Questions

- What is identity theft?
- How can one guard against identity theft at a personal and business level?
- What is the importance of conducting a cybersecurity readiness audit?

- Who should perform audits and how often?
- What are the risks of financial management tools?
- What are the vulnerabilities of financial management tools?
- What are the assets affected?
- Why are humans the weak link in business data protection?
- What is the most targeted industry of ransomware?
- How could a data breach at a financial institution affect an agribusiness?

Task Number 98

Develop a cyber plan to safeguard data.

Definition

Development should include

- identifying the type of data
- identifying how the data is handled and protected
- determining who has access to the data and under what circumstances
- developing a privacy policy
- ensuring data protection protocols
- creating layers of security
- controlling access to data
- securing data
- creating a plan in case of data loss or theft.

Process/Skill Questions

- What is the importance of conducting a cybersecurity readiness audit?
- What are the risks?
- What are the vulnerabilities?
- What are the assets affected?
- How are spreadsheets used in agribusiness?
- How can one identify software suited to agribusiness needs?
- How are databases used in agribusiness?
- When is email more appropriate for communication than speaking in person or via telephone?

Task Number 99

Explain how to protect a business against online scams and fraud.

Definition

Explanation should include

- describing social engineering
- sharing personal information or account details through email, social networks, or other online venues

- recognizing phishing
- recognizing fake antivirus software
- protecting against malware
- protecting against malicious software
- protecting against spyware
- protecting against adware.

Teacher resources:

STOP. THINK. CONNECT, Department of Homeland Security

Cyber Security Planning Guide, Federal Communications Commission

Process/Skill Questions

- What are the risks of backing up and restoring files?
- What are the vulnerabilities of backing up and restoring files?
- What are the assets affected?
- Why is it important to back up one's work?
- What are examples of methods or media used to back up work?
- What are the consequences of failing to back up work?
- How can one ensure that saved work is secure?
- How can data be restored on a computer?

Task Number 100

Research the implications of intellectual property (IP) theft.

Definition

Explanation should include the

- definition of *intellectual property (IP)*
- individual contributions to corporate development
- issues of ownership
- long-term effects (e.g., massive revenue losses, cascade effect)
- short-term effects (e.g., lawsuits).

Process/Skill Questions

- What are the possible issues of ownership surrounding IP?
- What is the cascade effect?
- Why would a cybercriminal use malware to steal agricultural IP? When is it considered a crime?

Task Number 101

Explain key threats perpetrated by threat actors to manipulate the commodities market.

Definition

Explanation should include the

- definition of *commodity*
- manipulation of supply and demand curves
- manipulation of trade data
- manipulation of producer
- futures and securities contract activities
- data security of the markets.

Process/Skill Questions

- What is the result of supply/demand curve manipulation?
- What are the indicators of commodity stock manipulation?

Task Number 102

Explain national and international cybersecurity laws and policies related to agricultural enterprises.

Definition

Explanation should include information related to

- national law
- international law
- jurisdiction
- privacy policies
- IP
- cyber crime
- United States Department of Homeland Security (DHS)
- the National Conference of State Legislatures (NCSL) Agriculture Task Force
- 2017 Securing our Agriculture and Food Act.

Teacher resource: Securing our Agriculture and Food Act, The National Law Review

Process/Skill Questions

- What are the Food and Drug Administration (FDA), the Office of Criminal Investigations (OCI), and the USDA's Office of the Inspector General (OIG), respectively, responsible for when evaluating threat information?
- How does the National Counterterrorism Center (NCTC) respond to threats in the food and agriculture sector?

- Why are OCI and OIG agents involved in the Joint Terrorism Task Force (JTTF)?
- What is the role of the Federal Bureau of Investigations (FBI) in the enforcement of national and international cybersecurity laws and policies?
- What is the 2017 Securing our Agriculture and Food Act? Who is responsible for funding it? What were the results of its creation?

Task Number 103

Explain the importance of securing a company's network.

Definition

Explanation should include

- identifying all devices and connections on the network
- setting boundaries between the company's systems and the systems of others
- enforcing controls to ensure that unauthorized access, misuse, or DoS events can be stopped
- describing how to secure internal network and cloud services
- describing how to develop strong password policies
- securing and encrypting a company's Wi-Fi
- encrypting sensitive company data
- updating applications
- securing remote access
- creating a safe-use flash drive policy
- describing threats in email use and mobile devices.

Process/Skill Questions

- Why is it important to hold down the Shift key when inserting a flash drive?
- Why should one never put any unknown flash drive or USB into his/her computer?
- Why is it essential to encrypt a company's Wi-Fi?

Task Number 104

Explain the costs associated with a data breach, security incident, privacy violation, or phishing/skimming incident.

Definition

Explanation may include

- describing how the unintentional disclosure of personally identifiable information (PII) stemming from loss or theft of digital or printed information can be used to commit identity theft, tax fraud, medical and financial fraud, and theft
- describing how the compromise or disruption of business IT systems can result in a DoS attack, theft of IP, cyber extortion of business information, or a disruption of business service
- discussing forms of privacy violation and its consequences

- discussing phishing/skimming attacks and their consequences.

Process/Skill Questions

- What are the public costs associated with litigation in cybersecurity cases?
- What are examples of relevant federal cases and associated verdicts or precedents?
- What were the causes and effects of the Equifax data breach?

Exploring Cybersecurity Careers in the Agriculture, Food, and Natural Resource Industries

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Task Number 105

Research careers associated with cybersecurity in agriculture.

Definition

Research should include

- federal intelligence agencies
- state and local opportunities
- international trade organizations
- companies specializing in cybersecurity in the agriculture sector
- software engineers
- data scientists.

Process/Skill Questions

- What state and local agencies have career opportunities in cybersecurity?
- What federal intelligence agencies have career opportunities related to cybersecurity?
- What does a cybersecurity engineer do?

Task Number 106

Research educational requirements for cybersecurity jobs in agriculture.

Definition

Research should include

- bachelor's degree in a computer-related field
- credentials (e.g., Cisco Certified Network Associate [CCNA])
- key skills (e.g., analytical, written and verbal communication, problem-solving).

Process/Skill Questions

- What are the educational requirements for jobs in cybersecurity?
- What are the key skills needed for someone wishing to pursue a career in cybersecurity?
- What college-level courses are relevant to the study of cybersecurity?
- What colleges offer programs of study related to cybersecurity?

Task Number 107

Conduct research on cybersecurity in the food, agriculture, and natural resource industries.

Definition

Conducting research should include

- choosing a topic
- identifying reliable sources (e.g., universities, extension programs)
- exploring different sources
- summarizing findings.

Process/Skill Questions

- How does one determine which website(s) to use for research?
- What are legal issues regarding the use of website content?
- How can one evaluate the credibility of web resources?
- What are some reliable and trustworthy resources for agricultural research?
- What are other sources of information in addition to the Internet?

Task Number 108

Conduct an oral presentation on a subject related to cybersecurity in the food and agriculture industries.

Definition

Conducting a presentation should include

- researching an assigned topic
- delivering an electronic presentation, using presentation software, graphics, and other visual enhancements
- practicing elements of effective public speaking (e.g., voice level, posture, eye contact).

Teacher resource: Prepared Public Speaking, National FFA Association

Process/Skill Questions

- What are examples of presentation software?
- What are the characteristics of an effective public speaker?
- Why should electronic equipment be tested prior to a presentation?
- How can one become a more effective speaker?

SOL Correlation by Task

39	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.	English: 11.3, 11.5, 12.3, 12.5
40	Participate in an SAE.	English: 11.5, 11.8, 12.5, 12.8
41	Identify the benefits and responsibilities of FFA membership.	English: 11.5, 11.6, 11.7, 11.8, 12.5, 12.6, 12.7, 12.8
42	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.	English: 11.5, 12.5 History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11
43	Apply for an FFA degree and/or an agricultural proficiency award.	English: 11.5, 12.5
44	Explain the steps required for logical problem solving.	English: 11.5, 12.5 History and Social Science: VUS.8, WHII.4, WHII.8 Mathematics: COM.1, COM.4, COM.16
45	Develop a graphic or concept map for the logical flow of information among devices within a network.	English: 11.2, 12.2 History and Social Science: VUS.14, WG.17, WHII.14
46	Explain the communication processes on a machine and across networks.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
47	Compare wired and wireless networks.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
48	Create wired networks.	History and Social Science: VUS.14, WG.17, WHII.14
49	Create wireless networks.	History and Social Science: VUS.14, WG.17, WHII.14
50	Compare networking conceptual models.	English: 11.5, 12.5

		History and Social Science: VUS.14, WG.17, WHII.14
51	Explain connection-oriented and connectionless protocols.	English: 11.5, 12.5
52	Explain services, their relationship to the OSI model, and potential vulnerabilities.	English: 11.3, 11.5, 12.3, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
53	Explain how confidentiality is achieved through cryptology.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
54	Generate key pairs for data encryption.	History and Social Science: VUS.14, WG.17, WHII.14
55	Use key pairs to encrypt/decrypt data.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
56	Explain how to generate a symmetric key.	English: 11.5, 12.5
57	Explain certificates and public keys.	English: 11.5, 12.5
58	Identify groups affected by the use or misuse of PA.	English: 11.5, 11.8, 12.5, 12.8 History and Social Science: VUS.14, WG.17, WHII.14
59	Explain the confidentiality, integrity, and availability (CIA) triad model of information security.	English: 11.3, 11.5, 12.3, 12.5
60	Identify key threats to confidentiality.	English: 11.5, 12.5
61	Identify key threats to integrity.	English: 11.5, 12.5
62	Identify key threats to availability.	English: 11.5, 12.5
63	Explain methods for strengthening the CIA triad as it applies to security in food and agriculture.	English: 11.5, 11.8, 12.5, 12.8
64	Identify information management and cyber threats facing embedded and digital tools used by PA.	English: 11.5, 12.5 History and Social Science: WHII.14
65	Identify baseline security controls necessary to mitigate threats in PA.	English: 11.5, 12.5 History and Social Science: WHII.14
66	Explain agricultural industry standards related to cybersecurity.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
67	Develop best practices to protect and build resilience into PA.	English: 11.3, 11.5, 11.8, 12.3, 12.5, 12.8 History and Social Science: VUS.14, WG.17, WHII.14
68	Identify the Center for Internet Security's (CIS) top 20 critical security controls.	English: 11.2, 11.5, 11.8, 12.2, 12.5, 12.8 History and Social Science: VUS.14, WG.17, WHII.14

69	Explain methods of building resilience into rural navigation, communication, and embedded tool applications.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
70	Explain the technologies used in PA and precision agronomics.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
71	Describe technologies used in greenhouse production.	English: 11.5, 12.5
72	Describe the technologies used in precision livestock farming (PLF).	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
73	Explain threats to PA technologies used in crop and livestock production.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
74	Explain the vulnerabilities of the technologies used in livestock production.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
75	Explain how PLF improves animal welfare and minimizes negative environmental effects.	English: 11.3, 11.5, 12.3, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
76	Identify vulnerabilities in PA technologies used in crop production.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
77	Explain how in-situ monitoring and data collection technologies are used in production agriculture.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
78	Explain how PA technologies are used on agricultural machinery and equipment.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
79	Identify how ML algorithms can be integrated into decision-support tools in PA.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
80	Explain how DSS are used in agriculture.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
81	Explain the advantages and disadvantages of the Internet of Things (IoT).	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14

82	Research AI-driven technologies in agriculture and how they help increase food production with fewer resources.	English: 11.8, 12.8 History and Social Science: VUS.14, WG.17, WHII.14
83	Explain threats to food and animal feed processing and manufacturing.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
84	Explain how facilities engaged in the manufacture of food and feed for animals are vulnerable to cyberattack.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
85	Develop a mitigation plan to address cybersecurity threats related to agricultural production or processing facilities.	English: 11.1, 11.5, 12.1, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
86	Explain how to mitigate cybersecurity threats related to agricultural equipment and machinery.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
87	Propose methods to ensure agricultural equipment and machinery are resistant to cyberattack.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
88	Explain the importance of accuracy of information derived from sensor-based systems.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
89	Explain how social engineering can promote cybersecurity intrusion.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
90	Evaluate animal, plant, soil, and/or mechanical test results to identify cybersecurity intrusion.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14 Mathematics: AFDA.6, AFDA.7, AFDA.8, PS.1*, PS.2*, PS.4*, PS.10*
91	Explain threat vectors in the wholesale and retail distribution sectors of agricultural and food products industries.	English: 11.5, 12.5 History and Social Science: WG.17
92	Explain methods of distribution disruption.	English: 11.5, 12.5 History and Social Science: WG.17
93	Create a mitigation plan for threat vectors in the agricultural product transportation systems.	English: 11.1, 12.1 History and Social Science: WG.17

94	Explain how cyber intrusion might affect an agricultural enterprise.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
95	Design a plan to use management controls to secure information and operations and prevent security breaches.	English: 11.1, 12.1 History and Social Science: VUS.14, WG.17, WHII.14
96	Create a secure customer relationship management (CRM) database.	
97	Identify cybersecurity threats facing financial institutions and the effect on the agricultural business sectors.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
98	Develop a cyber plan to safeguard data.	English: 11.1, 11.5, 12.1, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
99	Explain how to protect a business against online scams and fraud.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
100	Research the implications of intellectual property (IP) theft.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
101	Explain key threats perpetrated by threat actors to manipulate the commodities market.	English: 11.3, 11.5, 12.3, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
102	Explain national and international cybersecurity laws and policies related to agricultural enterprises.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
103	Explain the importance of securing a company's network.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
104	Explain the costs associated with a data breach, security incident, privacy violation, or phishing/skimming incident.	English: 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
105	Research careers associated with cybersecurity in agriculture.	English: 11.5, 11.8, 12.5, 12.8 History and Social Science: VUS.14, WG.17, WHII.14
106	Research educational requirements for cybersecurity jobs in agriculture.	English: 11.8, 12.8

107	Conduct research on cybersecurity in the food, agriculture, and natural resource industries.	English: 11.8, 12.8 History and Social Science: VUS.14, WG.17, WHII.14
108	Conduct an oral presentation on a subject related to cybersecurity in the food and agriculture industries.	English: 11.8, 12.8 History and Social Science: VUS.14, WG.17, WHII.14

Teacher Resources

The Cybersecurity in Food and Agriculture, Advanced course framework relies heavily on the article, Threats to Precision Agriculture, written by the 2018 Public-Private Analytic Exchange Program with the support of the Department of Homeland Security (DHS) and which provides the following disclaimer: “This document is provided for educational and informational purposes only. The views and opinions expressed in this document do not necessarily state or reflect those of the U.S. Government or the Public-Private Analytic Exchange Program participants, and they may not be used for advertising or product endorsement purposes. All judgments and assessments are solely based on unclassified sources and are the product of joint public and USG efforts.”

AFA CyberPatriot is the National Youth Cyber Education Program created by the Air Force Association to inspire K-12 students toward careers in cybersecurity or other science, technology, engineering, and mathematics (STEM) disciplines critical to our nation's future. At the core of the program is the National Youth Cyber Defense Competition, the nation's largest cyber defense competition that puts high school and middle school students in charge of securing virtual networks.

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Cloud Essentials Certification Examination
- IC3 Digital Literacy Certification Examination
- IT Fundamentals+ Certification Examination
- Microsoft Technology Associate (MTA) Examinations
- Security Pro Certification Examination
- Security+ Certification Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Cybersecurity Fundamentals (6302/36 weeks)
- Cybersecurity in Food and Agriculture (8074/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	**Occupations**
Agribusiness Systems	**Agricultural Commodity Broker** **Agricultural Economist**

Career Cluster: Business Management and Administration	
Pathway	**Occupations**
Administrative Support	**Administrative Assistant** **Computer Operator** **Data Entry Specialist** **Information Assistant** **Legal Assistant** **Management Analyst**
Business Information Management	**Account Executive** **Administrative Assistant** **Applications Integrator** **Budget Analyst** **Chief Executive Officer** **Communications Equipment Operator** **Computer Support Specialist**

Career Cluster: Business Management and Administration	
Pathway	**Occupations**
	Cost Analyst **Customer Service Representative** **Data Entry Specialist** **Database Analyst** **Desktop Publisher** **Executive Assistant** **Financial Analyst** **Front Office Assistant** **Information Assistant** **Legal Assistant** **Maintenance Technician** **Management Analyst** **Market Research Analyst** **Marketing Manager** **Records Processing Assistant** **Software Test Engineer** **Systems Analyst** **Technical Writer** **Word Processor**
General Management	**Management Analyst**
Human Resources Management	**Compliance Officer**
Operations Management	**Administrative Services Manager** **Billing Manager** **Chief Operating Officer** **General Manager** **Internet Entrepreneur** **Management Analyst**

Career Cluster: Education and Training	
Pathway	**Occupations**
Teaching and Training	**Training Consultant/Training Specialist**

Career Cluster: Government and Public Administration	
Pathway	**Occupations**
National Security	**Combat Specialty Officer** **Cyber Defense Analyst** **Military Enlisted Personnel** **Military Intelligence Specialist** **Military Officer** **Special Forces Personnel**
Public Management and Administration	**Government Accountant/Auditor**
Regulation	**Compliance Officer** **Cyber Crime Investigator** **Environmental Compliance Inspector** **Financial Analyst** **Financial Manager** **Privacy Compliance Manager**

Career Cluster: Government and Public Administration	
Pathway	**Occupations**
Revenue and Taxation	**Compliance Officer** **Financial Analyst** **Financial Manager**

Career Cluster: Information Technology	
Pathway	**Occupations**
Information Support and Services	**Account Executive** **Administrative Assistant** **Applications Integrator** **Communications Equipment Operator** **Computer Numerical Control Programmer (CNC Programmer)** **Computer Support Specialist** **Computer Systems Engineer, Architect** **Customer Service Representative** **Data Entry Specialist** **Data Modeler** **Database Administrator** **Database Analyst** **Executive Assistant** **Geographic Information Systems (GIS) Technician** **Information Systems Analyst** **Information Systems Security Developer** **Information Systems Security Manager** **Instructional Coordinator** **Internet Entrepreneur** **Maintenance Technician** **Network Systems and Data Communication Analyst** **Software Test Engineer** **Systems Analyst** **Technical Writer** **Word Processor**
Network Systems	**Computer and Information Systems Administrator** **Computer Operator** **Computer Security Specialist** **Computer Software Engineer** **Computer Support Specialist** **Computer Systems Engineer, Architect** **Database Analyst** **Information Security Analyst** **Network and Computer Systems Administrator** **Network Architect** **Network Systems and Data Communication Analyst** **Radio, TV Broadcast Technician** **Software Test Engineer** **Sound Engineering Technician** **Systems Analyst** **Telecommunications Equipment Installer, Repairer** **Telecommunications Specialist**
Programming and Software Development	**Applications Integrator** **Computer Software Engineer** **Informatics Nurse Specialists** **Multimedia Artist, Animator**

Career Cluster: Information Technology	
Pathway	**Occupations**
	Network Systems and Data Communication Analyst **Programmer** **Project Manager** **Software Applications Engineer** **Software Test Engineer** **Systems Analyst** **Web Developer**
Web and Digital Communications	**Applications Integrator** **Computer Support Specialist** **Computer Systems Engineer, Architect** **Game Designer, Programmer** **Graphic Designer** **Instructional Coordinator** **Multimedia Artist, Animator** **Project Manager** **Radiologic Technologist, Radiographer** **Software Test Engineer** **Systems Analyst** **Web Developer** **Webmaster**

Career Cluster: Law, Public Safety, Corrections and Security	
Pathway	**Occupations**
Legal Services	**Cyber Legal Advisor**

Career Cluster: Manufacturing	
Pathway	**Occupations**
Manufacturing Production Process Development	**Network Designer** **Precision Inspector, Tester, or Grader** **Production Manager** **Programmer** **SPC (Statistical Process Control) Coordinator**
Quality Assurance	**Calibration Technician** **Precision Inspector, Tester, or Grader** **Quality Control Technician** **SPC (Statistical Process Control) Coordinator**

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	**Computer Hardware Engineer** **Computer Programmer** **Computer Software Engineer**

Career Cluster: Transportation, Distribution and Logistics	
Pathway	**Occupations**
Logistics Planning and Management Services	**Logistics Analyst** **Logistics Engineer** **Logistics Manager**