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| **Grade: 9 - 12** | **Unit: Networking** |
| **N3: Exploring Network layers by deconstructing WiFi packets** |
| **Topic:** * Network Layers of TCP/IP Stack
* IP Packet headers
 | **Materials:*** Computer-less Network Activity:
	+ Box of Envelopes (50)
	+ Manilla Envelopes (20)
	+ Slips of “Packet” paper (50)
	+ Class set of “Node” Instructions
* Class set of computers, with:
	+ Internet connection
	+ [Wireshark/tshark](https://www.wireshark.org/download.html) installation
* Network stack diagram worksheets
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| **Science & Engineering Practices (SEPs)** | **Disciplinary Core Ideas (DCIs)** | **Crosscutting Concepts (CCs)** |
| * **Not applicable**
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 | * **Not applicable**
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| **APCSP Enduring Knowledge Standards:*** EK6.2.2F The Internet is a packet-switched system through which digital data is sent by breaking the data into blocks of bits called packets, which contain both the data being transmitted and control information for routing the data.
* EK6.2.2G Standards for packets and routing include transmission control protocol/Internet protocol (TCP/IP)
* EK6.2.2J The bandwidth of a system is a measure of bit rate -- the amount of data (measured in bits) that can be sent in a fixed amount of time.

**CSTA K-12 Computer Science Standards*** 3A-CS-01 Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects.
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| **Essential Question:** * What roles do different layers of the TCP/IP network stack play in transmitting data over a network?
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| **Learning Target** | SWBAT explain the merits of the TCP/IP model of the Network Stack. |
| **Engage** | **(JOURNAL)*** Students answer the following prompt in their notebooks:

.“In the win”* After 2 minutes, students share their answers with a partner.
* Choose 3 groups to share their answers.
* Highlight answers that include:
	+ Starting Location
	+ Ending Location
	+ Intermediate stops
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| **Explore** | **(COMPUTER-LESS NETWORK ACTIVITY V3: NETWORK STACK)*** This is a remix of the Computer-less Network Activity from the previous lesson, with an additional emphasis on the layers of data the packet holds.
* Prepare the manilla envelopes ahead of time by drawing a t-chart on them with labels: “TO location”, “FROM location”
* Pass out modified Instructions to students for Version 3.
* Designate roles. (You can mix up who is the Client and Server to give more kids a chance to be active.)
	+ “TCP Client” -1
	+ “UDP Client” -1
	+ “Dead Nodes” - designate at least 2
	+ “Client” - 1 or 2
	+ “Routers” - everyone else
* Before you start, come up with a location scheme that the class can use to identify each seat in the classroom (for example: (1,1) could represent row1, seat1)
* Run the new network.
* Make sure the clients are using the manilla envelope and writing the Location on it.
* Each router should be crossing off the old TO/FROM coordinates and writing new ones for every single pass of the envelope. (This activity should be moving much slower than the previous ones.)
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| **Explain** | * “How was the information packet different today than yesterday?”
* Explain about Physical addresses on a network:
	+ “MAC Address” = a 12 digit hexadecimal number uniquely assigned to every actual component on a network
* Introduce 5-layer (or TCP/IP) model of a network:
	+ [“What is TCP/IP model video?” (1:45)](https://www.youtube.com/watch?v=pfQ3ORRQUH0)
	+ [“TCP/IP Protocol” video (4:03)](https://www.youtube.com/watch?v=KEWe-5Bk3Q0)
* Provide definitions for the TCP/IP 5-Layer Network Stack diagram:
	+ “Physical Layer”
	+ “Link Layer”
	+ “IP Layer”
	+ “Transmission Layer”
	+ “Application Layer”
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| **Extend**  | **(DECONSTRUCTING PACKET HEADER DATA)*** Students use Wireshark to capture several packets
* Students use Wireshark Analysis tool to visualize the binary > hex > ASCII of the data
* Students explore which bytes of the packet represent various parts of the header (frame, mac address, IP address, SSL?, data payload)
* Choose a HTTP packet that originated from your computer, complete sketch of Network Stack using data from packet.
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| **Evaluate** | * Discussion with Students:
	+ 2 Student groups share how they were able to find network stack data.
* Exit Slip:
	+ “Why are MAC addresses needed to be included in packet headers?”
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| **Differentiation** |  |