Health Sciences

By Jobs for the Future (JFF) and Beyond School Bells (BSB)

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Afterschool Curriculum:

This curriculum was developed by Jobs for the Future (JFF) in collaboration with Beyond School Bells (BSB).

These Health Science lessons provide fun, hands-on activities to engage students in learning about bones, blood, handwashing, and more! These lessons also allow for a natural connection to health science careers.

We encourage you to be intentional about connecting these lessons to health careers by partnering with real health professionals, sharing the JFF career posters with students (included in this curriculum packet), and giving students time to explore topics in which they have a particular interest.

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Overview

An eight-lesson learning unit developed by Jobs for the Future (JFF)

Notes to the Teacher/Site Director:

- **This curriculum is meant to be flexible.** Feel free to change the order of lessons, skip lessons, and/or combine lessons together!
- We highly recommend **bringing in community members with jobs in the health science field** to share about their jobs with students. This will help students see the possibilities of health science careers in their own communities.
- Several of the lessons have **highlighted "Career Connections" with corresponding posters and videos** to go along with them. Please use this resource to strengthen the career exploration aspect of these lessons.

L1. Introduction – Health Professional Gallery Walk and/or Health Professional Panel

What might interest me in the allied health sciences?

L2. Respiration Part One – Building a Lung Model

How do our lungs work?

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What is blood?

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What is a blood type? When donating blood and receiving blood, why does blood type matter?

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How does skin heal? How do surgeons suture wounds?

L8. Hand Washing Lab – Contamination Lab

How does disease spread?

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L1 Introduction – Health Professional Gallery Walk and/or Health Professional Panel

Big Questions: What might interest me in the allied health sciences?

Setting the Stage: When I say Health Science what do you think? Often people think "doctors and nurses," but the Health Science sector is much more diverse. Some allied health professionals deal with emergencies and trauma—blood and guts! Other professionals deal with advanced equipment and technology—no blood in sight. Some allied health professionals enter the field with a certificate that took 6 months to obtain, others have a degree that required twelve years of effort. Whether you like fast paced and high-pressure work or more relaxed customer care, the Allied health field offers something for everyone—and much opportunity today and tomorrow. Let's look at snapshots of the diversity of the Allied Health field.

Activity:

1. Read "Setting the Stage"
2. Split students into small groups of 2-3 and assign each group to a career poster to start with.
3. Give students 3-5 minutes to look at their career poster and write down and/or discuss
   - o Things they already know about that career
   - o Things they see in the images and how the career relates to those images
   - o Things about that career they might like
4. Have groups rotate to the next poster in the room and repeat step 3. Continue rotating until all groups have seen all posters.
5. Complete the "Reflection".

Materials:

- Gallery Walk Images
- Career Posters

Reflection:

1. Ask students to share:
   - o Three things about the health sciences they are most excited to learn about
   - o Two careers that interest them most
   - o One thing about the career posters that surprised them

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L2 Respiration Part One – Building a Lung Model

Big Questions: How do our lungs work?

Setting the Stage: Today we are going to build a simplified model of our respiratory system that shows the interactions of the bronchi, lungs, and diaphragm as we breathe. This two-liter bottle represents our chest cavity. What might the two small balloons represent? (Lungs). The straws represent our bronchi, or two large tubes that connect our lungs to the trachea, or windpipe (touch windpipe). Follow along, and let's build a simplified respiratory system.

Activity:

1. Read "Setting the Stage"
2. Have students watch the first half of the video "How do lungs work?" (watch to 1:50)
3. Depending on supply availability, students can work individually or in small groups to build their lung models.
4. Instruct students how to put the model together:
   a. First, let's connect the lungs (hold up balloons) to the bronchi (hold up straws). Attach the balloons and secure them with rubber bands.
   b. Seal off the tops of the chest cavity with the play dough (where the lid would normally go). Insert your bronchi through the play dough through the bottom of the chest cavity.
   c. Ask: Does anyone know what the muscle is called that expands and contracts as we breath? (The diaphragm). The larger balloon represents the diaphragm. Stretch this out over the bottom of the bottle.
   d. Now, let's make our respiratory system work. Pull down on the diaphragm. What do you notice? (The volume of the chest cavity increases, decreasing pressure and inflating the lungs). Take a deep breath and see if you can feel your diaphragm move down and your lungs expand.
      § Now, gently push the balloon in. What do you notice? (The balloon lungs contract as the volume of the chest cavity gets smaller and pressure increases)
5. Ask students to draw a diagram of their respiratory system including the following terms:
   - Lungs
   - Diaphragm
   - Bronchi
   - Chest Cavity
   - Trachea (Windpipe)
6. Complete the "Reflection".

Materials:

(one set per group)

- A 2-liter bottle
- Two plastic or paper drinking straws
- Two nine-inch balloons
- One larger balloon
- Play dough
- Two rubber bands
- Paper and drawing supplies (markers, colored pencils, crayons, etc.)

Reflection:

1. What parts of the lungs are included in your model and diagram?
2. Are any parts of the lungs missing or not represented in this diagram?

Hint: *think back to the video you watched before we made our models*

Answer: bronchioles and alveoli (branches and little air sacs within your lungs). This is a good model to show how the diaphragm works. However, the lungs themselves are more like sponges with lots of tiny air sacs rather than big empty balloons.

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L3 Respiration Part Two – Respiration and Heart Rate Lab

Big Questions: How does breathing affect circulation and the work of the heart?

Setting the Stage: Today we will be conducting an experiment to collect data on the interconnectedness of the respiratory and circulatory systems.

Safety Consideration: *During the lab on respiratory distress, anyone who is sick or already has respiratory issues should not be the test subject. At any point, if the test subject gets light-headed, have them stop and have their group take and record their respiratory rate and pulse. We do not need anyone passing out!!*

Activity:

1. Read "Setting the Stage" and "Safety Consideration"
2. Have students watch the second half of the video "How do lungs work?" (start at 1:40)
3. Split students into groups of four. Each student will have a role in their group. You can assign these or have students decide their roles within their groups.
   - o Roles:
     - Lab director (conducts and oversees trials)
     - Test subject (participates in trials)
     - Data collector (keeps track of time and records data
     - Lab assistant (supplies straws and monitors safety of the test subject)
4. Pass out the Respiratory Distress Lab: Procedure and Data Collection, the small, medium, and large straws, and the timer.
5. Practice finding your pulse as a large group.
   - Instructions: To check your pulse at your wrist, place two fingers between the bone and the tendon over your radial artery—which is located on the thumb side of your wrist.
6. With a volunteer, model measuring respiratory rate, or how many times someone breathes each minute, by watching the rise and fall of the volunteer's chest.
   - Demonstrate finding the volunteer's pulse: Instruct the young professionals to find their own pulse in their wrist or neck and to count the number of beats for 15 seconds
   - Model how to multiply this number by 4 in order to calculate the number of beats per minute (bpm)

(continued on next page)

Materials:

- Procedure and Data Collection sheet (one per student)
- Small, medium, and large straws (one per lab pair)
- Timers (one per lab pair)
- Respiratory Lab Graph (one per student)

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L3 Respiration Part Two – Respiration and Heart Rate Lab

7. Give students a few minutes to complete the control (no straw) within their group and record their results.
   - Circulate and assist groups as needed
8. After a few minutes, regroup and make sure everyone had a chance to complete the control test. Instruct the groups to work through the mild, moderate, and severe respiratory distress trials.
   - Circulate and assist groups as needed
   - **Important Reminder: During the lab on respiratory distress, anyone who is sick or already has respiratory issues should not be the test subject. At any point, if the test subject gets light-headed, have them stop and take the respiratory rate and pulse.**
9. As groups finish their four trials, pass out the Respiratory Distress Lab Graph and have students work together to fill out the graph.
   - Circulate and assist groups as needed
10. Complete the "Reflection".

Reflection:

1. What parts of the lungs are included in your model and diagram?
2. Are any parts of the lungs missing or not represented in this diagram?

Hint: *think back to the video you watched before we made our models*

Answer: bronchioles and alveoli (branches and little air sacs within your lungs). This is a good model to show how the diaphragm works. However, the lungs themselves are more like sponges with lots of tiny air sacs rather than big empty balloons.

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L4 Bones – Splinting Challenge

Big Questions: How do health professionals help heal broken bones?

Setting the Stage: Allied health professionals are trained to deal with emergencies. They spend time practicing standard ways of treating emergencies in the field. We are now going to learn how professionals apply a splint and then practice splinting using a simplified EMT checklist.

Important Reminder: *We are practicing splinting today in class, but we are not health care providers and have not been first aid trained. From First Responders to EMTs (Emergency Medical Technician) to Paramedics, our health care professionals go through rigorous training and practice before they work in the field. Therefore, in a real emergency, you should call 911!*

Activity:

1. Read "Setting the Stage" and show students the video "What Do EMTs Do on the Job?" (watch to 0:56)
2. Read the "Important Reminder" before passing out materials
3. Put students into pairs and hand out the Splinting Checklist
4. Pass out the splinting materials and give students time to decide who is the patient and who is the EMT. Let students know they can swap roles halfway through!
5. Play the video "How to splint a forearm" (0:56) to give students an idea of what a professional splint looks like. Remind them that for this design challenge, their splints can look different than the video as long as they meet the criteria.
6. Give students 10-15 minutes to create a splint on their partner's arm and remind them that they will be graded based on the Splinting Checklist.
   - Circulate and assist groups as needed
   - Important Reminder: Make sure students do not wrap their partners arm too tightly. Let students know that each "patient" student should always be able to feel their fingers!! If their arm begins to tingle or go numb, the splint is too tight!!
   - If students finish early, encourage them to think of other ways to improve their splint – could it be more fashionable? More comfortable?
7. At the end of the 10-15 minutes, have the students grade their own splint based on their checklist. Take pictures of their splints and allow pairs to show off what they made.
8. Then, allow students to switch roles and work for another 10-15 minutes.
9. Complete the "Reflection."

Career Connection: EMT

Materials:

(one set per group):

- Splint (magazine/notebook)
- Wrapping bandage
- Two triangle bandages
- Padding (can be t-shirts, cut up towels, etc.)
- EMT Splinting Checklist

Reflection:

Remind students one last time that while we practiced splinting today, we are not trained health professionals. In a real emergency, we should call 911 for help.

1. Which criteria on the EMT checklist were the hardest to meet? Which were the easiest?
2. Which materials worked best for immobilizing the arm? Which did not work so well?
3. What other skills may first responders need to be trained in when responding to emergencies?

Example Answer: CPR

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L5 Blood Part One – Components of Blood

Big Questions: What is blood?

Setting the Stage:

Part One — The allied health fields are filled with many different careers. Some are well-known, like doctors and nurses. However, many different healthcare professionals contribute to patient health and recovery.
Let's talk about a person that many of us have interacted with, but few of us know their title: the phlebotomist.

Part Two — What is blood? We know it runs through our veins and can get messy if we cut ourselves. But what purpose does it have, and what is it made of? Let's create a model to help us learn about the parts of our blood and their functions.

Activity:

1. Read "Setting the Stage" part one and watch "My job in a minute: Phlebotomist – Nebraska Medicine" (1:52)
2. Read "Setting the Stage" part two and watch the "Human Blood Video" (watch to 2:18)
3. Put students into small groups of 3-4 and hand out the materials.
4. Give the following instructions to all groups
   - Add ½ cup of light corn syrup to a clear bowl to represent plasma.
   - Add ½ cup of Red Hots to represent the red blood cells. Stir.
     - o Ask students: What do you notice?
     - o Example Answer: The red blood cells turn the liquid red.
   - Add 5 dry lima beans to represent the white blood cells.
     - o Ask students: What does our model tell you about the ratio of white blood cells to red blood cells?
   - Add 1 tablespoon of dry lentils to represent the platelets.
     - o Ask students: Does anyone remember from the video what platelets do?
     - o Example Answer: Help stop bleeding
   - Stir the mixture together.
5. Give students a few minutes to sketch and label a diagram of their model blood. Encourage students to capture the ratios they see in their models. Additionally, they should include the following terms:
   - Plasma
   - Red blood cells
   - White blood cells
   - Platelets
6. Complete the "Reflection".

Career Connection: Phlebotomist

Materials:

(one set per group):

- Phlebotomist Career Poster
- 1 red solo cup or glass jar
- ½ cup of light corn syrup
- ½ cup of Red Hots (candy).

  This candy will color the liquid as real red blood cells. Not all Red Candy will have the same effect (i.e., skittles).
- 5 dry lima beans
- 1 tablespoon of dry lentils

Reflection:

1. Recap: what does a phlebotomist do?
2. Are there any traits you and a phlebotomist may have in common (based on the video and poster)
3. Recap: what are the four components of the blood we reviewed today?
4. Were any of these components new to you?

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L6 Blood Part Two – Blood Types

Big Questions: What is a blood type? When donating blood and receiving blood, why does blood type matter?

Setting the Stage:

Part One — The allied health fields are filled with many different careers. Some are well-known, like doctors and nurses. However, many different healthcare professionals contribute to patient health and recovery.
Let's talk about a person that many of us have interacted with, but few of us know their title: the phlebotomist.

Part Two — What is blood? We know it runs through our veins and can get messy if we cut ourselves. But what purpose does it have, and what is it made of? Let's create a model to help us learn about the parts of our blood and their functions.

Activity:

1. Read "Setting the Stage" part one and watch "My job in a minute: Phlebotomist – Nebraska Medicine" (1:52)
2. Read "Setting the Stage" part two and watch "What are Blood Types?"
3. Split students into small groups of 3-4 students each.
4. Pass out the materials and Transfusion Lab handout to each group.
5. Instruct each of the groups to do the following:
   - **Step 1.** Set out four clear plastic cups labelled: O, A, B, and AB. Ensure the labels are high on the cups so they can be seen through the liquid. Mix the blood type cups in advance.
   - **Step 2.** Fill each cup about halfway with water.
   - **Step 3.** Leave one cup filled with clear water- this will be the 'O' cup.
   - **Step 4.** Put several drops of red food coloring in the 'A' cup and stir.
   - **Step 5.** Put several drops of blue food coloring in the 'B' cup and stir.
   - **Step 6.** Put equal amounts of red and blue in the 'AB' cup and stir (purple).
   - **Step 7.** There will now be a cup of clear water (Type O), a red water cup (Type A), a blue water cup (Type B), and a purple water cup (Type AB).
   - **Step 8.** Finally, set out several empty cups to use for the blood transfusion experiment.
6. Next, students will complete their chart to decide if each receiver/donor pair is a match or not by first adding donor blood, then adding receiver blood to each empty cup (if the color of water of the receiver does not change completely, it is a match! If the water color of the receiver changes, it is not a match!). Give students 15-20 minutes to complete their charts.
   - Circulate and assist groups as needed
7. Complete the "Reflection".

Career Connection: Phlebotomist

Materials:

- 4 small plastic cups of water
- 16 small empty plastic cups
- Red and blue food coloring
- Sharpie (to label cups)
- Transfusion Lab Handout
- Transfusion Lab Answer Key

Reflection:

1. The "universal donor" is the blood type everyone can accept. Which blood type is the universal donor and why?
2. The "universal recipient" can accept all types of blood. Which blood type is the universal recipient and why?
3. When would it be important to know someone's blood type?

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L7 Skin – Banana Suture Lab

Big Questions: How does skin heal? How do surgeons suture wounds?

Setting the Stage:

Your training as a Physician Assistant included a lot of time studying human anatomy and physiology. You know a lot about the skin as an organ of the body and how to **suture**, or stitch up, **lacerations**, or cuts in the skin *(display the definitions of suture and lacerations on board)*. You are a suture perfectionist, so you practice at home to make your sutures even better to reduce scarring. As you practice, remember that a health professional spends hours practicing—expect to make mistakes on your first attempt.

Safety:

Take time to establish procedures and norms for lab safety prior to conducting the labs in this unit. This lesson contains a lab that requires the use of sewing needles. Set the expectation that the young health workers take lab experiences seriously and behave in a professional manner. For example, the first time a student acts inappropriately or unsafely with sharp materials, they lose participation privileges. Take their needle and let them observe. Ensure they understand this "one strike, you're watching" approach before receiving materials.

Activity:

1. Show "What do Physician Assistants Do?" (1:18)
2. Read "Setting the Stage"
3. Show "Interrupted Sutures" (4:43) and "Continuous Sutures" (4:43) to the students. During the videos, record the key points of both suturing techniques as a group or individually. Review key points after the video.
4. Say "You are now going to receive your professional tools for the lab. These include a sharp instrument, and I will record who has received them. To leave club, you will need to return your equipment and be checked out. If needles are used for any other purpose—as toys or in an unsafe way—you will be asked to sit this lab out. There are NO second chances."
5. Pass out a suture kit and "Lab: Suturing a Banana" handout to each student (or one kit per small group of students depending on supplies)
   - **Important Reminder: Take a moment to count how many kits you are passing out so you can ensure you get the same number of needles back that you handed out.**
6. Give students 10-15 minutes to practice suturing their bananas. While they work, you can show the suturing videos in the background.
   - Circulate and assist groups as needed
7. At the end of the work time, collect each suturing kit and make sure all equipment (especially the needles!) have been returned.
8. Complete the "Reflection".

Career Connection: Surgical Technician and Physician's Assistant

Materials:

- One knife (a butter or kitchen knife is fine, for preparing the bananas—this is for teacher use only)
- Banana (1/2 per student)
- Dental floss (approx. 10 inches per wound)
- Curved needle (1 per student)
- Forceps or tweezers (1 per student)
- Suturing a Banana handout

Materials Distribution:

With sharp materials, take care to have accountability in distributing and collecting the needles. Consider using a checklist to ensure all needles are returned. There are also tutorials online for suturing a pig's foot rather than a banana which can be used to increase the relevance and rigor of this lesson.

Reflection:

1. Give students time to look around the room at each other's sutures.
2. What was hardest about suturing?
3. What was easiest about suturing?
4. Could you see yourself as a Physician's Assistant (PA) in the future giving real sutures to patients?

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L8 Hand Washing Lab – Contamination Lab

Big Questions: How does disease spread?

Setting the Stage:

Bacterial infections can be spread through contact with anything that is unwashed or unsterilized—hands, arms, equipment, even the sheets that cover the patient on the operating table. The bacteria that cause hospital associated infections, or HAI, are present at all times on skin and anything skin has touched. Careful washing and disinfecting are all that protect the patient from HAI. This is a role the surgical technician takes very seriously. Today, we are going to do a simulation where one of you is the source of an infection. Be prepared to solve the mystery!

Set Up Before Club:

The Contamination Simulation is from Glo Germ Classroom Kit Lessons by Educational Innovations, Inc. The original source can be found here. It's an activity that requires some preview and organization.

- Enter the names of your class members in the record sheet.
- Number the handles of the spoons and name tags.
- Decide which student will receive Glo Germ lotion. That student will have his hand shaken about **three-quarters** of the way through the first round of handshaking. This student remains known only to you throughout the demonstration.
- Place a 1/4 teaspoon-sized glob of lotion into each numbered spoon. The amount does not need to be exact; use the measuring spoon for the first glob just to see what the correct quantity looks like in your plastic spoons. **Only the selected student (the source) will receive Glo Germ lotion; all the others receive regular hand lotion.**
- Be careful not to contaminate any of the regular hand lotion spoons with Glo Germ lotion. See this link for additional clarifications.

Students may need guidance on how to use the record sheet. If necessary, project the sample record sheet for students to review on page 13. Page 14 provides a sample of how to record data if you decide to do two rounds of shaking hands.

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Materials:

- UV LED light (black light)
- Glo Germ lotion 2 oz.
- Hand lotion similar in color and consistency to Glo Germ lotion
- Self-adhesive, numbered name tags or small, numbered squares of paper and tape
- Small plastic spoons (one per student)
- 1/4 teaspoon measuring spoon
- Paper towels
- Contamination simulation record sheet (to project and then copy for teams)
- Contamination Claims-Evidence-Reasoning Note-catcher (one per team)

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L8 Hand Washing Lab – Contamination Lab

Activity:

1. Read "Setting the Stage" and show "How do infectious diseases spread?" (1:04) Discuss what the video shows about the spread of disease as a group.
2. Demonstrate how to apply the lotion to the palm of the right hand, paying particular attention to keeping the lotion off the right hand or other surfaces in the room. Use a finger to scrape the lotion off the spoon.
3. Distribute the appropriate numbered tag, a glob of lotion in a small plastic spoon, and a paper towel to each student.
4. Have students apply the lotion to the palm of their right hand, using the back of the spoon to smear the lotion to cover the entire palm.
   - They should not use their fingers on the other hand to do this; we are trying to confine the lotion to the palms of the hands. The spoons should be placed on the paper towels, not laid directly on the tabletop.
   - When students aren't actually shaking hands, they should keep their right hands loosely closed, palm-side up, to avoid contaminating the surfaces or objects in the room.
5. Ask all of the students to stand up and tell them that one of them is the source of an infection.
6. Have student #1 shake the hand of student #2, then sit down. Student #2 shakes the hand of student #3, then sits down. Student #3 shakes the hand of student #4, and so on until every student is seated.
7. Check each student's left hand under the black light, recording results in the record sheet. Note: It is vitally important that you record each handshake in order on the record sheet as they occur, or this activity will not work.
8. After the students have spread the infection, they can wash their hands. Check how clean their hands are with the black light to show that the average person does not get their hands very clean after washing— this reinforces the importance of the sterilization technician.
9. Provide a copy of the record sheet to each team of students.
10. Invite teams to analyze the results and decide who started the epidemic.
    - For a single round of handshaking, this should be quick.
    - Time permitting and for extra challenge, try the "two-round extension".

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L8 Hand Washing Lab – Contamination Lab

11. Distribute the Contamination Claims-Evidence-Reasoning Note-catcher to students.
12. Project the Sample Recording Sheet
13. Model making a claim with evidence and reasoning:
    - Your claim is that student #9, in this model, was the infected student.
    - Your evidence is that only #9 shook hands with both students #8 and #10.
    - Your reasoning is that student #7 was not infected, so student #8 could not have been the culprit; but because student #8 was infected, student #10 also could not have been the start of the epidemic.
14. Give about 5 minutes for teams to work together to analyze the data table.
15. Invite each team to present its findings to the class, including the evidence and reasoning behind their claim.
16. Complete the "Reflection".

Reflection:

1. What was hardest about today's contamination challenge?
2. What is something you learned?
3. How might you apply what you learned to your real life?

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