Big Sky Brain Project

Infectious Brain Diseases Field Trip

Objective: For 5th-12th graders to learn about the brain, neurological diseases, epidemiology (how diseases spread), and vaccination.

Materials:



1. 15ml Conical tubes labeled 1-? # of kids
2. Small plastic tubes labeled 1-? # of kids
3. Pipetors
4. Water H2O
5. vinegar
6. Put 1ml vinegar in both #4 labeled tubes +3ml H2O (this is the infected patient 0)
7. Put 3ml H2O in all other tubes
8. Bromthymol blue (Ph indicator but we pretend its an antibody specific for our disease)
9. Dry erase board and marker
10. 1 Sheep brain with dissection tray, tools and gloves

Introduction for our young guests: 5 mins

Today we're going to learn about diseases that can affect our brain and nervous system but first we're going to play a quick game. This game is called "Stand on the Line". If you agree with what I say, then stand on this line, if you disagree then stand on this line. If you don't know, then you can stand in the middle of the two lines."

1. I like to eat pizza.
2. I like science.
3. The food I eat affects how well my brain works.
4. My brain is my most important organ.
5. Exercising helps my brain form new memories.
6. I have gotten sick from a cold this year.
7. I enjoy being sick.
8. There are some diseases that do not spread from person to person.
9. Going outside in the cold with wet hair or without a jacket can make me catch a cold.
10. My brain can catch a disease from another person.

Experiment:

Intro to Brains: 10 mins

1. "What is the coolest thing your brain does for you? 1-3 word answers please" (expect all kinds of answers)
2. Our brain receives signals and our brain sends signals: how? (chemicals, electricity and neurons talking to each other and body parts) What kind of messages does our brain send? (movement, language etc.) What kind of messages does our body receive? (sensory info)

3. Do very quick Brain Dissection: pick areas affected by diseases (ie: talk about Pain: Have you ever heard that pain is all in your head? Well it's all in your brain. The thalamus here can decide if it is going to send the pain signal on to the part of your brain that receives info for that part of your body.

Intro to diseases: 10 mins

All these questions are on the powerpoint

1. What sorts of things make us sick?

Answer: germs

OK, what kinds of things/living organisms are germs?

Answer: bacteria, viruses, parasites, fungi, worms

2. How are diseases spread?

Answer: sneezing-saliva particles in the air, germs on your hands that get wiped off onto a surface that another person touches, drinking out of the same cup-sharing bodily fluids, vectors like mosquitoes, ticks

3. When we go to the doctors we often get shots. What do these shots do for us?

Answer: educates our immune cells-the cells that fight infection so those cells make antibodies that are specific for the disease we're getting vaccinated for so our body fights off the disease before we get really sick.

Edward Jenner, a country doctor living in Berkeley (Gloucestershire), England, who in 1796 performed the world's first vaccination. He observed that milkmaids infected with cowpox, visible as pustules on the hand or forearm, were immune to subsequent outbreaks of smallpox that periodically swept through the area. Taking pus from a cowpox lesion on a milkmaid's hand, Jenner inoculated an eight-year-old boy, James Phipps. Six weeks later Jenner variolated two sites on Phipps's arm with smallpox, yet the boy was unaffected by this as well as subsequent exposures. Based on twelve such experiments and sixteen additional case histories he had collected since the 1770s.

Vaccines work by stimulating our immune system to produce antibodies (substances produced by the body to fight disease) without actually infecting us with the disease. They trigger the immune system to produce its own antibodies, as though the body has been infected with a disease. This is called "active immunity".

4. What kind of diseases do we get vaccinated for?

*measles, (respiratory virus) very contagious-infects 90%, 0.2%mortality rate 1/1000 brain swelling

*Pertussis, (whooping cough-respiratory bacteria)

*Mumps, (virus swollen salivary glands) meningitis in 40%

*rubella ("german measles"),

*influenza (flu), (virus)

chicken pox, (virus can swell brain)

meningitis (infection in membrane around brain),

tetanus (toxoid from bacteria (neurotoxin), tightness of muscles)

*hepatitis, (viruses-liver)
*rotavirus, (virus-diarrhea)
diptheria (toxoid from bacteria (neurotoxin) Thick coating in throat hard to breathe
Hib, (bacteria causes meningitis 1/20 die)
pneumococcus (bacteria that cause meningitis)

5. Which of those diseases do you think affect the brain or nervous system?

predominantly affect CNS: chicken pox, meningicoccus, pneumococcal, diptheria, tetanus

Occasionally affect CNS: measles (meningitis and brain swelling), mumps, rubella, influenza, smallpox

Part 1: 10 mins

1. Give each student a numbered conical tube. Have students pick an infectious disease to 'spread' with visitors. (For example: chicken pox, meningitis, cerebral malaria, HIV-Associated dementia, etc.)
2. Tell students this is their bodily fluids

Have each participant pair with another and exchange 1 mL of fluid from their vial.

Ask participant to remember/write down who they interacted with. Pencil and paper may be used if needed.

3. Repeat exchange with a different partner.
4. Exchange 3 times if the group of visitors consist of more than 10 visitors.
5. Tell students that the bromthymol blue is an antibody specific for the virus/bacteria you are spreading today. We have engineered it such that if the antibody binds to an antigen (or part of a virus/bacteria/parasite), then the solution changes color. This means, if the solution turns yellow, then you have the virus/bacteria and you are infected.

Blue means no infection, yellow means infection was detected.

Part 2: 15 mins

Identify patient zero (1st person to be infected). We're epidemiologists now!
Make a list of all the people who were infected on dry erase board.
Go through each person to identify who gave to who and if it was the first interaction or 2nd or 3rd

Part 3: redo the "pick the line" icebreaker questions

1. There are some diseases that do not spread from person to person. (most cancers)

2. Going outside in the cold with wet hair or without a jacket can make me catch a cold. (where's the infections agent-virus, bacteria making you sick?)
3. My brain can catch a disease from another person.
4. There are people who have died from the flu or influenza (not the stomach flu).
5. Kids get vaccinated for diseases that can infect the brain. (yes!)
6. Epidemiologists figure out which person started an outbreak.
7. Vaccination prevents people from getting sick and dying.
8. In order to go to college, I must be vaccinated.

Alarming Disease info:

Measles: Measles virus is spread from person to person through the air in coughed-out aerosolized droplets that are inhaled. It is more than a rash:

The virus typically first comes in contact with host lung tissue, where it infects immune cells called macrophages and dendritic cells, which serve as an early defense and warning system. From there, the infected cells migrate to the lymph nodes where they transfer the virus to B and T cells. A surface protein on these white blood cells, known as CD150, serves as the virus's point of entry during this critical step. The infected B and T cells then migrate throughout the body releasing virus particles into the blood. The spleen, lymph nodes, liver, thymus, skin, and lungs are eventual destinations for the virus. In rare instances (about one in 1000 cases), the virus can cross the blood-brain barrier and **cause dangerous swelling of the brain;** infection of lung cells causes a hacking cough that keeps the virus circulating in the population. The rash is a symptom of inflammation occurring in the skin. As the virus travels in the blood, it infects capillaries in the skin. Immune cells detect the infection and respond by releasing chemicals such as nitric oxide and histamines, which destroy the viral invaders and call other immune cells into action. These same chemicals, however, cause swelling and damage to host cells, resulting in the often itchy skin rash

Pertussis: In babies younger than 1 year old who get pertussis, about half need care in the hospital. The younger the baby, the more likely treatment in the hospital will be needed. Of those babies who are treated in the hospital with pertussis about:

- 1 out of 4 (23%) get pneumonia (lung infection)
- 1 out of 100 (1.1%) will have convulsions (violent, uncontrolled shaking)
- 3 out of 5 (61%) will have apnea (slowed or stopped breathing)
- 1 out of 300 (0.3%) will have encephalopathy (disease of the brain)
- **1 out of 100 (1%) will die**

Information on diseases and vaccination