Fighting Infections with Your Immune System

Name: _____

Date: _____

Student worksheet

Directions: Prepare for the experiment.

1. Before the Experiment

a. Which parts of your model represent which part of the immune system?

Salt: _____

Iron filings: _____

Jar: _____

Magnets: _____

b. What do you think will happen when you add more antibodies to your model?

2. Experiment

Follow these steps to do your experiments:

1. Setting up your immune system model

a. Label the pieces of magnetic tape 1, 2, and 3 by writing large, bold numbers on the paper backing.

b. Put each magnetic tape square in the middle of a plastic wrap square with the adhesive side (covered by paper) facing up.

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Directions: Follow the directions below to do the experiment.

c. Pull the ends of the plastic wrap together around each magnetic tape square, twist them together, and secure them with a twist tie as shown below.

d. Make sure there are no openings in the plastic wrap surrounding any of the magnets!



e. Measure the mass of each piece of magnetic tape, including the plastic wrap and twist tie, and record these values below:

Tape 1: _____ grams [g]

Tape 2: _____ grams [g]

Tape 3: _____ grams [g]

f. Measure 1 cup of salt and pour it into the glass jar. Then measure out 1 tbsp. of iron filings and add it on top of the salt in the jar, as shown below.

g. Put the lid on the jar tightly and then mix the salt and iron filings together by flipping the jar upside down and then right-side up again. Do this, about one flip per second, until the iron filings appear evenly dispersed throughout the salt in the jar, as shown below.



h. Examine the jar and describe below how its content looks. Can you see the iron filings dispersed in the salt?

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Directions: Continue the experiment.

2. Simulating the primary immune response



a. Take one of the magnetic tape pieces (make sure to remember which one) and put it in the jar, resting on top of the mixture, as shown at right. Then put the lid back on the jar tightly and flip it ten times.

b. Carefully remove the piece of magnetic tape from the jar.

   i. Only grab it by the twist tie or twisted plastic. Do not touch where the iron filings are.

   ii. Turn the tape upside down so that any salt trapped in the twisted plastic wrap falls back into the jar.

   iii. Be careful not to shake any attached iron filings off.

c. Examine the magnetic tape. How much salt versus iron filings is stuck to the magnet?

d. Measure the mass of the magnetic tape, including any attached salt or iron filings.

   i. Place a piece of paper onto the scale in case any iron filings fall off.

   ii. Zero the scale.

   iii. Measure the mass of the magnet and record this value below.

   Magnetic tape mass including attached particles: _____ grams [g]

e. Hold the magnetic tape over the piece of paper, untie the twist tie, and carefully open the plastic wrap so the salt and iron filings fall onto the paper.

f. Use the paper to carefully funnel the iron filings and salt back into the jar and secure the lid. Mix the iron filings and salt again by flipping the jar ten times.

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Directions: Continue the experiment.

3. Simulating the secondary immune response

a. Repeat step 2, but instead of just one piece of magnetic tape, put all three in the jar together, as shown below.



Mass of all three magnetic tapes including attached particles:

_____ grams [g].

When you remove the pieces of tape, do they look similar or different from the primary immune response model?

Were you able to bind more, less, or the same amount of iron filings (pathogens) compared to the primary immune response?

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Directions: Analyze your results.

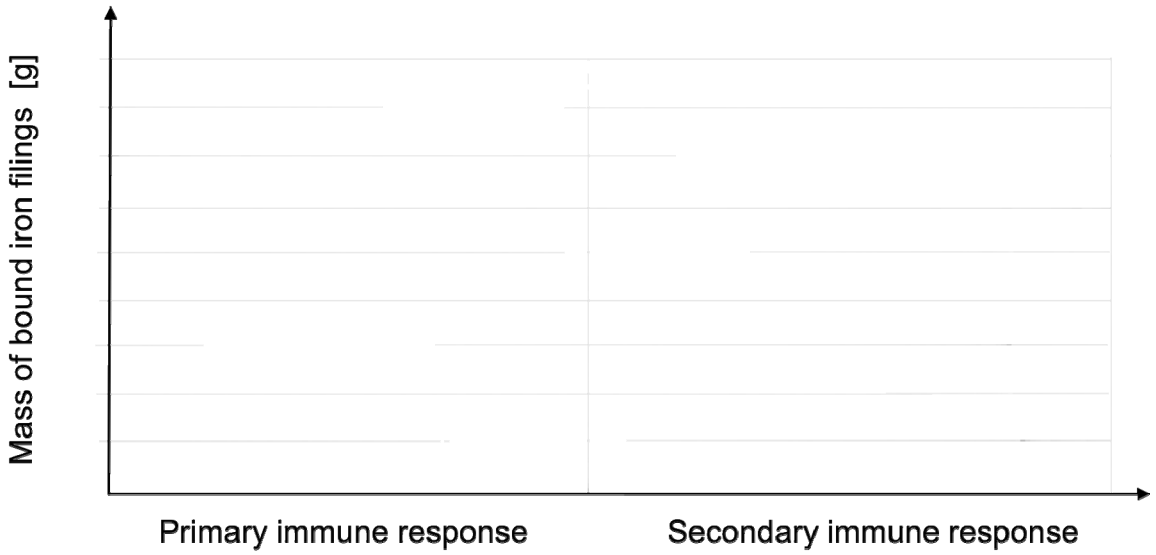
3. After the experiment

a. Calculate the mass of iron filings (pathogens) removed by the magnetic tape (antibodies) in both the primary and secondary immune responses. Do this by subtracting the initial mass of the tape (no iron filings) from the final mass (including iron filings). Record your results in the table below.

	Primary immune response	Secondary immune response
Initial mass of magnetic tape(s) [g]		
Final mass of magnetic tape(s) [g]		
Mass of attached iron filings [g]		

b. Make a bar graph representing the mass of iron filings (pathogens) removed during the primary and secondary immune response.

- Label the vertical axis (y-axis) so that your mass of iron filings fit within the range of your y-axis.
- Draw two bars that show the mass of iron filings for each of the immune response scenarios.



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Directions: Use your data to answer the questions.

c. In which scenario, the primary or secondary immune response, were more iron filings bound to the magnetic tape? In your own words, explain why.

d. What roles do memory cells play during the secondary immune response? Why are they so important?

e. Based on your results, can you explain why we use vaccines to protect ourselves from certain diseases?