

## Finding a Perfect Fit: A lesson to teach antigen-antibody interactions

### PURPOSE

The purpose of this pre-lab is to explore the interaction between antibodies and antigens. Here, students will learn about the specific manner in which antibodies bind to antigens. **Note: this is likely a two day activity.**

### MATERIALS

- Plaster of Paris
- Water
- Mixing Bowls
- Plastic Spoons
- Small plastic bowls, or disposable plastic containers
- Brown paper grocery bags
- Vegetable oil spray

### LESSON PLAN

#### Engagement (25+ minutes, Day/Session 1)

Inform your students that they are going to make antibodies using objects pressed in Plaster of Paris. Each student should bring in a different small object (not too heavy and something they don't mind getting messy). They must keep their object for the following day as well. If two or more students bring in the same object, *do not* have them find a new object.

First, have the student's write their names on the bottom of their container before the plaster is poured. Add water to the Plaster of Paris in large mixing bowls until plaster is stiff but creamy. Pour some plaster into each container.

Have your students spray their object lightly with oil and press the object straight down into the plaster at any angle they choose (press firmly but not too far into the plaster), and allow the plaster to harden, at least one hour. Carefully remove the object from the plaster and allow plaster to harden fully. Make sure your students remember the angle at which they placed their object. If everyone in the class brought different objects, use one of the students' objects to make the teacher's mold (but at a different angle). At least two containers in the class should use the same object, but at different angles.

#### Exploration (30 minutes, Day/Session 2)

Instruct your students to line up in front of the containers (antibodies) randomly placed on the table with their objects (antigens) in hand. Tell your students that they are antigens and must find the right antibody as quickly as possible (before infection spreads). The students should fit their mold with their object.



### Objectives

- Define antibodies and antigens
- Understand the high variability associated with antigen and antibody structure
- Demonstrate and test the specificity of antibody-antigen complexes



### Antibodies are specific

An antibody recognizes a particular spot or region of an antigen. Every antigen has many different antibodies directed against it, each recognizing the antigen at a different spot. To model this with your students, make two molds which used the same object (antigen) placed into the plaster at a different angle.

### Fact Files

#### What Causes an Allergy?

Our immune systems protect us from potentially harmful antigens such as bacteria and viruses every day. However sometimes they overreact to an antigen that is not dangerous. This overreaction or hypersensitivity is what we call an allergic response or allergy. Allergic reactions can be mild, such as a runny nose to severe, like anaphylactic shock.

Organize students into pairs. Have each student switch objects with their partner. While this is happening, place each container randomly into a numbered paper bag. Have the students walk through the line of paper bags and without looking, test each mold with the new object. Ask the students to remember the number of the bag which matched their item. Go through each bag and ask for the correct object; compare with the initials on the bottom of the container.

(Optional) Have each student pick up someone else's container. Ask your students to link their object (antigen) to the correct container (antibody) while still holding on to *their* container. Eventually, everyone in the class will be linked.

### Explanation

Explain that antibodies can only bind to specific antigens in the body. Lead the class in a discussion about the specificity of the antibody-antigen complex. Possible discussion questions include:

1. Were there any containers that your object could fit into? Could not?
2. Do you think antibodies recognize similar-shaped antigens?
3. Does the angle at which you held the object to make the mold matter?
4. Did anyone hold the object at a different angle and not find the correct antibody? Different angles = different epitopes, or different recognition sites, of the same antigen
5. Would it be easier if partners taught each other the correct angle at which to hold their object?
6. What happens if two people bring in the same object? Can you tell the antigens apart?
7. How long would it take one person to line up each antigen with the correct antibody?
8. Would you have a more comprehensive immune system as an adult if you were exposed to a lot or only a few antigens in your youth?
9. Would you rather have a few antibodies for many different antigens or a lot of antibodies for a few antigens?

### Assessment

Have the students describe what they learned about antigens and antibodies in their own words.

### What is in a Vaccine?

Our immune systems remember what antigens we have been exposed to. Doctors take advantage of this "memory" by exposing us to weakened or dead forms of an organism, which will not make us sick, but still cause the body to produce antibodies. Since the body has made antibodies previously, should a vaccinated person ever come in contact with that organism again, it will be able to mount an active immune response quickly, protecting the person from infection.

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