



Connections to Curriculum

- ✓ Scientific Inquiry
- ✓ Decision Making
- ✓ Group Work
- ✓ Personal Perspectives/ Reflection
- ✓ Working in Science
- ✓ B11-5-01 Describe the body's defence mechanisms for protection from foreign agents. Include: non-specific and specific defences.

Senior Years Science Teachers' Handbook

Chapter 4: Science-Technology-Society-Environment Connections

- ✓ 4.14 Case Studies of STSE Issues
- ✓ 4.15 Evaluating Medical Technology

Chapter 10: Building a Scientific Vocabulary

- ✓ 10.4 Level One Strategies

Unit 5 Protection and Control

Organ Transplant Rejection Lesson Plan

Objectives

Students will

- understand how the body recognizes its own cells and knows to attack foreign cells
- be able to articulate the importance of matching donor tissue with recipient tissue in organ transplants
- be able to describe the cell membrane, define cell surface markers, and explain the matching process for organ transplants

Materials

- pictures of the following: hockey game (or other sport) including teams, referee, fans (for each team and another team **not** involved in the game)
- whiteboard and whiteboard markers
- leukocyte diagram (BLM 5.1) (one per student)
- Antigen Templates (BLM 5.2) and Antibody Templates (5.3) (two per student)
- scissors, tape/glue
- Organ and Tissue Rejection: Student Analysis/Discussion (BLM 5.4) (one per student)

Anticipatory Set

1. Show the picture of a hockey game (or other team sport, depending upon the season), complete with two teams, referees (officials), and the fans. Ask students to identify which people belong on the playing surface and which have another role. Students should easily identify the players, coaches, and officials. Ask students how they came to their determination. Students should reply that they are all wearing uniforms for identification.
2. Show a close-up picture of a player from each team; ask students what his or her job is at the game.

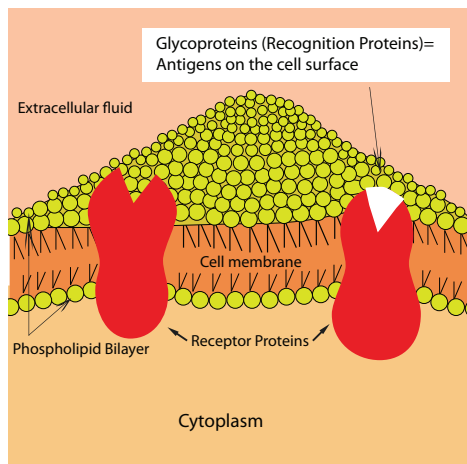
Show a close-up picture of a referee; ask students what his/her job is.

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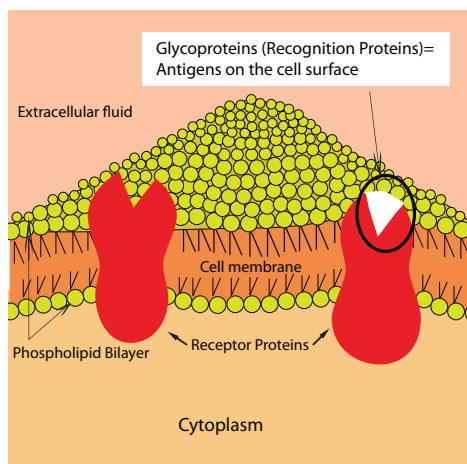
Show a close-up picture of a fan (wearing a team jersey); ask students what his/her job is.

Show a close-up picture of a fan wearing a jersey for a different team, perhaps even for a different sport; ask students what his or her job is—students should reply something like “What are they doing there?”

3. Relate the hockey game to the human body. The body must be able to recognize which cells belong to it (the players, the fans, the referees), which cells don't (fans of the wrong team), where the cells should be, and which job the cell should be doing.
4. Ask students to recall the structure of a cell (plasma) membrane. Make a list on the overhead or whiteboard. Ensure the following structures are mentioned: *phospholipid bilayer*, *receptor protein*, and *recognition protein*.
5. Ask students to draw a diagram of the cell (plasma) membrane in their notebook and add the labels from the list. Students diagrams should resemble the diagram below:



6. Ask students to circle the part of the cell that is involved in identifying “self” cells (i.e., cells that belong to you). (Answer: *glycoproteins, or recognition proteins*).



(continued)

7. Students should identify this now as an antigen and label it accordingly on the diagram. Each person has a unique set of antigens on their cells, different from other peoples' antigens.

If an unknown antigen enters the body, a person's immune system will respond by producing antibodies to combat and destroy the cell with the foreign antigens.

8. The uniqueness of an individual's cell surface markers explains why organ donor tissue and recipient tissue must be carefully matched before transplantation. Human beings have complicated defence mechanisms against bacteria, viruses, and other foreign materials that enter the body. These defences make up the immune system. Unfortunately, the immune system cannot differentiate between the disease-causing organisms (bad), and the cells of a lifesaving transplant (good). Both are looked upon by the body as foreign, and the immune system will attack them. This attack by the immune system (rejection of the transplanted organ) is a great problem in organ transplants.

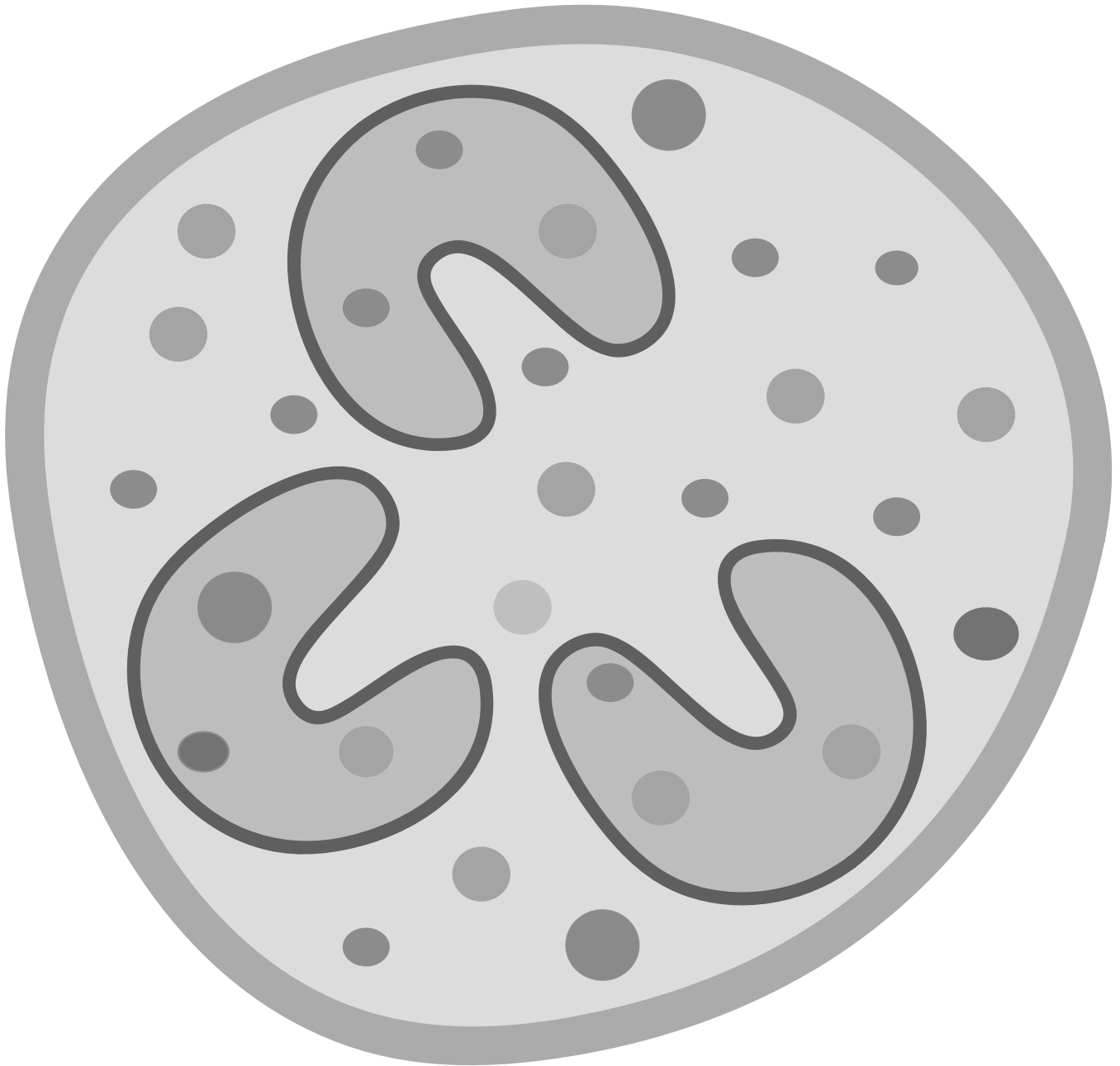
Lesson Sequence

1. Explain the following before the simulation:

“Each of us has several genetic markers (antigens) located on the surface of most of our white blood cells. One of these groups of genetic markers is referred to as the HLA, or Human Leukocyte Antigens. Define *leukocyte* (white blood cell), and *antigen* (genetic marker). The donor cells have Human Leukocyte Antigens on their cells. The recipient might have an antibody (protein) in his or her blood plasma that will attack and destroy these antigens, and destroy the donor organs cells.”

2. Hand out a Leukocyte cell (BLM 5.1) to each student.
3. Ask each student to draw two cards from a bag containing antigens (see BLM 5.2 for templates).
Note: Leukocytes and antigens should be cut out ahead of time by the teacher.
4. Students attach antigens to the surface of the leukocyte using glue or tape. The leukocyte represents the cells of the donated tissue/organ.
5. Ask each student to draw two cards from a bag containing antibodies (see BLM 5.3). Antibodies are not added to the surface of the leukocyte, but rather circulate in the blood plasma of the recipient. These are the proteins that cause rejection when they bind to the antigen.
Note: Antibodies may not cause a rejection with the student's leukocyte. Students should recognize that if the antibody “fits” into the antigen like a puzzle piece, it will cause a rejection reaction and the donated tissue/organ will be destroyed. If the antibody does not “fit” into the antigen the tissue would be accepted.
6. Ask students to work in pairs. Students should be able to determine if the new cell will be rejected by their own antibodies. Students should also be able to determine if they are able to have a successful donation with their partner based on the antigens and antibodies that each drew from the bags.
7. Ask students to complete Organ and Tissue Rejection: Student Analysis/Discussion (BLM 5.4).

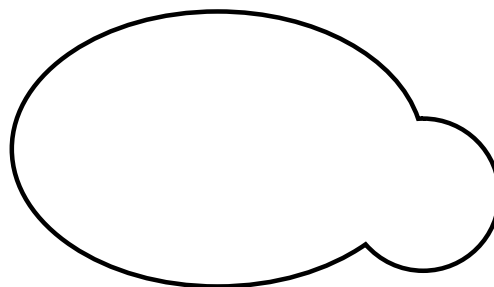
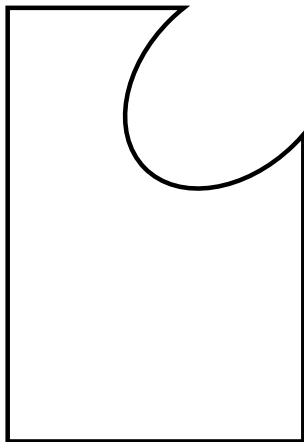
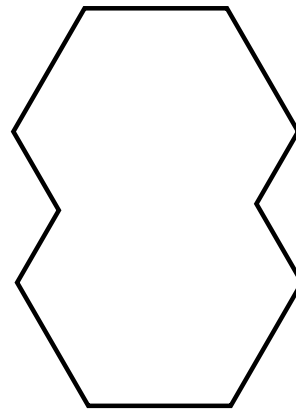
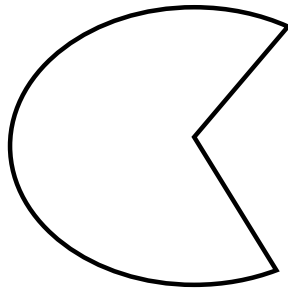
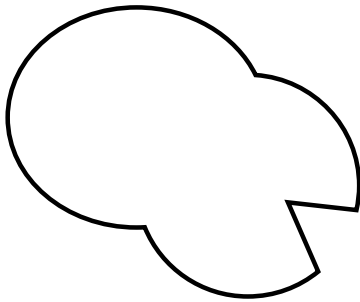
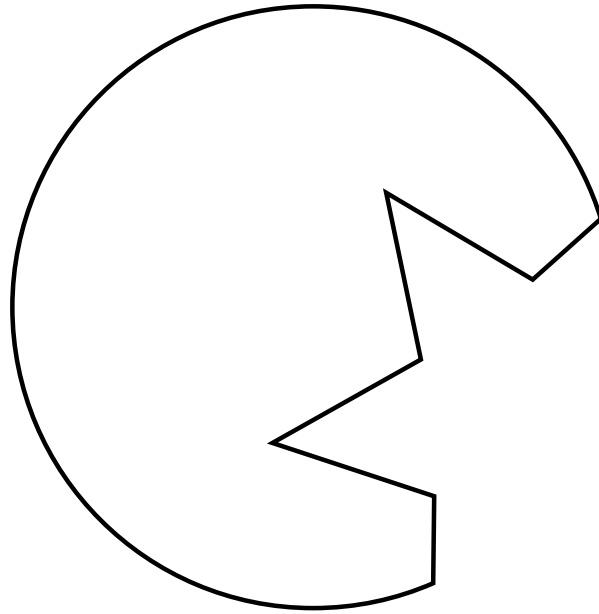
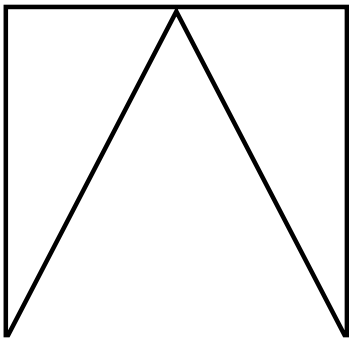
Leukocyte



Note: Ideally this diagram should be enlarged to 11 x 17 paper for student use.

Antigen Templates

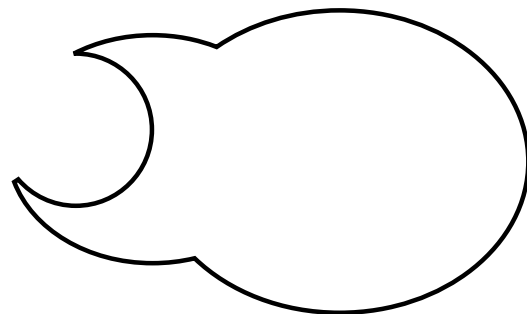
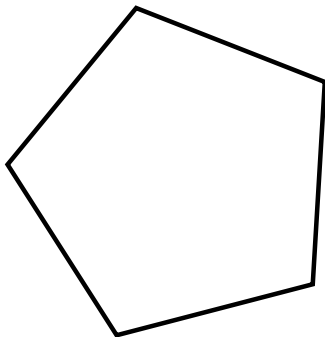
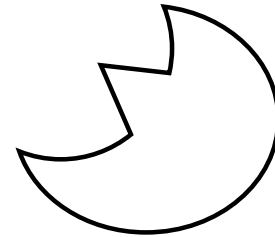
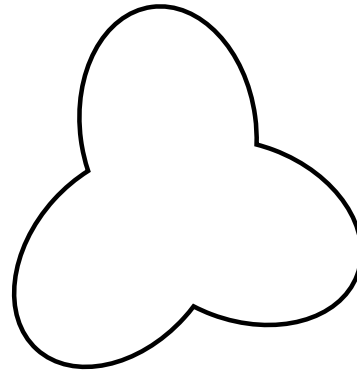
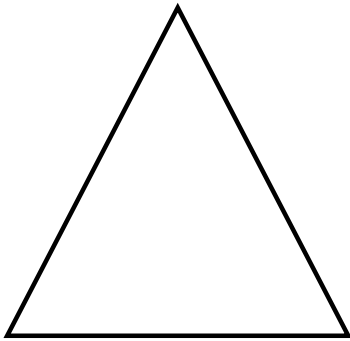
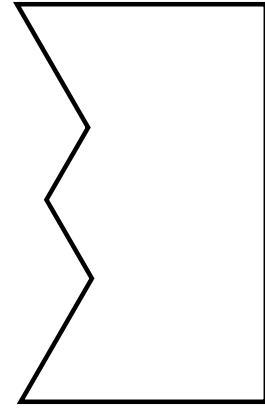
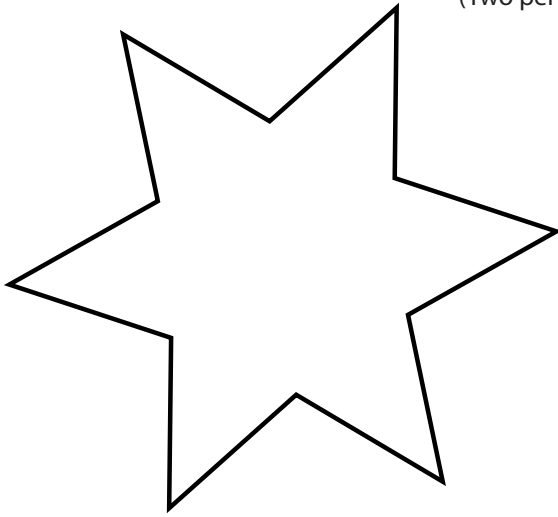
(Two per student)



Note: The shapes are for conceptual purposes only. They do not reflect the actual shapes of antigens.

Antibody Templates

(Two per student)



Note: The shapes are for conceptual purposes only. They do not reflect the actual shapes of antibodies.

Organ and Tissue Rejection: Student Analysis/Discussion

1. Draw your donated leukocyte complete with surface antigens. Remember to include labels for identification purposes.

2. Based on the antigens you were assigned, would a transplant with the leukocyte you drew above be successful? Explain.

3. Your antibodies circulate throughout your body in your blood plasma and have the potential to come in contact with all cells of your body.

- a. If your partner's leukocyte was transplanted and you were the recipient, would it be successful? Explain.

- b. Would you be able to donate your leukocyte to your partner based on his/her antibodies? Explain.

4. Recipients of organ transplants are prescribed anti-rejection medication (also known as an immunosuppressant medication) that is to be taken regularly after the transplant and for the life of the transplanted organ.

- a. Using the vocabulary above (*antigens, antibodies, donor, and recipient*), explain the purpose of the anti-rejection medication.

- b. What do you think would happen if a recipient failed to take the anti-rejection medication(s) for a few days at some point following the transplant?

- c. Predict what could happen to a person's overall health if he/she is taking anti-rejection medication.
