Kidney Donor

Teacher information

Summary:

Students collect and analyze data to determine which potential living kidney donor could safely donate a kidney to a patient with kidney failure. They perform simulated urinalysis, blood typing, and HLA testing.

Core concepts:

- Organisms have feedback mechanisms that detect deviations from the normal state and take corrective actions to return their systems to normal.
- Failure to maintain the chemical aspects of the internal environment within narrow limits favorable for cell activities can result in disease or death.
- The immune system protects against antigens associated with foreign substances.
- Some white blood cells produce antibodies that attack invaders or mark them for killing.
- Sometimes the immune system may attack transplanted organs

Class time required:

Two 40-minute class periods, plus homework

Teacher preparation:

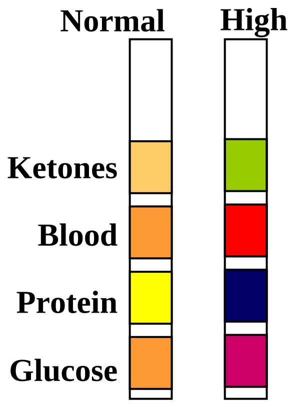
For Test 1 - Urinalysis

1. Make the following simulated urine samples: Mix pH buffer solutions and then add just enough yellow food color to make the solutions look like urine. Then, fill 2ml microtubes or small test tubes with the simulated urine samples.
   - **Patient** = pH 11 buffer + yellow food color
   - **Donor X** = pH 4 buffer + yellow food color
   - **Donor Y** = pH 4 buffer + yellow food color
   - **Donor Z** = pH 2 buffer + yellow food color

2. Put the following items into a bag or container labeled "Test 1 – Urinalysis":
   - 4 microtubes with each of the urine samples prepared above
   - Test 1 Urinalysis Kit instructions (see next page) with instructions for urinalysis. (Consider laminating this for reuse)
   - A small bag labeled "Urinalysis Test Strips" containing 4 EMD pH 0-14 test strips. These can be ordered from VWR Scientific: Catalog # EM-9590-1, Colorphast pH Test strips, EMD Chemicals. Approximately $17.00 per 100 strips. (http://vwrlabshop.com/colorbphbast-ph-test-strips-emd-chemicals/p/0011566/)

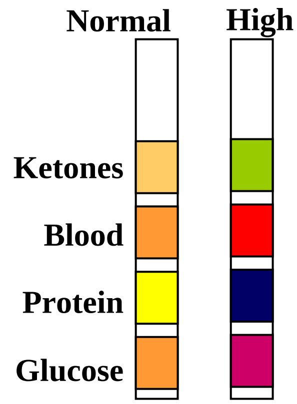
Print in color and cut into 4 squares. Put one in each "Test 1 – Urinalysis" bag.

Test 1
Urinalysis Kit



1. Dip the test strip into the urine sample for 1 second.
2. Immediately compare the color of the test strip to the strips shown on the right.
3. Record whether the levels of each substance (Ketones, Blood, Protein, and Glucose) are NORMAL or HIGH.

Test 1
Urinalysis Kit



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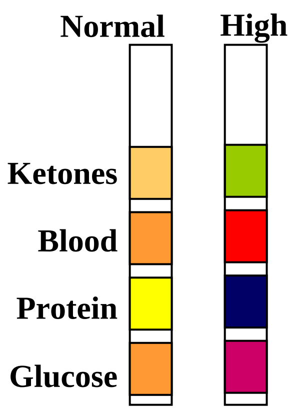
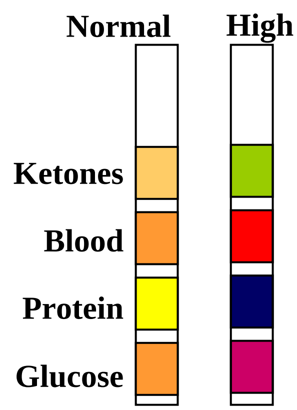
Test 1
Urinalysis Kit



1. Dip the test strip into the urine sample for 1 second.
2. Immediately compare the color of the test strip to the strips shown on the right.
3. Record whether the levels of each substance (Ketones, Blood, Protein, and Glucose) are NORMAL or HIGH.

Test 1
Urinalysis Kit



1. Dip the test strip into the urine sample for 1 second.
2. Immediately compare the color of the test strip to the strips shown on the right.
3. Record whether the levels of each substance (Ketones, Blood, Protein, and Glucose) are NORMAL or HIGH.

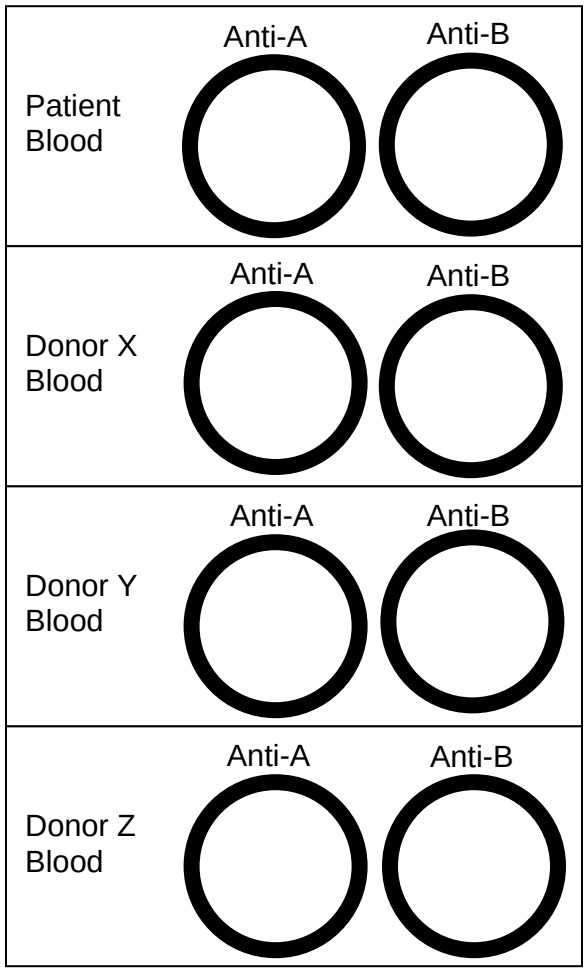
For Test 2 - Blood Typing

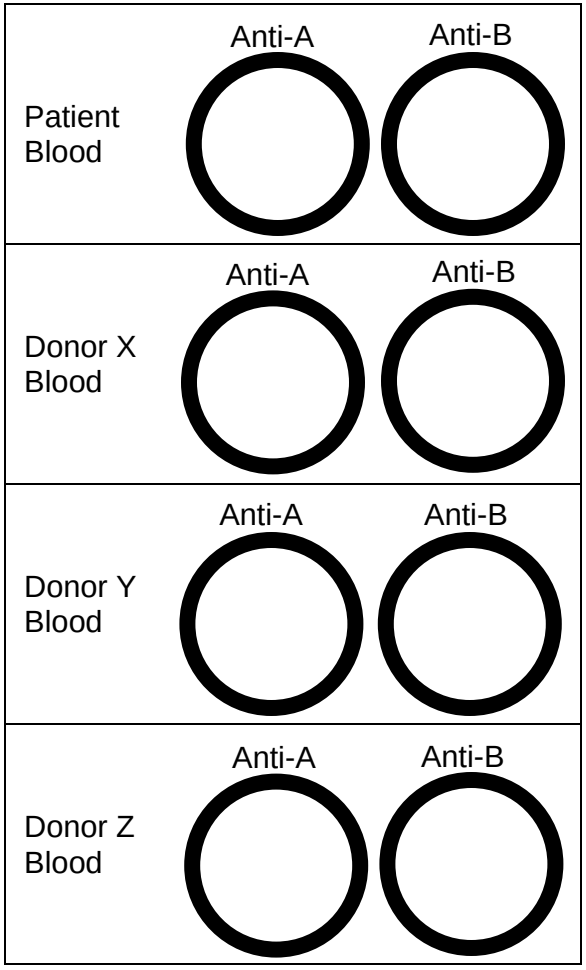
1. Prepare simulated blood typing solutions (100 ml of each):
   - **Anti A** = 15% calcium chloride solution with yellow food color to make faint yellow
   - **Anti B** = 8% baking soda solution with blue food color to make faint blue
   - **Patient** = 8% baking soda solution (Type A blood). Add 10 drops red food color and 1 drop green food color to each 100 ml to make the solution look like blood
   - **Donor X** = 15% calcium chloride solution (Type B blood). Add 10 drops red food color and 1 drop green food color to each 100 ml to make the solution look like blood
   - **Donor Y** = water (Type O blood). Add 10 drops red food color and 1 drop green food color to each 100 ml to make the water look like blood.
   - **Donor Z** = 15% calcium chloride solution (Type B blood). Add 10 drops red food color and 1 drop green food color to each 100 ml to make the solution look like blood

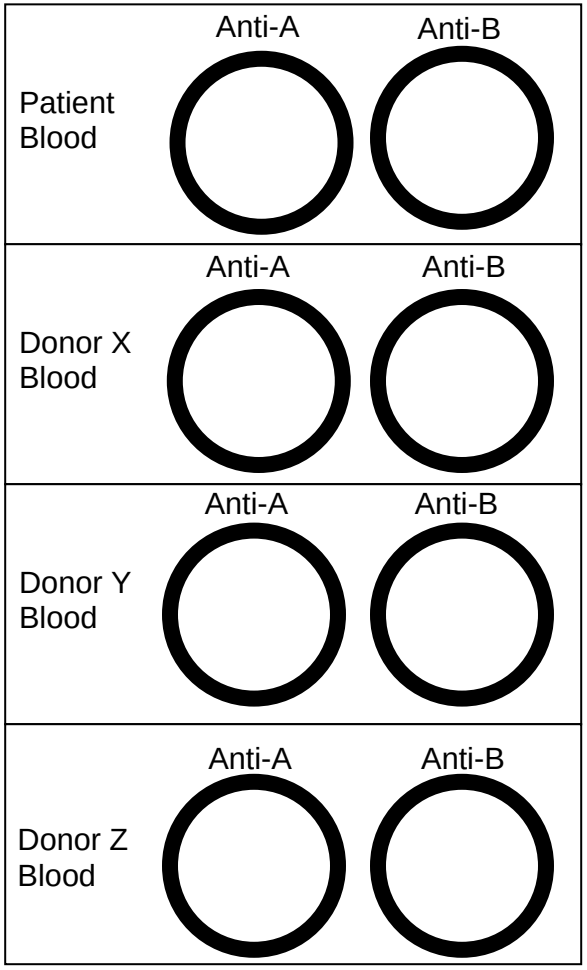
2. Transfer the prepared blood typing solutions to labeled microtubes or small test tubes (NOTE: you can pre-fill dropper pipets with these solutions):
   - "Patient Blood" - approximately 0.5 mL per tube
   - "Donor X Blood" - approximately 0.5 mL per tube
   - "Donor Y Blood" - approximately 0.5 mL per tube
   - "Donor Z Blood" - approximately 0.5 mL per tube
   - "Anti-A Antibodies" - approximately 1.0 mL per tube
   - "Anti-B Antibodies" – approximately 1.0 mL per tube

3. Put the following items into a bag or container labeled "Test 2 - Blood Typing"
   - 1 transparency strip printed with blood typing template (see following pages)
   - Test 2 Blood Typing Kit instructions (see following pages) with instructions for blood typing.
   - 6 microtubes of blood typing solutions as per above
   - 6 dropper pipets – one for each blood typing solution (Optional: Label the dropper pipets to avoid cross contamination)
   - 8 plastic or wooden toothpicks

Print on transparency film and cut out:







Test 2
Blood Typing Kit

IMPORTANT: Be sure to use a different dropper for each solution!

1. Place two drops of Anti-A antibody solution on the Anti-A circles of the plastic slide and place two drops of Anti-B antibody solution on the Anti-B circles of the plastic slide.

2. Place two drops of the blood to be tested (Patient, Donor X, Donor Y, or Donor Z) on each of the appropriate circles on the plastic slide.

3. Use a different toothpick to stir the fluid in each circle for 5 seconds.

4. Observe each circle to determine whether the blood is clumped (cloudy) or is not clumped (clear). It may be easier to see the clumping if you place the test strip on a dark surface.

Test 2
Blood Typing Kit

IMPORTANT: Be sure to use a different dropper for each solution!

1. Place two drops of Anti-A antibody solution on the Anti-A circles of the plastic slide and place two drops of Anti-B antibody solution on the Anti-B circles of the plastic slide.

2. Place two drops of the blood to be tested (Patient, Donor X, Donor Y, or Donor Z) on each of the appropriate circles on the plastic slide.

3. Use a different toothpick to stir the fluid in each circle for 5 seconds.

4. Observe each circle to determine whether the blood is clumped (cloudy) or is not clumped (clear). It may be easier to see the clumping if you place the test strip on a dark surface.

Test 2
Blood Typing Kit

IMPORTANT: Be sure to use a different dropper for each solution!

1. Place two drops of Anti-A antibody solution on the Anti-A circles of the plastic slide and place two drops of Anti-B antibody solution on the Anti-B circles of the plastic slide.

2. Place two drops of the blood to be tested (Patient, Donor X, Donor Y, or Donor Z) on each of the appropriate circles on the plastic slide.

3. Use a different toothpick to stir the fluid in each circle for 5 seconds.

4. Observe each circle to determine whether the blood is clumped (cloudy) or is not clumped (clear). It may be easier to see the clumping if you place the test strip on a dark surface.

(For Test 3 - Evaluate the Health of the Donor, the graphs are provided in the student handout. No extra materials required.)

Test 4 - HLA Tissue Typing

1. Print the HLA testing strips on the next page on card stock.

2. Use a cotton swab or small paint brush to paint small spots of 2% phenolphthalein solution in the center of the boxes as indicated in colored circles below:

Use this template as a guide for where to paint the spots…

	HLA Antigen A				HLA Antigen B			HLA Antigen DR	
	A-1	**A-2**	**A-3**	**A-4**	**B-1**	**B-2**	**B-3**	**DR-1**	**DR-2**
1. Patient	○	●	○	●	○	●	●	●	●
2. Possible Donor	●	●	○	○	●	○	●	●	●

3. Put the following items into a bag or container labeled “Test 4 - HLA Tissue Typing”

- One of the painted HLA Tissue Typing test strips prepared as per above.
- Test 4 HLA Testing Kit instructions (see following pages) with instructions for HLA testing.
- 1 microtube (or small test tube, or pre-filled dropper pipet) labeled “Patient” containing about 1 ml of pH 10 buffer.
- 1 microtube (or small test tube, or pre-filled dropper pipet) labeled “Possible Donor” containing about 1 ml of pH 10 buffer.
- 2 dropper pipets

Print on card stock and cut out. Then, paint small spots of 2% phenolphthalein solution in the center of the boxes as indicated in colored circles on the previous page

HLA Tissue Typing

	HLA Antigen A				HLA Antigen B			HLA Antigen DR	
	A-1	A-2	A-3	A-4	B-1	B-2	B-3	DR-1	DR-2
1. Patient	○	○	○	○	○	○	○	○	○
2. Possible Donor	○	○	○	○	○	○	○	○	○

HLA Tissue Typing

	HLA Antigen A				HLA Antigen B			HLA Antigen DR	
	A-1	A-2	A-3	A-4	B-1	B-2	B-3	DR-1	DR-2
1. Patient	○	○	○	○	○	○	○	○	○
2. Possible Donor	○	○	○	○	○	○	○	○	○

HLA Tissue Typing

	HLA Antigen A				HLA Antigen B			HLA Antigen DR	
	A-1	A-2	A-3	A-4	B-1	B-2	B-3	DR-1	DR-2
1. Patient	○	○	○	○	○	○	○	○	○
2. Possible Donor	○	○	○	○	○	○	○	○	○

Print and cut into 4 squares. Place 1 in each "Test 4 - HLA Tissue Typing" bag.

Test 4
HLA Tissue Typing Kit

IMPORTANT: Use a different dropper for each solution

1. Place 1 drop of Patient white blood cells in the center of each box in Row 1.
2. Place 1 drop of Possible Donor white blood cells in each box of Row 2.
3. A pink color results when antigens on the white blood cells bind to antibodies on the test strip.
4. A pink color indicates that a specific HLA antigen is present.

Test 4
HLA Tissue Typing Kit

IMPORTANT: Use a different dropper for each solution

1. Place 1 drop of Patient white blood cells in the center of each box in Row 1.
2. Place 1 drop of Possible Donor white blood cells in each box of Row 2.
3. A pink color results when antigens on the white blood cells bind to antibodies on the test strip.
4. A pink color indicates that a specific HLA antigen is present.

Test 4
HLA Tissue Typing Kit

IMPORTANT: Use a different dropper for each solution

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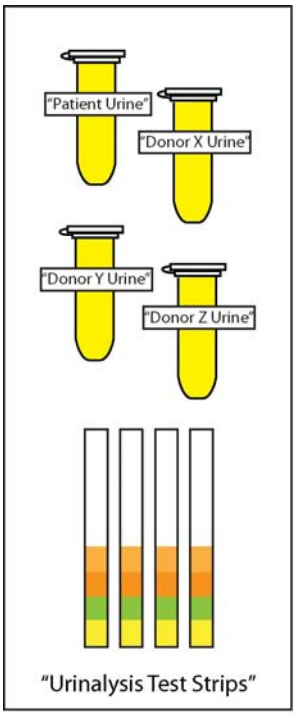
3. A pink color results when antigens on the white blood cells bind to antibodies on the test strip.
4. A pink color indicates that a specific antigen is present.

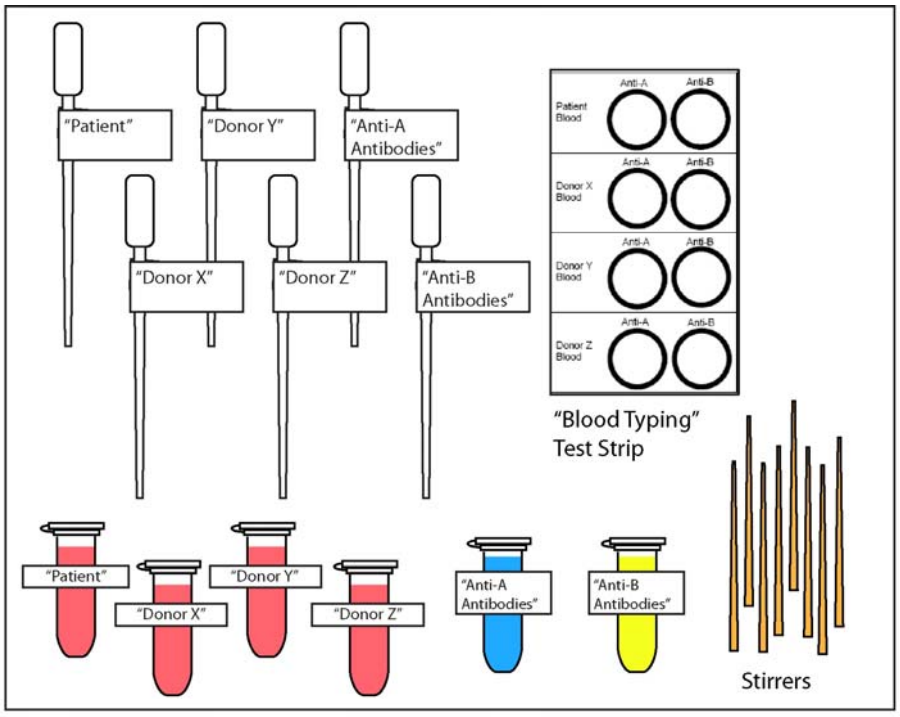
Test 4
HLA Tissue Typing Kit

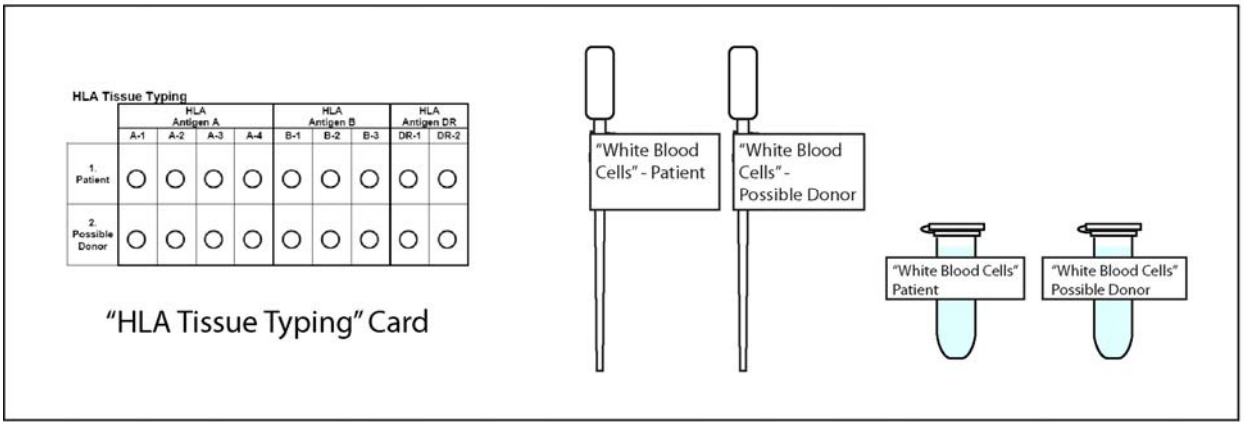
IMPORTANT: Use a different dropper for each solution

1. Place 1 drop of Patient white blood cells in the center of each box in Row 1.
2. Place 1 drop of Possible Donor white blood cells in each box of Row 2.
3. A pink color results when antigens on the white blood cells bind to antibodies on the test strip.
4. A pink color indicates that a specific antigen is present.

Quick Guide:







During Class:

1. Group students into lab teams of 2-4 students.
2. Distribute to each student 1 copy of *Kidney Donor*
3. Read *The Case* and *Your Task* aloud to the entire class.
4. Ask students to work with their team members to complete the *Kidney Donor* activity.
5. Optional: Ask teams (or the class) to make a list of what they know about kidney donation or other types of organ transplants. Consider inviting a speaker to discuss the importance of signing an organ donor card and discussing organ donation with their families.

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