# Human Excretion: Biological Investigation Worksheet

## Learning Objectives

- Understand the key components and functions of the human excretory system
- Analyze the process of filtration and reabsorption in kidneys
- Investigate the relationship between lifestyle factors and kidney health
- Develop critical thinking skills through practical investigations

## Initial Knowledge Assessment (15 minutes)

*Answer the following questions to the best of your knowledge:*

1. Define excretion and explain its importance in human body function:

2. Complete the table below with the main excretory organs and their functions:

| Excretory Organ | Main Function | Waste Products Removed |
|---|---|---|
| Kidneys | | |
| Skin | | |
| Lungs | | |
| Liver | | |

## Kidney Function Investigation (25 minutes)

**Practical Activity: Modeling Kidney Filtration**

*Working in groups of 3-4, create a model to demonstrate how kidneys filter blood.*

**Materials Provided:**

- Large beaker with colored water (representing blood)
- Coffee filter (representing glomerulus)
- Small beads (representing blood cells)
- Salt (representing waste products)
- Collection container (representing collecting duct)

**Procedure:**

1. Mix the provided materials according to your understanding of kidney filtration
2. Draw and label your experimental setup below:

[Space for diagram]

**Analysis Questions:**

1. Explain how each material in your model represents parts of the kidney:

2. Describe what happened during the filtration process:

3. How does this model help explain real kidney function?

## Data Collection and Analysis (20 minutes)

*Complete the following investigation about factors affecting kidney function.*

### Part 1: Analyzing Urine Production Factors

Study the following data table showing water intake and urine output for different scenarios:

| Scenario | Water Intake (mL) | Activity Level | Temperature | Urine Output (mL) |
|---|---|---|---|---|
| Normal Day | 2000 | Moderate | 20°C | 1500 |
| Sports Day | 3000 | High | 25°C | 1200 |
| Cold Day | 1500 | Low | 10°C | 1400 |

**Analysis Questions:**

1. What relationship do you observe between water intake and urine output?

2. How does activity level affect urine production?

3. Explain why urine output varies with temperature:

## Creative Assessment Task (20 minutes)

*Choose ONE of the following tasks to demonstrate your understanding:*

1. Design an informative poster about kidney disease prevention
2. Create a flowchart showing the journey of a water molecule through the excretory system
3. Write a creative story from the perspective of a nephron processing waste

[Space for creative work]

## Homeostatic Control Investigation (30 minutes)

*Explore how the kidneys maintain homeostasis through various feedback mechanisms.*

### Experiment: Blood Concentration Regulation

**Scenario Analysis:** Study the following blood test results and explain the kidney's response:

| Parameter | Normal Range | Patient A | Patient B | Patient C |
|---|---|---|---|---|
| Sodium (mmol/L) | 135-145 | 148 | 142 | 132 |
| Blood Pressure (mmHg) | 120/80 | 135/90 | 118/78 | 110/70 |
| ADH Levels (pg/mL) | 1-5 | 2.1 | 4.8 | 6.2 |

**For each patient, explain:**

1. The likely cause of their condition:
2. The kidney's homeostatic response:
3. Recommended lifestyle changes:

## Hormonal Control Mapping (25 minutes)

**Complete the following hormone pathway diagram:**

[Insert hormone pathway diagram here]

**Match the hormones with their functions:**

| Hormone | Function | Trigger |
|---|---|---|
| ADH | | |
| Aldosterone | | |

| | | |
|---|---|---|
| ANP | | |

## Kidney Disease Case Studies (40 minutes)

### Case Study 1: Chronic Kidney Disease

Patient X is a 45-year-old male with a 10-year history of type 2 diabetes. Recent tests show elevated creatinine levels and protein in urine.

| Test | Result | Normal Range |
|---|---|---|
| GFR (mL/min) | 45 | >90 |
| Protein in Urine (mg/day) | 150 | <150 |
| Blood Pressure (mmHg) | 145/95 | 120/80 |

1. Identify three risk factors that contributed to this condition:
2. Explain how diabetes affects kidney function:
3. Suggest a treatment plan including lifestyle modifications:

### Case Study 2: Acute Kidney Injury

Patient Y is a 28-year-old athlete admitted after a marathon with severe dehydration and muscle pain.

**Symptoms:**

- Dark colored urine
- Reduced urine output
- Muscle tenderness
- Fatigue and confusion

1. Explain the relationship between extreme exercise and kidney function:
2. Describe the immediate treatment priorities:
3. Suggest preventive measures for future athletic events:

## Advanced Kidney Function Assessment (35 minutes)

### Investigation: Urine Analysis Techniques

**Materials Required:**

- Urine test strips
- pH meter
- Microscope
- Sample collection containers
- Safety equipment

| Test Parameter | Normal Range | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|---|
| pH | 4.5-8.0 | | | |
| Protein (mg/dL) | 0-20 | | | |
| Glucose (mg/dL) | 0-15 | | | |

**Microscopic Analysis:**

[Draw and label any cellular components observed]

**Analysis Questions:**

1. What does the presence of protein in urine indicate?
2. How does pH variation affect kidney function?
3. Explain the significance of glucose in urine samples:

## Final Assessment and Reflection (30 minutes)

### Knowledge Application

**Create a detailed concept map linking the following terms:**

- Nephron
- Filtration
- Reabsorption
- Homeostasis
- Blood pressure
- Hormones
- Waste products

[Space for concept map]

**Personal Reflection:**

1. What was the most challenging concept to understand?
2. How has this investigation changed your understanding of kidney function?
3. What lifestyle changes would you consider after learning about kidney health?

### Extension Challenge

Choose ONE of the following research topics:

1. The impact of artificial kidneys (dialysis) on patient life quality
2. Emerging technologies in kidney disease treatment
3. Cultural perspectives on organ donation

[Space for research notes and findings]

## Reflection and Summary

*Complete these final reflection questions to consolidate your learning:*

1. What was the most interesting thing you learned about the excretory system today?

2. How would you explain kidney function to a younger student?

3. What questions do you still have about human excretion?

### Teacher Assessment

| Learning Objective | Achieved | Comments |
|---|---|---|
| Understanding of excretory system | | |
| Practical investigation skills | | |
| Data analysis and interpretation | | |