Urinalysis, or evaluation of the urine, is helpful in providing information about many diseases. Abnormalities seen on a urinalysis may be a reflection of systemic disease processes involving many organ systems or may reflect problems in the urinary tract itself. Urine is a waste product produced by the kidneys and is voided to the outside world via the urethra (see PowerPage on Kidneys for more information regarding urine production and anatomy of the urinary system).

### Collecting Urine

Urine may be collected three different ways:

1) **Free catch** (a voided sample) may include contaminants from the genitalia as the sample passes out of the body. Not useful for culture. The act of urination is known as *micturition*.

2) **Cystocentesis** - insertion of a needle into the bladder for sterile collection. Samples may contain a small amount of iatrogenic blood when obtained in this manner. This is the preferred method for urine culture. Between the last nipples on mid-line is the most reliable location for collection.

3) **Urinary catheterization** (easier in male dogs, more difficult in females without sedation and rarely performed in females). It is a sterile procedure (using sterile gloves, sterile u-cath, and the prepuce/penis or vulva is cleansed prior to sample collection).

### Gross Evaluation of the Sample:

1) **Color** - Normal urine is yellow. Whether the urine is dark or light yellow is often a reflection of sample concentration or whether it contains pigment such as bilirubin (which often gives a bright yellow appearance).

2) **Transparency** - Normal yellow is clear in dogs and cats. In large animals it is more turbid or cloudy. Causes of cloudiness may be from crystals, infection (white blood cells or bacteria), mucus, casts, sperm, etc.)

3) **Odor** - Urine may smell like ammonia. In ketoacidosis, the urine may smell like acetone. A foul odor is sometimes noticed if there are bacteria in the urine. Sometimes certain medications may cause the urine to have an odor.

4) **Quantity** - The quantity of urine that is voided may be helpful in determining if the animal is completely voiding. Normal urine production for species per day in mL per pound: dogs 12-30mL, cats 5-9mL, bovine 8-20mL, equine 2-8mL, swine 2-14mL, sheep/goats 4.5-18mL.

### Urine Specific Gravity

To evaluate the concentration of urine, a Urine Specific Gravity (USG) is performed, which is a reflection of osmolality. This is done by placing a drop of urine on a *refractometer*. Normal specific gravity is around 1.025-1.050. Dilute urine samples (less than 1.025) may be caused by the kidney’s inability to concentrate the sample (renal failure), or by increased drinking due to other reasons (diabetes mellitus, hypoadrenocorticism, hot weather, etc.). It is best to perform the USG on a first morning sample for most accurate results. A hyper-concentrated sample (greater than 1.050) is most often a result of dehydration. Isosthenuria is a low concentration (1.008-1.012). Hypostenurusia is inability to concentrate (less than 1.008).
Urine Reagent Strip (dipstick)

The urine is typically tested via a dipstick which gives results for:

1) **pH** - tests the **acidity. A pH less than 7 is acidic and a pH greater than 7 is alkaline.** Samples left sitting out for extended periods may result in increased (alkaline) pH. The pH of the urine is often related to diet, medications, or time of collection.

2) **Protein** - often indicates urinary tract disease, especially renal disease; may also be positive if contaminants are present in the sample (cells, bacteria); may be confirmed by the **sulfosalicylic acid test.**

3) **Glucose** - Glucosuria is caused when renal threshold is exceeded (more than 170 mg/dl in dogs). The most common cause of glucosuria is diabetes. In cats that are excited or stressed/scared, hyperglycemia may occur, exceeding the renal threshold, and may cause glucosuria. Renal glucosuria (which is rare) may also occur due to decreased resorption of glucose in the renal tubule due to kidney disease.

4) **Ketones** - decreased catabolism of fatty acids results in ketonuria. Causes include: 
   a) **Pregnancy Toxemia:** energy requirement for milk production exceeds energy intake and body fat is metabolized, causing ketone production. Important cause in cattle and small ruminants.
   b) **Diabetes** - lack of insulin leads to inappropriate metabolism of carbs such that fat is broken down and ketones are produced.
   c) **Starvation** or prolonged hypoglycemia, low carb diet, or long standing **fever** may also cause the production of ketones.

5) **Bilirubin** - may be normal in dogs and cattle. It is never normal in cats, pigs, sheep, or horses. Presence suggests **biliary obstruction** or **hemolytic anemia** (liver cannot excrete the excess bilirubin which is released from the lysed erythrocytes). Confirmed with the **Ictotest.**

6) **Blood** - reagent strip will react to erythrocytes, hemoglobin and myoglobin. Differentiate these with sediment exam. **Erythrocytes** suggest bleeding from urinary or genital tract. **Hemoglobin** suggests intravascular hemolysis. **Myoglobin** suggests muscle damage.

7) **Nitrate** - positive reaction suggests bacteriuria, but negative doesn’t rule out the presence of bacteria.

8) **Leukocytes** - more reliable in dogs on a test strip. False positives very common in cats. Confirm presence of white blood cells on sediment exam. Suggest urinary tract infection or inflammation in the urogenital tract.

Sediment Evaluation

The urine sample is centrifuged on low speed to separate the sediment from the supernatant. The supernatant is poured off, and the sediment and remaining urine is mixed and a drop applied to a slide and coverslipped for microscopic evaluation.

Possible sediment findings:

1) **cells** (red blood cells, white blood cells, transitional cells - the cell type found in the urinary tract)
2) **crystals** (calcium oxalate, struvite, urate, bilirubin, cystine, other) These may be normal in concentrated urine specimens. Animals with ethylene glycol toxicity often have calcium oxalate crystalluria. See Power Page on Kidneys for detailed description of crystals and uroliths.
3) **casts** - cylindrical mold of renal tubules made of protein or cells (hyaline, granular, cellular).
4) **bacteria** (with presence of leukocytes, infection is likely, or may be from contamination if the sample was voided)
5) **sperm** in free catch intact male samples or females if recently bred
6) **fat**
**References**

