Urinalysis can easily be performed in a veterinary practice. A complete urinalysis consists of the physical and chemical evaluation of urine as well as examination of the sediment. The physical examination of urine includes evaluation of color, turbidity and measurement of specific gravity. Chemical evaluation is performed with the use of reagent strips (dipsticks). Examination of the urine sample should be performed soon after collection, preferably within 30 minutes. If the urinalysis cannot be performed within that time the urine sample should be stored in the refrigerator and analyzed within six hours. Urine samples should be brought back to room temperature before evaluation.

**PHYSICAL EXAMINATION OF URINE**

Color and turbidity may yield clues as to what might be found in the urine sediment. Normal urine is typically pale yellow, yellow or dark yellow in color and transparent. The turbidity of a urine sample is a reflection of amount of particulate matter in the sample; therefore samples that are cloudy in appearance may have a significant amount of sediment present after being centrifuged. Particles that may affect the turbidity of urine include bacteria, crystals and cells. Intensity of the yellow color may vary with urine concentration. Colorless and pale yellow urines generally have low specific gravities, whereas dark yellow urines may have high specific gravities and sometimes positive bilirubin on the dipstick analysis. Red, clear urines may have a positive blood on the dipstick but few intact red blood cells present in the sediment. Red, cloudy urines generally have a positive blood on the dipstick and red blood cells present in the urine sediment. Coffee colored urines (suspect myoglobin in the urine) often have a positive blood on the dipstick and few red blood cells present in the urine sediment.

Specific gravity gives an indication of the kidneys' ability to either dilute or concentrate urine. It is easily measured with a refractometer and can be measured either before or after centrifugation of the urine. The measurement of specific gravity using reagent strips (dipsticks) is unreliable and should not be used.
CHEMICAL EVALUATION OF URINE

The chemical evaluation of urine is generally performed using commercially available reagent strips (dipsticks). It is imperative to read and follow the manufacturers’ instructions when using reagent strips. Individual tests need to be read at the precise time recommended by that manufacturer as results can change as time progresses. Urine should be well mixed before reagent strip testing.

Urine pH

Urine pH can be affected by multiple factors such as the animal’s acid base status, diet, sample age or presence of a urinary tract infection. Generally the urine of carnivores is acidic and the urine of herbivores is alkaline. Awareness of the urine pH may be helpful when looking at other components of the urine sample. A high pH (alkalotic, pH > 8.0) in the urine sample may cause the deterioration of red blood cells, white blood cells and casts, making them difficult to identify in the urine sediment. Knowledge of the pH of the urine may also be helpful when identifying crystals, as certain crystals may be more likely to form in either an acidic or alkaline environment.

Protein

Reagent strips are used as a screening test for proteinuria. The reagent strips are sensitive to albumin but relatively insensitive to globulins, especially those such as Bence-Jones proteins. False positive readings can occur in samples with an alkaline pH, when the reagent strip has been kept in the sample too long, the reagents leach out, or with certain types of disinfectants (quaternary ammonium compounds). The sulfosalicylic acid test can be used to confirm the presence of protein in a urine sample. Both the reagent dipsticks and the sulfosalicylic acid test are considered semi-quantitative screening tests for urine protein. For more precise levels of urine protein a urine protein:creatinine ratio (UPC) should be considered.

Glucose

The level of glucose found in normal urine is below the sensitivity (detection) of the reagent strip. Several of the most commonly used brands of reagent strips, such as Multistix® and Petstix® absorb urine on the glucose test pad from the side of the pad, not the top. Therefore, urine must contact the side of the test pad to be measured. If an individual drop of urine is placed on top of these test pads glucose will not be measured. It is important to follow the manufacturers’ directions when using reagent strips.

False positive reactions on the glucose test pad may be caused by some cleaning products such as bleach and hydrogen peroxide. False negative reactions on the
glucose test pad can be caused by high levels of ascorbic acid (vitamin C) in the urine, outdated reagents, reagents that have been exposed to sunlight and certain drugs such as salicylates.

A drop of urine was placed on top of the urine glucose reagent pad. Because this brand of reagent pad absorbs the sample from the sides not the top, glucose is not being measured correctly in this case.

Timing is critical when reading glucose levels. The images show examples of changes in glucose levels. The image on the left displays the glucose level at the proper reading time (30 seconds for this brand of reagent strip). The image on right displays the glucose level on the same sample but the time is now 5 seconds past the proper time to read the result. Small changes in timing can impact test results, so it is imperative to read results at the proper time.

Ketones
Ketone bodies include acetoacetic acid, acetone and beta-hydroxybutyric acid. Most reagent strips primarily measure for the presence of acetoacetic acid and acetone. The reagent strips do not detect the presence of beta-hydroxybutyric acid. The ketone measuring test pad on the reagent strip is sensitive to exposure to heat, light and moisture so care should be taken to promptly recap the container after removal of a test strip and the test strip should be used without delay. False negatives can result if urine samples are not analyzed immediately; if urine samples cannot be analyzed immediately they should be refrigerated as ketones are volatile and may evaporate quickly. False positive reactions may result from urine that is highly pigmented.

Bilirubin
Bilirubin levels on the reagent test pad can be difficult to assess because color changes (light tan to beige) may be subtle. More sensitive confirmatory tests such as the Ictotest® can be used to further judge the presence or absence of bilirubin in the urine sample. Bilirubin is unstable, particularly when left at room temperature. Exposure to light will also degrade bilirubin. Therefore, urine samples should be analyzed within at least 30 minutes of collection or refrigerated. False positive reactions can occur when the urine is discolored. Some examples of urine discoloration include macroscopic hematuria, usage of synthetic blood products or certain types of drugs. False negative results are possible in old urine samples due to degradation of bilirubin. High levels of ascorbic acid (vitamin C) may also inhibit the sensitivity of the test.
Occult Blood
Reagent strips will indicate the presence of hematuria, hemoglobinuria or myoglobinuria. Evaluation of the urine sediment may be helpful in differentiating hematuria from hemoglobinuria or myoglobinuria. Red blood cells should be seen microscopically in cases with hematuria. The urine supernatant will have a normal color if there is no significant lysis of red blood cells in the sample. With hemoglobinuria and myoglobinuria there is a lack of red blood cells seen microscopically in the urine sediment and the urine supernatant remains discolored. Possible causes for a positive result on the occult blood test pad of the reagent strip, but yet a lack of red blood cells seen microscopically in the urine sediment include: hemoglobinuria, myoglobinuria, misidentification of the red blood cells (possibly as fat or air bubbles), red blood cell lysis due to dilute or an alkaline urine sample. Causes for a negative reaction on the occult blood test pad of the reagent strip, but where there are red blood cells seen microscopically in the urine sediment include: sampling supernatant or testing a poorly mixed urine sample, using expired reagents or the misidentification of red blood cells.

Urobilinogen
A fresh urine sample is needed in order to accurately assess urobilinogen. However, the correlation between urobilinogen and liver disease is poor. Therefore, urobilinogen is not very useful.

Nitrite
Nitrite is produced by some bacteria. However, the reagent strip cannot reliably detect the presence of bacteria; therefore, it is recommended that this test not be used.

Leukocytes
The leukocyte test pad is designed to detect the presence of white blood cells or partial white blood cells in the urine; however, they were developed to do this in humans not animal species. False positives frequently occur in cats. In dogs there are many false negatives. This test is not reliable and therefore should not be used.

Specific Gravity
The specific gravity test pad on the reagent strip is not reliable for use in animals. The highest value that the specific gravity test pad can measure is approximately between 1.025 and 1.030, which is not adequate for determining the renal concentrating capacity in animals. Alkaline urine may cause low specific gravity readings and protein present in moderate levels may cause elevated specific gravity readings on the reagent strip. Using a refractometer is the best method available to measure the specific gravity in urine.

Conclusion
While urinalysis can easily be performed in practice situations, care must be taken to handle samples properly and attention must be paid to correctly performing testing procedures and the understanding of their limitations. Using reagent strips to test urine is economical and easily performed. All veterinary practices should be capable of performing these tests accurately in-house. In-house performance of urinalysis helps provide accurate, timely results, thus reducing the incidence of test results which have been affected by aging changes in the urine sample itself.