Honors Physiology **Name: _____**
Urinary System Reading Exchange

Directions: ***Before reading***, in the first column, write "A" or "D," indicating your agreement or disagreement with each statement. ***As you and your group members read,*** compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

Me	Text	Statement
		1. Most people produce less than one liter of urine a day.
		2. If you are dehydrated, your urine is darker because there is less water to dissolve the chemicals, so their concentration is higher.
		3. Urine can be green, blue, orange, yellow, or wine-colored, due to different medications, vitamins, foods, or genetic conditions.
		4. Some medical conditions can be detected by simply observing urine.
		5. Dipsticks can measure pH, glucose, leukocytes, and concentration of urine.
		6. The pH of urine ranges from 7-9.
		7. Glucose is usually found in urine.
		8. Dipsticks can tell which antibiotics would be most effective in treating an infection.
		9. Scientists do not know why eating asparagus causes the urine of many people to smell.

Directions: As you and your group members read, use the chart below to describe how urine can help doctors diagnose medical problems.

Test	Possible diagnosis
Dark color	
Cloudiness	
Red or brown color	
Change in smell	
pH	
Sugar	
Leukocytes	
Nitrites	

Why are our kidney's so critical to our health? (cite information from the articles!)

Why does asparagus make our urine smell?

Claudia Hammond, 18 August 2014
Health Science & Environment Genetics Human body Nature Organ

After eating asparagus, some people can detect a strange smell, while others claim not to notice a thing. What's going on?

We've been aware of the pungent properties of asparagus for a long time. Back in 1731 the Scottish mathematician and doctor, John Arbuthnot wrote that asparagus gives urine "a foetid smell". Not everyone dislikes the smell, though: Marcel Proust said it had the effect of transforming his "humble chamber pot into a bower of aromatic perfume".

A quick straw poll over dinner (assuming you feel it's the right time to raise this kind of subject), typically reveals your guests fall in to certain camps. Some people will have never detected anything strange about their urine after they've eaten asparagus. Others assume that because their urine smells so strong afterwards, then so must everyone's. Then someone else may complicate matters by revealing they've smelt it after their partner has been in the bathroom, but can't detect it in their own urine.

On the basis of these observations, it seems that some people are producers of pungent asparagus-tainted urine, while some are detectors – but the two don't necessarily go together. But data is not the plural of anecdote, so more evidence is needed.

It's no good just asking people whether or not they can smell asparagus in their own urine. If they say yes, they're both a producer and a detector, but if they say no, we don't know whether they simply couldn't detect the smell. So what we need are laboratory experiments. Sniffing other people's urine might not be everyone's idea of fun, but several experimenters have managed to recruit enough volunteers to do it.

In 1956, a team of British researchers demonstrated that fewer than half of people produce the odour in their urine, which was assumed to be down to the influence of a single gene. Another British study from 1987, with a larger sample of 800, found a similar proportion. Confusingly, other studies have found a much higher percentage of producers. An American study from 1985 put the number at 79%, and one in 2010 at almost 92%. This raises the possibility there may be ethnic differences in the trait.

Perhaps further clues might come from the chemicals that produce the signature smell. One prime suspect from many studies is a sulphur compound called methanethiol. In the 1956 study, though, the researchers found methanethiol present in the urine of some asparagus-eaters and not others. But the researchers were only looking for compounds in the urine itself, which doesn't necessarily mean the smell could be detected. For that you need to examine the vapour given off by the urine. Analysis of the vapour using gas chromatography revealed four compounds. The strongest smelling are methanethiol and dimethyl sulphide which smell like old cabbage. There are also two compounds which might give the odour that tinge of sweetness.

These compounds are unlikely to have been in the asparagus when we ate it; they are small and delicate molecules that cooking would destroy. So what we need is a substance only found in asparagus, which remains intact during cooking, but is broken down by the body to produce the smaller odorous compounds. Appropriately there is a substance unique to asparagus called asparagusic acid. Could this be the source of the smell? So far no one has been able to prove that it creates the distinctive smell, but nor can they find another chemical that fits the description.

That's as much as we know about producers, but what about the detectors? Some studies seem to confirm the suspicion that not everyone is able detect the pong. When people in Israel were given different dilutions of the urine to sniff, only 10% could detect the asparagus. And in a Chinese sample only 24% could do it.

The problem with some studies, such as the Israeli one, is that people were asked to compare asparagus urine with water, rather than with non-asparagus urine, so they could have been detecting other notes in the urine, rather than asparagus in particular.

At the Monell Chemical Senses Center in Philadelphia, physiological psychologist Marcia Pelchat was determined to get to the bottom of the mystery. One day she had her volunteers drink a bottle of water and eat asparagus which had been roasted for eight minutes in some olive oil with a little salt. Then nature took its course and two hours later the ensuing urine was put into the deep freeze. The next day the same people were given the same-sized bottle of water along with an Italian bread roll containing the same amount of oil and salt as the asparagus. Then the rest of the procedure was repeated. Of the volunteers that sniffed their own and other subject's urine, only 8% were non-producers and only 6% were non-detectors.

It is theoretically possible that people may lack an enzyme which prevents them from both producing and detecting a particular odour in urine. But so far there doesn't seem to be much evidence of this – the study showed just one person neither produced nor detected the asparagus.

From her results, Pelchat found evidence that the ability to detect the smell was related to a single gene, but she saw no such link for odour production. So we still don't know why it is that some people seem not to create this smell. Is it that they've not absorbed it, not processed it on the body or not excreted it? Or perhaps we all excrete it, but some do so in such tiny quantities that they would need to eat several bunches of asparagus before it was detectable by other humans.

So, we still can't answer a simple question like why asparagus makes our urine smell strange. And even if we do find the solution we may never know why Arbuthnot thought the smell is repugnant while some, like Proust, find it so delightful. Sometimes, there's just no accounting for taste.

What's In Pee? Urine Composition Study Reveals More Than 3,000 Chemical Compounds

By: Bahar Gholipour
Posted: 09/08/2013 10:25 am EDT Updated: 09/08/2013 10:25 am EDT

Looking for an encyclopedia of pee? Scientists have laid out the entire chemical composition of human urine, revealing that more than 3,000 compounds are found in the fluid, and have published it all in an online database.

In the study, which took seven years to complete, the researchers found that at least 3,079 compounds can be detected in urine. Seventy-two of these compounds are made by bacteria, while 1,453 come from the body itself. Another 2,282 come from diet, drugs, cosmetics or environmental exposure (some compounds belong to more than one group).

"Urine is an incredibly complex biofluid. We had no idea there could be so many different compounds going into our toilets," said study researcher David Wishart, professor of biology and computing science at the University of Alberta. [Pee Rainbow: From Red to Indigo, What Urine Colors Mean]

The complete list of all metabolites that can be detected in human urine using current technologies has been placed into an online public database called the Urine Metabolome Database.The word metabolome refers to the complete collection of metabolites, which are the products of metabolism and include hormones, vitamins and other molecules.

A favorite among fluids

"Urine has long been a 'favored' biofluid among metabolomics researchers," because it is sterile and can be obtained easily in large volumes, the scientists wrote in their study published Wednesday (Sept. 4) in the journal PLOS ONE.

However, the chemical complexity of urine has made it a difficult substance to fully understand, the researchers said. As a biological waste material, urine typically contains metabolic breakdown products from a wide range of foods, drinks, drugs, environmental contaminants, waste metabolites of the body and bacterial by-products.

Compared to other body fluids such as saliva or cerebrospinal fluid, urine contains about five to 10 times more compounds, and shows a larger chemical diversity, the researchers found. The compounds found in human urine fall into 230 different chemical classes.

"Given that there are only 356 chemical classes in the entire human metabolome, this certainly demonstrates the enormous chemical diversity found in urine," the researchers said.

The researchers also found that more than 480 compounds in urine were not previously reported to be in blood, contrary to the long-standing idea that the collection of chemicals in urine is a subset of compounds found in the blood.

Why so many chemicals?

"The fact that so many compounds seem to be unique to urine likely has to do with the fact that the kidneys do an extraordinary job of concentrating certain metabolites from the blood," the researchers said.

To find the chemicals in urine, the researchers used a variety of techniques, including nuclear magnetic resonance spectroscopy, gas chromatography, mass spectrometry and liquid chromatography. They analyzed urine samples from 22 healthy people, and scoured more than 100 years of scientific literature about human urine to supplement their findings.

The chemical composition of urine may be of interest to physicians, nutritionists and environmental scientists because it reveals medical conditions, as well as information about what a person has consumed, and what chemicals she or he has been exposed to in the environment.

The database of urine chemical composition will continue to grow as new techniques and instruments are developed to identify additional compounds, the scientists said.

"This is certainly not the final word on the chemical composition of urine," Wishart said.

Urine Dipstick Analysis

Physical examination

→ Color

The color of the urine can vary greatly. Normal urine varies from colorless to dark yellow. Various factors can affect urine color.[1]

Common Causes of Urine Discolouration		
Colour	**Pathological causes**	**Food and drug causes**
Brown	Bile pigments, myoglobin	Levodopa, metronidazole, nitrofurantoin, some antimalarial agents, fava beans
Brownish-black	Bile pigments, melanin, methaemoglobin	Cascara, levodopa, methyldopa, senna
Green or blue	Pseudomonal urinary tract infection (UTI), biliverdin	Amitriptyline, indigo carmine, IV cimetidine, IV promethazine, methylthioninium chloride, triamterene
Orange	Bile pigments	Phenothiazines, phenazopyridine, rifampicin, hydroxocobalamin
Red	Haematuria, haemoglobinuria, myoglobinuria, porphyria	Beets, blackberries, rhubarb, phenolphthalein, rifampicin
Yellow	Concentrated urine (orange to gold in dehydration)	Carrots, cascara

→ Turbidity

Cloudy urine may be due to:

Contamination with vaginal mucus or epithelial cells.
Excess phosphate crystals precipitating in alkaline urine (no clinical significance).
Pyuria secondary to infection.[2]
Chyluria (presence of chyle/lymph in the urine - usually secondary to filariasis).[3]
Hyperuricosuria secondary to a diet high in purine-rich foods.[4]
Lipiduria.[5]
Hyperoxaluria.[6]

→ Odor

The normal odor is described as urinoid. In concentrated specimens this can be strong but does not imply infection, which has a more pungent smell. Alkaline fermentation causes an ammoniacal smell, and patients with diabetic ketoacidosis produce a urine that may have a sweet or fruity odor. Other causes of abnormal odors are cystine decomposition (a sulphuric smell), gastrointestinal-bladder fistulae (a faecal smell), medications (eg, vitamin B6), and diet (eg, asparagus).

→ pH

The range is 4.5 to 8, but urine is commonly acidic (ie 5.5-6.5) due to metabolic activity.
Acidic urine (low pH) may be caused by diet (eg, acidic fruits such as cranberries)[10] and uric acid calculi.[11]
Urine pH generally reflects the blood pH but in renal tubular acidosis (RTA) this is not the case. In type 1 RTA (distal) the urine is acidic but the blood alkaline. In type 2 (proximal) the urine is initially alkaline but becomes more acidic as the disease progresses. Alkaline urine (high pH) is seen in the initial stages of type 2 RTA and also with infection with urease-splitting organisms, and may be associated with the formation of stag-horn calculi.[12]

→ Glucose

Nearly all glucose filtered by the glomeruli is reabsorbed in the proximal tubules and only undetectable amounts appear in urine in healthy patients. Above the renal threshold (10 mmol/L) glucose will appear in urine. The test relies upon reaction of glucose with glucose oxidase on dipstick to form hydrogen peroxide which causes colour change. This is specific to glucose and no other sugar.
Useful screen for diabetes mellitus.
False positive results: seen when high levels of ketones are present.[16] Also seen in patients taking levodopa.[17]
False negatives: seen where SG is elevated, in uricosuria and in patients taking ascorbic acid.

Leukocyte esterase and nitrite test

→ Nitrites

This test relies on the breakdown of urinary nitrates to nitrites, which are not found in normal urine.
Many Gram-negative and some Gram-positive bacteria are capable of producing this reaction and a positive test suggests their presence in significant numbers (ie more than 10,000 per ml). A negative result does not rule out a UTI.[1][19]
The reagent is highly sensitive to air exposure, which may cause a false positive response.[20]
False negative results may be seen where:
Bladder incubation time is shortened (less than four hours).
There is absence of dietary nitrate.
There is presence of nitrate reductase-negative organisms (eg, some mycobacteria strains).[21]
Urine SG is elevated.[1]
The pH is less than 6.0.[1]
There is presence of urobilinogen and urinary vitamin C.

→ Leukocyte esterase
This relies on the reaction of leukocyte esterase produced by neutrophils and a positive result suggests pyuria associated with UTI.[1]
Isolated trace results may be of questionable significance, but repeated ones should not be ignored.
False positive results may be caused by contamination with vaginal discharge.[1]
Elevated urine glucose or oxalic acid concentrations may reduce sensitivity, and this may also be seen in patients taking tetracycline or cefalexin.[1]

Efficacy
→ Nitrites
There have been many studies evaluating the accuracy of dipsticks tests. These are mostly in relation to their role detecting bacteriuria and UTI. A meta-analysis of 26 studies in children, showed wide differences in diagnostic accuracy across studies. This could not be fully explained by differences in age, or by differences in the definition of the criterion standard.[22] The lack of an adequate explanation for the heterogeneity of the dipstick accuracy stimulates an ongoing debate.

Overall, the sensitivity of the urine dipstick test for nitrites in testing for a UTI has been found to be low (45-60% in most situations) with higher levels of specificity (85-98%).[23] The test for nitrites has its highest accuracy in specific populations such as pregnant women, urology patients and elderly people. The test for nitrites may perform better in asymptomatic patients and in patients who are not on antibiotics.

→ Leukocyte esterase
When testing for urinary tract infections, the sensitivity of the urine dipstick test for leukocyte esterase has been found to be, in general, slightly higher than for the dipstick test for nitrites (48-86%), while the specificity was slightly lower (17-93%).[23] Generally, this results in a lower accuracy, compared to the test for nitrites, lower predictive values of positive test results and similar predictive values of negative test results.

The leukocyte esterase test has been found to have a much higher accuracy in urology patients. Sensitivity is highest in primary care, but requires further investigations because of the high rates of false positives. In primary care, negative results do not exclude the presence of infection.

Kidney Disease, an Underestimated Killer

By JANE E. BRODY JULY 15, 2013 12:01 AM July 15, 2013 12:01 am

Kidney disease doesn't get the attention, funding or concern associated with cancers of the breast or prostate. But it actually kills more Americans — 90,000 a year — than both malignancies combined.

Even when it is not fatal, the cost of treating end-stage kidney disease through dialysis or a kidney transplant is astronomical, more than fivefold what Medicare pays annually for the average patient over age 65. The charges do not include the inestimable costs to quality of life among patients with advanced kidney disease.

Much is known about who faces the greatest risks of developing chronic kidney disease and how it can be prevented, detected in its early stages, and treated to slow or halt its progression. But unless people at risk are tested, they are unlikely to know they have kidney disease; it produces no symptoms until it is quite advanced.

Perhaps no one knows this better than Duane Sunwold, 55, a culinary arts instructor at Spokane Community College in Spokane, Wash., whose compromised kidney function was not uncovered until a blood pressure crisis landed him in the hospital. A physician assistant found that abnormal amounts of protein were spilling out in his urine.

Mr. Sunwold, then only 43, was referred to a nephrologist, who diagnosed a condition called minimal-change disease: damage to the tiny blood vessels within the kidney that filter wastes from the blood to make urine. Protein is not supposed to be among those wastes. Although Mr. Sunwold's personal physician was treating him for high blood pressure, a leading cause of kidney failure, the doctor never checked to see how well his vital organs were functioning.

Such a lapse is hardly uncommon. Kidney disease often is not on the medical radar, and in as many as three-fourths of patients with risk factors for poor kidney function, physicians fail to use a simple, inexpensive test to check for urinary protein.

This fact has turned Mr. Sunwold into a proselytizer with a potentially lifesaving message for 26 million Americans who have kidney disease (many of whom don't yet know it) and an additional 76 million at high risk of developing it: Make sure your doctor checks the amount of protein in your urine at least once a year.

After his diagnosis, Mr. Sunwold brought all his risk factors under control and succeeded in improving his kidney function. He offers tips online and recipes for good kidney health, which are also good for the heart, diabetes and weight control.

A study published in April online in The American Journal of Kidney Disease demonstrated how common lifestyle factors can harm the kidneys. Researchers led by Dr. Alex Chang of Johns Hopkins University followed more than 2,300 young adults for 15 years. Participants were more likely to develop kidney disease if they smoked, were obese or had diets high in red and processed

meats, sugar-sweetened drinks and sodium, but low in fruit, legumes, nuts, whole grains and low-fat dairy.

Only 1 percent of participants with no lifestyle-related risk factors developed protein in their urine, an early indicator of kidney damage, while 13 percent of those with three unhealthy factors developed the condition, known medically as proteinuria. Obesity alone doubled a person's risk of developing kidney disease; an unhealthy diet raised the risk even when weight and other lifestyle factors were taken into account.

Overall, the risk was highest among African-Americans; those with diabetes, high blood pressure or a family history of kidney disease; and those who consumed more soft drinks, red meat and fast food.

In commenting on the study, Dr. Beth Piraino, president of the National Kidney Foundation, said, "We need to shift the focus from managing chronic kidney disease to preventing it in the first place."

Which is exactly the approach Mr. Sunwold has adopted. "I had been feeling like I had the flu — bone-tired, exhausted all the time," he said. "I'm now a wannabe vegan. Meat makes up less than 5 percent of my diet. In just two weeks after changing my diet to one that is plant-based, I really felt much better."

He also swims laps every day and maintains his 6-foot frame at 180 pounds. His kidney function, which is now normal, is checked every three months, and he religiously takes medication to control his blood pressure.

Dr. Leslie Spry, director of the Dialysis Center of Lincoln in Nebraska and another online proselytizer for a kidney-healthy lifestyle, noted that people with high blood pressure, Type 2 diabetes or obesity who manage to avoid a heart attack or stroke remain at risk for kidney disease, which he likened to the third rail.

Having just one risk factor raises the chances of developing kidney disease from one in 10 to one in three, Dr. Spry said.

A family history of kidney disease is not the only genetic risk. In addition to African-Americans, Hispanic Americans, Asian-Americans and American Indians are more likely than white Americans to develop kidney disease.

"People can't change their genetics," Dr. Spry said in an interview. "But I wouldn't have to work so hard if they didn't smoke, reduced their salt intake, ate more fresh fruits and vegetables, and increased their physical activity. These are things people can do for themselves. They involve no medication."

He also urges everyone with any risk factor for kidney disease to be screened annually with inexpensive urine and blood tests. That includes everyone 65 and older, for whom the cost is

covered by Medicare. Free testing is also provided by the National Kidney Foundation for people with diabetes.

The urine test can pick up abnormal levels of protein, which is supposed to stay in the body, compared with the amount of creatinine, a waste product that should be excreted. The blood test, called an eGFR (for estimated glomerular filtration rate), measures how much blood the kidneys filter each minute, indicating how effectively they are functioning.

Anyone found to have kidney disease should be referred to a nephrologist, a specialist who can work with the family physician to control the disease.

Two medications commonly used to treat high blood pressure can often halt or delay the progression of kidney disease in people with diabetes: angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs). Careful control of blood sugar levels also protects the kidneys from further damage.