NUCLEAR GLOSSARY

A	
ABSORBED DOSE	The amount of energy deposited in a unit weight of biological tissue. The units of absorbed dose are rad and gray.
ALPHA DECAY	Type of radioactive decay in which an alpha (α) particle (two protons and two neutrons) is emitted from the nucleus of an atom.
ALPHA (α) PARTICLE.	Alpha particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus. They are a highly ionizing form of particle radiation, and have low penetration. Alpha particles are emitted by radioactive nuclei such as uranium or radium in a process known as alpha decay. Owing to their charge and large mass, alpha particles are easily absorbed by materials and can travel only a few centimetres in air. They can be absorbed by tissue paper or the outer layers of human skin (about 40 µm, equivalent to a few cells deep) and so are not generally dangerous to life unless the source is ingested or inhaled. Because of this high mass and strong absorption, however, if alpha radiation does enter the body through inhalation or ingestion, it is the most destructive form of ionizing radiation, and with large enough dosage, can cause all of the symptoms of radiation poisoning. It is estimated that chromosome damage from α particles is 100 times greater than that caused by an equivalent amount of other radiation.
ANNUAL LIMIT ON INTAKE (ALI)	The intake in to the body by inhalation, ingestion or through the skin of a given radionuclide in a year that would result in a committed dose equal to the relevant dose limit.
ANTI-NUTRIENT COMPONENTS	Components of the diet that have a negative impact on intake, digestion and/or livestock production.
ANTIGEN	An antigen is a molecule that stimulates an immune response.
ANTIBODY	Antibodies are proteins found in blood or other bodily fluids of vertebrates, and are used by the immune the system to identify and neutralize foreign antigens, such as proteins, bacteria and viruses.
ARTIFICIAL INSEMINATION	Artificial insemination (AI) is the process by which sperm is placed into a female's uterus or cervix using artificial means.
ATOMIC NUMBER	The number of protons in the nucleus of an atom; the number determines the element's position on the periodic table. All isotopes of an element have the same atomic number.
ATOM	The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core of protons and neutrons.
ATOM PERCENT (ATOM %)	The absolute number of atoms of a given isotope in 100 atoms of total element. For example, the nitrogen-15 content of air nitrogen is 0.3663 Atom %. For calculation, $At\% = [R_s / (R_s + 1) * 100]$ where R_s is the ratio of the light isotope to the heavy isotope of the sample.
ATOMIC WEIGHT	The nominal atomic weight of an isotope is given by the sum of the number of neutrons and protons in each nucleus. The exact atomic weight differs fractionally from that whole number, because neutrons are slightly heavier than protons and the mass of the nucleus is also affected by the binding energy.
AUTORADIOGRAPHY	A technique using X- ray film to visualize molecules that have been radioactively labelled. Autoradiography has many applications in the laboratory. Autoradiography can, for example, be used to analyze the length and number of DNA fragments after they are separated from one another by gel electrophoresis. Also, radioactive materials, which have been incorporated into cell structures, can be located by exposure to a photographic emulsion and the pattern formed on the film corresponds to the location of the radioactive compounds within the cell.
B	
BECQUEREL	A unit of radioactivity equal to one disintegration per second. It is equal to about 27 picocuries.
BACKGROUND RADIATION:	The naturally-occurring ionising radiation arising from the earth's crust (including radon) and from cosmic radiation, to which every living organism is exposed.
BETA DECAY	Beta decay is a process by which unstable atoms become more stable. There are two types of beta decay, beta-minus and beta-plus.

BETA (β) PARTICLE	A particle ejected from the nucleus during radioactive decay with a mass equal to 1/1837 that of a proton. A negatively charged **β** particle is identical to an electron. A positively charged **β** particle is called a positron. Beta radiation may travel several feet in air and is moderately penetrating. It can penetrate human skin to the germinal layer, where new skin cells are produced. If high levels of **β**-emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury. Beta-emitting contaminants may be harmful if deposited internally.
BIOASSAY	The determination of kinds, quantities, or concentrations and, in some cases, locations of radioactive material in the body, whether by direct measurement (*in vivo* counting) or by analysis and evaluation of materials excreted or removed (*in vitro*) from the body.
BIOFUEL	Biofuel is broadly defined as solid, liquid, or gas fuel consisting of, or derived from, plant or animal sources.
BIOLOGICAL SHIELD	A mass of absorbing material (e.g. thick concrete walls) placed around a reactor or radioactive material to reduce the radiation (especially neutrons and gamma rays, respectively) to a level safe for humans.
BREEDING TRAIT	A characteristic that can be used in livestock breeding that is expressed as qualitative or quantitative description of those characteristics.
BSE	Bovine spongiform encephalopathy (BSE), commonly known as mad-cow disease is a fatal, neurodegenerative disease in cattle that causes a spongy degeneration in the brain and spinal cord. The infectious agent in BSE is a specific type of misfolded prion protein.
C	
CARBON 13	Carbon 13 (^{13}**C**) is a stable isotope and is used in physiology and nutrition research as a tracer that can be incorporated in a wide range of compounds to replace carbon 12 without affecting the biological activity of the compound. *See*: B.J. Bequette, N.E. Sunny, S.W. El-Kadi, and S.L. Owens. Application of stable isotopes and mass isotopomer distribution analysis to the study of intermediary metabolism of nutrients. J. Anim. Sci. 2006 **84**:E50-E59.
CARBON 14	Carbon 14 (^{14}**C**) is similar to carbon 13. *See*: M.J. Linington, J.H.F. Meyer, J.G. van der Walt. The use of energy by the splanchnic tissues and their metabolism of VFA, glucose and FFA in sheep fed high- and low-fibre diets. Sth. Afr. J. Ani. Sci. 1998 **28**:99-119.
CHAIN REACTION	A reaction that stimulates its own repetition, in particular where the neutrons originating from nuclear fission cause an ongoing series of fission reactions.
CHROMIUM 51	Chromium 51 (^{51}CR) is a radioactive isotope and is used in physiology and nutrition research as a tracer mainly to determine fluid flows in the digestive tract of livestock. *See*: J.R. Lindsay, J.P. Hogan, J.B. Donnelly. The digestion of protein from forage diets in the small intestine of the sheep Aust. J. Agric. Res. 1980 31:589-600.
COMMITTED DOSE EQUIVALENT	Committed dose equivalent (CDE) is the dose to a specific organ or tissue that is received from an intake of radioactive material by an individual during the 50-year period following the intake. The CDE is expressed in rem or sieverts (Sv).
CRITICALITY	Condition of being able to sustain a nuclear chain reaction.
CURIE	The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 g of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second. It is named after Marie and Pierre Curie, who discovered radium in 1898.
C3 PLANTS	Plants (such as soybean, wheat, oats, cotton, etc) whose carbon-fixation products have three carbon atoms per molecule. C3 plants show a greater increase in photosynthesis with a doubling of CO_2 concentration and a smaller decrease in stomatal conductance, which results in an increase in leaf-level water-use efficiency. This plant type has higher levels the heavier ^{13}C than C4 plants.

C4 PLANTS	Plants (e.g., maize and sorghum, etc) whose carbon fixation products have four carbon atoms per molecule. C4 plants show little photosynthetic response to increased CO_2 concentrations above 340 ppm but show a decrease in stomatal conductance, resulting in an increase in their photosynthetic water-use efficiency.
D	
DECAY, RADIOACTIVE	The decrease in the amount of any radioactive material with the passage of time due to the spontaneous emission from the atomic nuclei of either alpha or beta particles, often accompanied by gamma radiation.
DELTA CARBON RATIO	The isotopic composition of a carbon compound is expressed as [Delta; δ] 13C, the proportional deviation of the 13C/12C ratio and is used to determine the ratio of C3/C4 plants in livestock diets.
DEUTERIUM	Deuterium, (^{2}H) is a stable isotope almost double the mass of the common hydrogen isotope and is used in physiology and nutrition research. As a tracer it can be incorporated in a wide range of compounds replace hydrogen without affecting the biological activity of the compound. It can be used to measure body composition, lean mass (protein), fat content, total body water, water turnover, and milk consumption by suckling young. *See*: J.R. Pluske, T.W. Fenton, M.L. Lorschy, J.E. Pettigrew, A.F. Sower, F.X. Aherne. A modification to the isotope-dilution technique for estimating milk intake of pigs using pig serum. J. Anim. Sci. 1997, 75: 1279-1283.
DEXA (DXA)	Dual Energy X-ray Absorptiometry (now DXA) was originally used to measure bone mineral density. Calibrations have now been developed to determine protein, fat and ash content for living animals, allowing determination of carcasses composition prior to slaughter.
DISINTEGRATION	Natural change in the nucleus of a radioactive isotope as particles are emitted (usually with gamma (γ) rays), making it a different element.
DROUGHT RESISTANT	Plants or animals that can survive better than others during periods of low rainfall.
DOSE, ABSORBED	The absorbed dose, given in grays, represents the energy absorbed from a radiation source in a gram of any material. Furthermore, the biological dose or dose equivalent, given in rem or sieverts, is a measure of the biological damage to living tissue from radiation exposure.
DOSE, CUMULATIVE	The total dose resulting from repeated exposures of ionizing radiation to an occupationally exposed worker to the same portion of the body, or to the whole body, over time.
DOSE RECONSTRUCTION	Estimating exposure by considering emissions, environmental measurements, and routes of exposure.
DOSE LIMIT	Regulatory limit set on the amount of radiation that an individual may receive from artificial sources (excluding medical sources). Worker limits are set higher than general population limits.
DOSIMETER	A small portable instrument (such as a film badge or thermoluminescent or pocket dosimeter) for measuring and recording the total accumulated personal dose of ionizing radiation.
DOT BLOT	A Dot blot is a simplification of the Southern blot or Western blot methods. In a dot blot the proteins to be detected are not first separated by chromatography, instead, a mixture containing the molecule to be detected is applied directly on a nitrocellulose membrane as a dot. This is then followed by detection using radio-labelled nucleotide probes.
DOUBLE- LABELLED ISOTOPE	An example is water that has been enriched in both deuterium and oxygen-18 which is used to determine energy expenditure as well as body composition and its components in free living humans or animals *See*: C.A. Toerien, T. Sahlu, W.W. Wong. Energy expenditure of Angora bucks in peak breeding season estimated with the doubly-labelled water technique. J. Anim. Sci. 1999 **77**:3096-3105.
E	
EFFECTIVE DOSE EQUIVALENT (EDE)	An equivalent dose to the whole body, calculated by multiplying the dose to a particular organ (or collection of organs) by a factor that allows a rough representation of equivalent whole body dose and hence the risk of radiogenic cancer.

ELECTRONS	An elementary particle with a negative charge and a mass 1/1837 that of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the element. Electrons were discovered by J. J. Thomson in 1897 and he was awarded the Nobel Prize in Physics in 1906.
ELECTRON BEAM	Electron beams, or e-beams, are used to sterilize food and medical equipment. They are a stream of high energy electrons, propelled out of an electron gun. This electron gun apparatus is a larger version of the device in the back of a TV tube. This electron beam generator can be simply switched on or off. No radioactivity is involved. Some shielding is necessary to protect workers from the electron beam, but not the massive concrete walls required to stop gamma rays. The electrons can penetrate food only to a depth of three centimetres.
ELECTRON CAPTURE	A process that unstable atoms can use to become more stable. During electron capture, an electron in an atom's inner shell is drawn into the nucleus where it combines with a proton, forming a neutron and a neutrino. The neutrino is ejected from the atom's nucleus. Since an atom loses a proton during electron capture, it changes from one element to another. For example, after undergoing electron capture, an atom of carbon (with 6 protons) becomes an atom of boron (with 5 protons). Although the numbers of protons and neutrons in an atom's nucleus change during electron capture, the total number of particles (protons + neutrons) remains the same. Electron capture is also called K-capture since the captured electron usually comes from the atom's innermost electron orbit the K-shell.
ELEMENT	A chemical substance that cannot be divided into simple substances by chemical means; atomic species with same number of protons.
ESSENTIAL AMINO ACIDS	An amino acid is any molecule that contains both amino and carboxylic acid functional groups. Amino acid is one of a class of simple organic compounds containing carbon, hydrogen, oxygen, nitrogen, and in certain cases sulphur. Hundreds of different amino acids exist in nature, and about two dozen of them are important to animal nutrition**.** Essential amino acids are those that cannot be synthesized in the body in adequate amounts and must be obtained from the diet. Eight amino acids are generally regarded as essential for humans: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Cysteine (or sulphur-containing amino acids), tyrosine (or aromatic amino acids), histidine and arginine are additionally required by infants and growing children.
EXTERNAL RADIATION DOSE	The dose from sources of radiation located outside the body. This is most often from gamma rays, though beta rays can contribute to dose in the skin and other relatively superficial tissues.
F	
FAST NEUTRONS	A fast neutron is a free neutron with a kinetic energy level close to a million electron volts (MeV) (100 Terajoules/kg), have a speed of 14,000 km/s and are produced by nuclear processes.
FROST RESISTANT	Plants or animals that can survive better than others during periods of low temperatures.
FAT COMPOSITION	The amount of fat in a live body or carcass.
FILM BADGE	Photographic film used for measurement of ionizing radiation exposure for personnel monitoring purposes. The film badge may contain two or three films of differing sensitivities, and it may also contain a filter that shields part of the film from certain types of radiation.
FISSION PRODUCTS	Daughter nuclei resulting either from the fission of heavy elements such as uranium, or the radioactive decay of those primary daughters. Usually highly radioactive.
FOOD IRRADIATION	Food irradiation is a food safety technology that can eliminate disease-causing organisms from foods. Treating raw meat and poultry with irradiation can eliminate commonly found bacteria, such as *E. coli* O157:H7, *Salmonella*, and *Campylobacter.*
FRACTIONATION	The enrichment or depletion of a stable isotope caused by natural or artificial processes.
G	

GAMMA COUNTER	A Gamma Counter is a machine to measure γ radiation emitted by a radionuclide. Up to 300 samples are placed in sealed vials or test tubes, and move along a serpentine track on a horizontal plain. One at a time, they move down inside a shielded detector, set to measure specific energy windows characteristic of the particular isotope. Depending on the half-life and concentration of the sample, measurement times vary from 0.02 minute to one minute.
GAMMA RAYS	High-energy, short wavelength, electromagnetic radiation emitted from the nucleus. For food irradiation, sources such as radioactive cobalt (Cobalt 60) or caesium (Caesium 137) are used. These substances give off high energy photons, called gamma rays, which can penetrate foods to a depth of several feet. These particular substances do not give off neutrons, which mean they do not make anything around them radioactive. Since γ rays are very penetrating they are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to x-rays.
GEIGER COUNTER,	Geiger counters are used to detect radiation, usually α and β radiation, but also other types of radiation as well. The sensor is a Geiger-Müller tube, an inert gas-filled tube (usually helium, neon or argon with halogens added) that briefly conducts electricity when a particle or photon of radiation temporarily makes the gas conductive. The tube amplifies this conduction by a cascade effect and outputs a current pulse, which is displayed by a needle or lamp and/or audible clicks**.** Common readout units are roentgens per hour (R/hr), milliroentgens per hour (mR/hr), rem per hour (rem/hr), millirems per hour (mrem/hr), and counts per minute (cpm).
GENETIC MUTATION	Dramatic change in the chromosomal DNA of an individual gene and the changes that are not lethal can be inherited by descendants.Mutations in some organisms can be made more frequent by irradiation and has been used to induce beneficial outcomes in breeding programmes. See: J.L. Wu, C.J. Wu, C. L. Lei., et al Chemical and irradiation induced mutants of indica rice IR64 for forward and reverse genetics. Plant. Mol. Biol. 2005 59: 85-97.
GLUCOSE TURNOVER	The metabolism of glucose in an animal or a tissue is usually measured using isotope labeled sugar to determine energy utilization. See: H. Shingu, H. Hayashi, E. Touno, et al. Characteristics of developmental changes in the kinetics of glucose and urea in Japanese Black calves: Comparison with Holstein calves**.** J. Anim. Sci. 2007 85**:** 2910-2915.
GRAY	The international system of units (SI) measure of absorbed dose. One gray is equal to an absorbed dose of 1 J/kg.
H	
HALF-LIFE	The time in which half the atoms of a particular radioactive substance will have disintegrated (decayed), becoming an isotope of another element and leaving half the original amount. Half of the residue will disintegrate in another equal period of time. Thallium-208, for example, decays into lead-208 with a half-life of 3.05 minutes. This means that half of a sample of thallium-208 will decay into lead-208 over that time period.
HALF-LIFE, BIOLOGICAL	The time required for an animal to eliminate, by natural processes, half of the amount of a radioactive material that has entered it.
HALF-LIFE, EFFECTIVE	The time required for a radionuclide contained in a biological system, such as a human or an animal, to reduce its activity by one-half as a combined result of radioactive decay and biological elimination.
HIGH-SULPHUR CONTAINING AMINO ACIDS	Methionine and cysteine are the two high-sulphur amino acids. Methionine is an essential amino acid and must be consumed in the diet.
HORMONE	A hormone is a messenger molecule that carries a signal from one cell (or group of cells) to another via the bloodstream.
HYDROGEN 3	Hydrogen 3 (^{3}H, Tritium) is a radioactive isotope and is used in physiology and nutrition research as tracer that can be incorporated in a wide range of compounds replace carbon 12 without affecting the biological activity of the compound. *See*: G.E. Lobley, K.D. Sinclair, C.M. Grant, *et al*. The effects of breed and level of nutrition on whole-body and muscle protein metabolism in pure-bred Aberdeen Angus and Charolais beef steers. Brit. J. Nutr. 2000 84:275-284.

HYDROGEN ISOTOPE RATIO	Water molecules containing the common hydrogen isotope has a mass of 18 and if it incorporates a deuterium atom has a mass of 19, over 5% heavier. The energy to vaporize the heavy water molecule is higher than that to vaporize the normal water so isotope fractionation occurs during the process of evaporation. The ratio of the two isotopes can be used to determine the source of water.
I	
INTROGRESSION	Introgression is the movement of a gene from one species to the gene pool of another by backcrossing an interspecific hybrid with one of its parents.
IODINE 125	Iodine 125 (^{125}I) is a radioactive isotope used in physiology and nutrition research as tracer that can used without affecting the biological activity of the compound. It is also regularly used in radioimmunoassays. *See*: B. Burguera, M.E. Couce, G.L. Curran, *et al.* Obesity is associated with a decreased leptin transport across the blood-brain barrier in rats. Diabetes 2000 49**:**1219-1223.
ION	(1) An atom that has too many or too few electrons, causing it to have an electrical charge, and therefore, to be chemically active. (2) An electron that is not associated (in orbit) with a nucleus.
ION BEAM	An ion beam is a type of particle beam consisting of ions moving in the same direction.
IONIZING RADIATION	Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, x-rays, neutrons, and ultraviolet light. High doses of ionizing radiation may produce severe skin or tissue damage.
IRRADIATE	Subject any material or organism including foodstuffs, antigens or vaccines to ionising radiation. Also a process for sterilization of medical equipment.
ISOTOPE	Atoms whose nuclei contain the same number of protons (and hence the same chemical properties), but a differing number of neutrons, and therefore, different atomic weights. The element hydrogen, for example, has three commonly known isotopes: protium, deuterium and tritium**.**
ISOTOPE RATIO	The ratio of the minor isotope over the major isotope. For example, nitrogen in air contains 0.3663 Atom % nitrogen-15 and 99.6337 Atom % nitrogen-14, giving an isotope ratio of 0.3663 / 99.6337 = 0.003676466. Isotope ratios have been used to validate the origin of livestock products, trace the grazing patterns of livestock, migration of birds, hormone contamination, and investigate changes in forage availability and type over time in tissues. *See*: F. Camin, L. Bontempo, K. Heinrich, *et al.* Multi-element (H,C,N,S) stable isotope characteristics of lamb meat from different European regions. Anal. Bioanal. Chem. 2007 389:309-320.
ISOTOPE RATIO MASS SPECTROMETRY (IRMS)	A mass spectrometer is an instrument for separation of molecules based upon their mass-to-charge ratio. In IRMS the mass spectrometer used separates isotopes of different mass within a magnetic field and precisely measures the ratio of two, or more, isotopes.
ISOTOPE SIGNATURES	An isotopic signature is a ratio of stable or unstable isotopes of particular elements found in a material.
L	
LEAN BODY MASS	The amount of protein in an animal's body or carcass.
LEAN MEAT	Meat with a lower than average fat content.
LEUCINE FLUX	Isotope labelled leucine is administered to a whole animal or tissue to determine protein turnover in the body or tissue. See: H. Sano, A. Kajita, T. Fujita. Effect of dietary protein intake on plasma leucine flux, protein synthesis, and degradation in sheep**.** Comp. Biochem. Physiol. B-Biochem. Mol. Biol. 2004 139:163-168.
LIGNIN	Indigestible plant component. As lignin content increases, digestibility is lowered and the amount of energy potentially available to the animal reduced.
LOW-LEVEL WASTE (LLW)	Mildly radioactive material usually disposed of by incineration and burial.
M	
MICROBIAL PROTEIN PRODUCTION	Microbial protein is produced in the rumen and then flows down the digestive tract to be made available to the animal. Production can be measured using radioisotopes, usually nitrogen 15.
MILK INTAKE	The amount of milk consumed.

N	
NATURAL ABUNDANCE	The concentration of isotopes as found in nature. (e.g. Nitrogen in air is 0.366% nitrogen-15 and 99.634% nitrogen-14).
NATURAL CONCEPTION	Conception that takes place within the bounds of the laws of nature.
NEUTRON	An uncharged elementary particle slightly heavier than a proton, found in the nucleus of every atom except hydrogen. Neutrons were discovered by James Chadwick in 1932. . Free neutrons are unstable, decaying into protons and electrons with a half-life of about 12 minutes.Experiments done at the Stanford Linear Accelerator Center in the late 1960's and early 1970's showed that neutrons are made from other particles called quarks. Neutrons are made from one 'up' quark and two 'down' quarks.
NEUTRON EMISSION	A process that unstable atoms can use to become more stable. During neutron emission, a neutron is ejected from an atom's nucleus. Since the number of protons within an atom doesn't change during neutron emission, it doesn't change from one element to another. It does, however, become a different isotope of that element. For example, after undergoing neutron emission, an atom of beryllium-13 (with 9 neutrons) becomes an atom of beryllium-12 (with 8 neutrons).
NEUTRINOS	Neutral particles that rarely interact with matter. Three types of neutrinos are recognized: electron-neutrinos, muon-neutrinos and tau-neutrinos.
NITROGEN 15	Nitrogen 15 (^{15}N) is a stable isotope and is used in physiology and nutrition research as a tracer that can be incorporated in a wide range of compounds to replace Nitrogen 14 without affecting the biological activity of the compound. *See*: C. Atasoglu, A.Y. Guliye, R.J. Wallace. Use of stable isotopes to measure de novo synthesis and turnover of amino acid-C and -N in mixed micro-organisms from the sheep rumen in vitro. Brit. J. Nutr. 2004 91:253-261.
NITROGEN ISOTOPE RATIO	The ratio of ^{15}N/^{14}N presents a characteristic distinction between herbivores and carnivores, as movement up the food chain tends to concentrate the ^{15}N isotope.
NORTHERN BLOT	The northern blot is a technique used in molecular biology to study gene expression. It takes its name from the similarity of the procedure to the Southern blot, used to study DNA, with the key difference that, in the northern blot, RNA, rather than DNA, is the substance being analyzed by electrophoresis and detection with a hybridization probe commonly using ^{32}P. The gels may be run on either agarose or denaturing polyacrylamide depending on the size of the RNA to be detected. A notable difference in the procedure in case of agarose gels, (as compared with the Southern blot) is the addition of formaldehyde which acts as a denaturant.
NUCLEUS	The nucleus of an atom is the central core that comprises almost all the weight of the atom. All atomic nuclei (except H-1, which has a single proton) contain both protons and neutrons. Discovered by Ernest Rutherford in 1911.
NUCLIDE	Elemental matter made up of atoms with identical nuclei, therefore with the same atomic number and the same mass number (equal to the sum of the number of protons and neutrons.
NUTRITION	The concept by which livestock obtains energy through food for growth, metabolism, and repair. This includes ingestion, digestion, absorption, transport, assimilation, and excretion.
NUTRITION SCIENCE	The science that deals with feed and nourishment, including dietary guidelines, feed composition, processing by the body of consumed nutrients for maintenance, growth, reproduction and health and the nutritional needs to meet these requirements.
O	
OXYGEN 18	Oxygen 18 (^{18}O) is a stable isotope of oxygen 16. The ratio of these two isotopes has been used in teeth enamel to determine temperature changes of historical time periods.
OXYGEN ISOTOPE RATIO	The ratio of ^{18}O/^{16}O in water depends on the amount of evaporation the water experienced. As the vapor tension depends on the concentration of dissolved salts, the ^{18}O/^{16}O ratio shows correlation on the salinity and temperature of water.
P	

PHOSPHORUS 32	Phosphorus 32 (^{32}P) is a radioactive β-emitter that is used routinely in life-science laboratories, primarily to produce radio-labeled DNA and RNA probes such as for use in Northern or Southern blots. This role is being replaced by dyes but is still the most sensitive assay system. *See*: R.A. Hubbard. Human papillomavirus testing methods. Arch. Path. Lab. Med. 2003 **127**:940-945. It is also been used for studies of the phosphorus status of livestock. *See*: R. S. Dias, E. Kebreab, S. S. Vitti, A. P. Roque, I. C. S. Bueno, J. France. A revised model for studying phosphorus and calcium kinetics in growing sheep. J Anim Sci 2006 84:2787-2794.
PROTON	An elementary particle with a positive electric charge and a mass that is given the value 1 on the scale of atomic weights.
PROTON EMISSION	A process that unstable atoms can use to become more stable. During proton emission, a proton is ejected from an atom's nucleus. Since an atom loses a proton during proton emission, it changes from one element to another. For example, after undergoing proton emission, an atom of nitrogen (with 7 protons) becomes an atom of carbon (with 6 protons).
POSITRONS	A positron is the antiparticle of the electron. It has the same mass but opposite charge (positive instead of negative). Positrons, created through the decay of a radioactive tracer, are detected in positron emission tomography (PET) scanners.
PHOTON	The indivisible unit, or quantum, of electro-magnetic radiation. The energy of the photons determines the nature of the radiation, from radio waves at the lowest energy levels, up through infra-red, visible, and ultra-violet light, to X-or gamma-rays, which have energy high enough to ionize atoms.
PRION	A prion is a protein molecule being produced in brain cells. Due to it's size, it is transmissible. Abnormally folded prions lead to brain damage as they cannot be metabolized by cellular enzymes. Prion diseases or transmissible spongiform encephalopathies (TSEs) are a family of rare progressive neurodegenerative disorders that affect both humans and animals. They are distinguished by long incubation periods, characteristic spongiform changes associated with neuronal loss, and a failure to induce inflammatory response. They are usually rapidly progressive and always fatal. Among animal prion diseases are Bovine Spongiform Encephalopathy (BSE), or Mad Cow Disease and Scrapie.
PURINE DERIVATIVES	Measured in the urine of ruminant animals to determine the rate of production of microbial production. See: A. Ojeda, O. de Parra, J, Balcells, *et al*. Urinary excretion of purine derivatives in Bos indicus x Bos taurus crossbred cattle. Brit. J. Nutr. 2005 93:821-828.
Q	
QUARKS	A physical particle that forms one of the basic building blocks of matter. Three families of quarks are known to exist. Each family contains two quarks. The first family consists of Up and Down quarks, the quarks that join together to form protons and neutrons. The second family consists of Strange and Charm quarks and only exists at high energies. The third family consists of Top and Bottom quarks and only exists at very high energies.
R	
RAD	Largely obsolete term for radiation absorbed dose, which is the amount of energy from any type of ionizing radiation (e.g., alpha, beta, gamma, neutrons, etc.) deposited in any medium (e.g., water, tissue, air). Replaced in SI by the term gray. A dose of one rad means the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue (100 rads = 1 gray).
RADIATION	The emission and propagation of energy by means of electromagnetic waves or particles. *(cf ionising radiation).*

RADIATION STERILIZATION	Radiation sterilization may be performed using either gamma rays from a radioisotope source or electron-beam or X-ray irradiation. The most suitable sources for radiation processing are ^{60}Co and ^{137}Cs because of the relatively high energy of their gamma rays and fairly long half-life. However, ^{137}Cs has been used primarily for the irradiation of blood and for insect sterilization. Electron beam and x-ray systems convert electricity in to electromagnetic radiation. These systems do not emit any radiation when turned off. Radiation causes cell death by inducing changes in DNA or cell membranes.
RADIATION WARNING SYMBOL	An officially prescribed symbol, a magenta or black trefoil, on a yellow background that must be displayed where certain quantities of radioactive materials are present or where certain doses of radiation could be received.
RADIOACTIVITY	The spontaneous disintegration of an unstable atomic nucleus, giving rise to the emission of radiation. The nucleus emits alpha particles, beta particles, and gamma rays. These are positively charged, negatively charged, and neutral, respectively.
RADIOISOTOPE	An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and artificial radioisotopes have been identified.
RADIOIMMUNOASSAY (RIA)	A sensitive method employing radioactive isotopes to quantify specific substances in biological samples. Most RIA methods employ ^{125}I as the radiolabel. This isotope emits gamma rays. It has a high specific activity so that a very small mass of isotope is needed, and a short half-life (60 days). These properties result in minimal disposal problems with leftover or spent reagents. Since background radiation is very low and the counting time can be extended if needed to generate more counts, RIA is the most sensitive of all immunoassay methods. There are two types of RIA, competitive and immunoradiometric (sandwich) assays.
RIA – COMPETETIVE ASSAY	Competitive assays use radiolabelled antigen. The labelled antigen "competes" with non-radioactive antigen in the sample for a limited number of binding sites on the reagent antibody. Following incubation, the free radiolabelled antigens are removed by decanting or washing and the radioactivity of the antibody-bound antigens is measured. The radioactivity of the antibody-antigen complexes is inversely proportional to antigen concentration.
RIA – IMMUNORADIOMETRIC ASSAY	In the immunoradiometric (IRMA) or sandwich assay, two antibodies are used and one is radiolabelled. In the test system, the sample is incubated with a specific antibody usually attached to a solid phase such as a plastic bead or the wall of a plastic test tube. After washing to remove unbound sample components, a radioactively labelled antibody is added. The second antibody may be directed against a different part of the antigen molecule, or it may be directed against the first antibody (e.g. anti-human immunoglobulin). The second antibody binds to the immune complexes making an antibody-antigen-antibody "sandwich." After washing to remove the unbound radiolabelled antibody, the radioactivity is measured. The amount of radioactivity is directly proportional to antigen concentration.
RADIONUCLIDE	A radioactive isotope of an element.
RADIO-SENSITIVITY	The relative susceptibility of cells, tissues, organs, organisms, or other substances to the injurious action of radiation.
RATE OF UPTAKE	Measurement of the uptake of specific compounds can be measured using isotopes. See: Thomas, N, Tivey, DR, Penno, NM, Nattrass, G and Hynd, PI. 2007 Characterization of transport systems for cysteine, lysine, alanine and leucine in wool follicles of sheep. J. Anim. Sci. 85: 2205-2213.
RELATIVE BIOLOGICAL EFFECTIVENESS (RBE)	A factor that is used to express the relative amount of biological change caused by a unit of energy deposited by a particular type of ionizing radiation into a specific part of the body. The RBE is complex and organ-specific. Due to its complexity, a simple parameter, called the quality factor, is applied to different types of radiation as a matter of regulatory practice for the purpose of estimating biological damage and the resulting cancer risk.

REM	The acronym for roentgen equivalent in man is a standard unit that measures the effects of ionizing radiation on humans. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor of the type of radiation.
ROENTGEN	A unit of gamma radiation measured by the amount of ionization in air. In non-bony biological tissue 1 roentgen delivers a dose approximately equal to 1 rad.
RUMEN UN-DEGRADE PROTEIN	The protein component of the diet that is not broken down in the rumen and passes to the lower digestive tract.
RUTHENIUM 103	Ruthenium 103 (^{103}Ru) is a radioactive isotope and is used in physiology and nutrition research as tracer main to determine dietary fibre flows in the digestion tract of livestock. *See*: T.N. Tan, R.H. Weston, J. P. Hogan. P. Use of 103Ru-labelled tris (1,lO-phenanthroline) ruthenium (11) chloride as a marker in digestion studies with sheep. Int. J. Appl. Rudiat. 1971 22. 301.
S	
SCINTILLATION COUNTER	An instrument used for the detection of radioactivity; the radiation is absorbed by a scintillator (a crystal or a compound, such as POPOP, in solution) which results in minute flashes of light that are detected by a photocathode. The resultant electron emission is amplified by a photomultiplier and an amplifier.
SPECIFIC ACTIVITY	A measure of the radioactivity of a unit weight (generally one gram) of material.
SIEVERT(Sv)	The basic unit in the SI system that is used to measure the amount of biological damage caused by various types of ionizing radiation, equal to the dose that produces the same amount of damage in human tissue as one gray of X-rays (100 rem or 8.38 roentgens).
SOLUBLE CARBOHYDRATE	Plant material contains a range of carbohydrates (monosaccharides, disaccharides, polysaccharides (mainly fructan), hemicellulose, cellulose, lignin, starch, sugar, pectin, etc) and the solubility of these in a range of solvents can been determined and related to feeding value for livestock.
SOUTHERN BLOT	DNA (genomic or other source) is digested with a restriction enzyme and separated by gel electrophoresis, usually on an agarose gel. The DNA is transferred to a suitable membrane. The DNA fragments retain the same pattern of separation they had on the gel. The blot is incubated with a radioactive probe which is single-stranded DNA. This probe will form base pairs with its complementary DNA sequence and bind to form a double-stranded DNA molecule. The probe cannot be seen but as it is radioactive its location is revealed by exposing the membrane to X-ray film directly.
SPONTANEOUS FISSION	The spontaneous splitting of the nucleus into two new nuclei, generally with the emission of one or more neutrons and the release of energy.
STABLE ISOTOPE	A non-radioactive isotope in which the number of protons and neutrons in the atomic nucleus is constant through time and is Incapable of spontaneous radioactive decay. Mass does not change over time. Stable isotopes pose no known physiological risk. Naturally occurring stable isotopes D/H, ^{13}C/^{12}C, ^{34}S/^{32}S and ^{15}N/^{14}N are known to vary geospatially and when incorporated into an animal's tissues can be used as an indicator of where the animal was when the sampled tissue was formed.
SULPHUR 35	Sulphur 35 (^{35}S) is a radioactive isotope and is used in physiology and nutrition research as tracer that can be incorporated into the amino acids, cysteine and methionine. The radioactive amino acid can be used to accurately measure wool or hair growth. *See*: A.C. Schlink, G. Mata, R.M. Lewis. Consequences of differing wool growth rates on staple strength of Merino wethers with divergent staple strengths. Wool Tech. Sheep Breed. 1998 46:271-285.
SYNTHETIC HORMONES	Manufactured hormones used for production purposes in livestock. The ^{14}C isotope is important in distinguishing biosynthesized hormones from man-made ones. Carbon in artificially made chemicals is usually derived from fossil fuels where the ^{14}C originally present has decayed below detectable limits. The amount of ^{14}C present in a sample therefore indicates the proportion of carbon of biogenic origin.
T	

TERRESTRIAL RADIATION	The portion of the natural background radiation that is emitted by naturally occurring radioactive materials, such as uranium, thorium, and radon in the earth.
TRACERS	An identifiable substance, a radioactive or stable isotope that can be introduced into a biological system and used to follow-through the course of a process, providing information on the biological processes involved.
TRITIUM	A radioactive isotope of hydrogen whose nucleus contains one proton and two neutrons. An atom of tritium consists of one proton, two neutrons and one electron. Tritium (Hydrogen 3, ^{3}H) is radioactive and has a half-life of about 12.5 years. It is used in physiology and nutrition research as tracer that can be incorporated in a wide range of compounds to replace carbon 12 without affecting the biological activity of the compound. *See*: G.E. Lobley, K.D. Sinclair, C.M. Grant, *et al*. The effects of breed and level of nutrition on whole-body and muscle protein metabolism in pure-bred Aberdeen Angus and Charolais beef steers. Brit. J. Nutr. 2000 84: 275-284.
U	
UNCONVENTIONAL FEEDS	Usually refers to livestock feed that is not sourced from agricultural based systems but harvested from natural and waste land vegetation.
UREA TURNOVER	Measurements of total turnover of urea provide information for evaluating the rate of protein and nitrogen metabolism in the ruminant. See: H. Hayashi, M. Kawai, I. Nonaka, *et al*. Developmental changes in the kinetics of glucose and urea in Holstein calves. J. Dairy Sci. 2006 89:1654-1661.
W	
WESTERN BLOT	Proteins are separated by gel electrophoresis, usually SDS-PAGE. The proteins are transferred to a nitrocellulose membrane. The proteins retain the same pattern of separation they had on the gel. The blot is incubated with a generic protein (such as milk proteins) to bind to any remaining sticky places on the nitrocellulose. A ^{125}I labelled antibody or Protein A or other probe is then added to the solution which is able to bind to its specific protein. The location of the antibody is revealed by autoradiography.
WHOLE BODY PROTEIN SYNTHESIS	Measurement of the rate of synthesis of protein in living animals and can be measured using isotope infusions. See: M. Al-Mamun, C. Ito, A. Sato, *et al*. Comparison of the [H-2(5)] phenylalanine model with the [1-C-13] leucine method to determine whole body protein synthesis and degradation in sheep fed at two levels**.** AJAS 2007 20**:**1517-1524.