LEDERBERG 2: DAUGHTER CELL
Written and Edited By: Eric Mukherjee, Michael Hausinger, Saajid Moyen, Mike Cheyne, Harrison Brown

PACKET 2 – SOLO DANCERS
THE LAST TOSSUP YOU READ SHOULD HAVE BEEN ON ANSWER: **Cache**

1. The distribution of these events is the subject of the Mogi donut hypothesis. The mechanism of these events can be calculated using a "beach ball" diagram, and such mechanisms include the double-couple source. The frequency of these events is given by an equation setting that value equal to 10 to the power of a minus bM, which is a law partly named for Gutenberg and notably doesn't apply during "swarms" of these events. The VAN method attempts to predict these events by using low-level (*) electrical signals. One theory about these events proposes that they are caused by strain energy being spontaneously released; that idea was posited by Harry Fielding Reid and is called the elastic rebound hypothesis. Another common method of predicting them measures anomalies in the ratio of P-wave to S-wave velocity, and the MMS has largely replaced the scale previously used to measure these events, which is a log-base-10 scale. For 10 points, name these events whose severity is measured by the Richter scale.
ANSWER: **earthquake**

2. The dynamics of this process can be measured with the time-resolved fluorescence Stokes shift technique. Non-equilibrium models for this process often decompose the polarization vector into fast and slow components using a partition named for either Pekar or Marcus. The bulk dielectric constant is set to infinity in one model for this process developed by Klamt and Schuurmann, and Cammi and Tomasi developed a key revision to the first (*) ASC method for modeling this process. Another model used for calculating the energy of this process involves placing a dipole in a cavity where it induces a reaction field in the surrounding medium. That model improves upon one developed by Born and was developed by Onsager. The equilibrium concentration after this process depends on temperature, and cooling a mixture in which this process has occurred can lead to supersaturation. For 10 points, name this process in which a second-phase compound is incorporated into a one-phase fluid.
ANSWER: **solvation** [or **dissolution**, accept word forms]

3. The fluid slip for a dilute gas is proportional to a parameter equal to 1.15 times this value. The Elliot-Yafet spin flip mechanism, unlike the Dyakonov-Perel mechanism, depends linearly on this parameter. Conductivity is equal to n e-squared over m times Fermi velocity all times this quantity. MHD assumes that this quantity is much smaller than a related characteristic. Ballistic transport occurs when this value for an electron is much greater than the (*) dimension of the system. The Knudsen number contains this value in the numerator, and this quantity is equal to kT over square root of 2 times pi times diameter times pressure. The mean velocity times this value is equal to the diffusion coefficient, and this quantity is inversely proportional to both the particle density and the cross section. For 10 points, name this quantity, the average distance that a particle travels before colliding with another.
ANSWER: **mean free path**

4. Ackland and Gallager developed a generalized form of this model that is stabilized by evolutionary feedback, and CS Holling modified these equations in order to posit his idea of a type I "functional response". Aditi and Ginzberg developed an alternative to this model which is based on a ratio, and David Hamilton Wright modified it to allow saturation behavior in order to allow an interaction coefficient to be negative. The fact that this model is continuous, rather than discrete, leads to the "atto-fox" problem. A linearized version of this model uses the (*) community matrix. The standard version of this model uses an exponential growth curve, though the competitive version incorporates a sigmoidal curve. Originally created to model fish in the Adriatic sea, the simplest form of this model predicts either an oscillatory relationship or extinction. For 10 points, name this set of equations, the most well-known variation of which models predator-prey interactions.
ANSWER: **Lotka-Volterra** equations/model/whatever

5. At this place, a woman named Yassim said "Evil must be opposed" and hung herself. It was liberated from enemy control in "Operation Return." A recreational facility here was once locked with a tripartite microsealing mechanism, had business conducted using gold pressed latinum, and was located on the Promenade. That business at this location notably had many gambling tables operated by "dabo girls." A scandal in this place involved Vedek Winn's objection to the teachings at Keiko's school. Denizens of this place include the barfly Morn and the tailor Garak. Originally known as (*) "Terok Nor," it was once led by Gul Dukat. This location was built by the Cardassians, but was taken over by the Federation due to its strategic location near the Bajoran wormhole. It was commanded by Benjamin Sisko and was home to Quark's bar. For 10 points, name this space station that was the title location of a *Star Trek* spin-off.
ANSWER: **Deep Space 9** [or **Terok Nor** until mentioned, prompt on the **Promenade** until mentioned]

6. One virus that affects this organ has a fusion protein that is inhibited by Palivizumab. Chatter bodies appear in another disease of this organ called PAP. It's not the liver but one infection of it can also be treated by Ribavirin, and like the liver this organ breaks down in those having two Z-alleles of alpha-1-antitrypsin. One rapidly-spreading cancer of this organ originates from neuroendocrine cells and has paraneoplastic symptoms caused by secretion of ACTH, ADH, and Lambert-Eaton (*) autoantibodies. Pancoast tumors occur in this organ, structural diseases of which are sorted by their FEV1 to FVC ratio into restrictive and obstructive types. This organ shows caseating necrosis and granuloma formation in people suffering from tuberculosis. For 10 points, name this organ, which is inflamed in bronchitis and several cancers of which are linked to smoking
ANSWER: **lung**

7. The Pati-Salam grand unified theory associated the "violet" quark color with these particles. The Koide formula relates the masses of three of these particles, and the BaBar experiment tests the fact that these particles' coupling to gauge bosons and branching ratios are only dependent on their mass; that finding is their namesake universality. One method of creating a pair of these particles involves a quark and an antiquark annihilating, creating a virtual photon which then becomes a pair of these; that is the Drell-Yan process. One of these particles was discovered by using the SPEAR ring at SLAC by Martin Perl, and has a lifetime of only 2.9 times 10 to the negative 13th seconds. Their namesake (*) quantum number is preserved by the decay of a neutron, but is violated by the chiral anomaly and sphaleron processes; however, those processes do preserve the difference between these particles' quantum number and the baryon number. The mass difference between the charged and uncharged types of these particles can be understood via the seesaw mechanism. These particles include the tau, the muon, the electron, and their associated neutrinos. For 10 points, name these particles that have spin one-half and don't undergo strong interactions.
ANSWER: **lepton**s [anti-prompt on "neutrinos"]

8. The rate of this process versus redshift is shown on a Madau plot. The surface density of this process is proportional to some power of the local surface density according to the Kennicutt-Schmidt law. The namesake spectroscopic feature of Lyman-break galaxies is caused by their Lyman-alpha lines being absorbed by regions in which this process occurs, and on a color-color diagram regions where this process occurs show infrared excess. Kroupa names a broken exponential function that gives the mass distribution of the products of this process; such a distribution is called an (*) IMF. This process can be triggered by the gravitational migration of neutral particles, called ambipolar diffusion, and the free-fall time is an important quantity in modelling it. CO luminosity is most often used as a proxy to detect the giant molecular clouds where this process occurs. This process, which can result in the formation of Herbig-Haro objects, occurs when a clump of matter in the ISM crosses the Bonnor-Ebert mass limit and collapses. For 10 points, name this process whose products go on to the Hayashi track of the HR diagram.
ANSWER: **star formation** [accept common-language equivalents like **stellar birth**]

9. One reagent commonly used in this procedure is often replaced by Oxyma Pure because said replacement is not explosive, and replacing one reagent in this procedure with PyBOP eliminates the creation of the carcinogen HMPA. Products of this process can be processed further via a reaction that uses an intramolecular S-N-acyl shift after a trans-thio-esterification step. An HMP-containing reagent named for Wang is activated in the first step of this procedure. Using an uronium reagent in this process eliminates the need for an activation step by a carbo-di-imide like DCC. Triazole reagents are used to increase stereospecificity in one step of this procedure, which also uses groups like (*) Cbz and alloc. Originally developed by Merrifield, this procedure occurs by first functionalizing a resin and repeatedly coupling, washing, and deprotecting t-BOC or Fmoc conjugated monomers. This reaction is commonly carried out on beads in DMF solvent, which is washed out at every step as a new amino acid is added. For 10 points, name this chemical procedure which creates short proteins in vitro.
ANSWER: Solid-phase **peptide synthesis**

10. The cardinality of the largest set that an algorithm of this type can shatter is called the Vapnik-Chervonenkis dimension, a measure of the effectiveness of these algorithms. A meta-algorithm in this field won the Godel prize for Schapire and Freund. Those two men wrote a seminal text in this field titled *Boosting*, which responds to the question of whether weak algorithms of this type can be combined into a strong one. Algorithms of this type that will most likely have a low error were identified by Leslie Valiant as being (*) "Probably Approximately Correct." One of the fundamental problems in this field is classification, and algorithms in this field can use decision tree models or artificial neural networks. These algorithms may be unsupervised or supervised, referring to whether outputs are checked for training data. For 10 points, name this field concerning systems that can gather information from data and update behavior accordingly.
ANSWER: machine **learning** [accept **classification** before mentioned; prompt on "artificial intelligence"]

11. This programming language includes a PhantomReference type that does not get cleared immediately when enqueued, unlike soft and weak references. The fifth version of this language implemented language-level support for explicit "enum" types, and this language also supports autoboxing for primitives. The most recent version of this language finally included closures, removing the need for Project Lambda. The Abstract Window Toolkit has mostly been replaced by the (*) Swing library for graphical user interfaces in this language. This language with automatic memory management in the form of garbage collection has a virtual machine that is able to execute files with the "class" extension. The magic words "public static void main string args" are used for Hello-World programs in this language. For 10 points, name this ubiquitous object-oriented programming language that was developed after C++.
ANSWER: **Java** [accept version numbers that are less than or equal to 8]

12. One organism originally placed in this genus is now the only member of genus Orientia. One method of distinguishing between members of this genus is via cross-reactivity between the Proteus antigens OX19, OXK, and OX2; that is the Weil-Felix test. Like Chlamydia, this genus contains organisms that are obligate intracellular parasites that appear pleomorphic under Giemsa staining. This genus contains the species felis, japonica, conorii, and akari, and it also contains the species most closely related genetically to the mitochondrion, called prowazekii. One member of this genus is carried by Dermacentor variabilis and causes a maculopapular centripetally-spreading rash. Besides containing the causative agent of (*) Rocky Mountain Spotted Fever, this genus also contains the causative agent of a disease transmitted by lice that killed many soldiers during World War II. For 10 points, name this genus of intracellular gram-negative bacteria, which contains the causative agents of typhus.
ANSWER: **Rickettsia**

13. One approach to doing *this* involves constructing a truncation of the tensor product of a one-dimensional multilevel basis. That approach was introduced by Smolyak and is known as "sparse grids." One class of methods for *this* involves subdividing an interval when two approximations of the output differ greatly; those methods are known as adaptive algorithms. When a function under consideration is (*) well-approximated by a polynomial, methods named for Gauss may be used. When many variables are involved, naïve methods for doing this fall victim to the "curse of dimensionality." Simple methods for this include Simpson's rule and the trapezoidal rule. For 10 points, name this operation, in the one dimensional case of which the area under a curve is estimated.
ANSWER: **numerical integration** [or obvious equivalents; accept numerical **quadrature**; accept **numerical discretization** before "approximations"; prompt on "integration" alone]

14. A form of vibrational spectroscopy based on this technique was developed by Stipe, Rezaei, and Ho via the IETS method. The apparatus for this technique is commonly calibrated by ensuring there is a "chicken wire" configuration when this technique is applied to HOPG. Apparatuses for this technique can operate at either constant height or constant current modes. This technique when used alongside CITS is able to measure the local density of states by temporarily disabling feedback and taking an I-V curve. Lutz, Eigler, and Crommie applied this technique to create a (*) quantum corral of iron. Invented by Nobelists Gerd Binning and Heinrich Rohrer at IBM, this technique relies on piezoelectric feedback for precise control of a platinum-iridium or tungsten tip as it's moved across a surface. AFM is an improvement of this technique, which relies on the formation of a bias voltage as electrons pass through a potential barrier. For 10 points, name this type of microscopy in which single atoms on a surface can be imaged.
ANSWER: **scanning tunneling microscopy** [or **scanning tunneling microscope** or **STM**; prompt on partial answer, but order does matter; accept **AFM** or **atomic force microscopy** or **atomic force microscope** until the word "AFM", prompt after]

15. *Clostridium ljungdahlii* (JUNG-dali) was isolated for its ability to produce this chemical from syngas. This compound can also be produced from syngas using a modified Fischer Tropsch molybdenum disulfide catalyst at high pressure, preferably with an H2 to CO ratio near 1. In dilute acid processes to produce this compound, conversion of the raw materials to a key intermediate is limited by the production of furfural. A team from the University of Florida constructed an operon including a gene from *Z. mobilus* for (*) pyruvate decarboxylase, and incorporation of that "pet" operon allowed transformed *E. coli* to produce high levels of this compound. In a common application, this compound replaced methyl tertiary-butyl ether as an anti-knock agent. In Brazil, this molecule is produced through fermentation of feedstocks derived from sugarcane. For 10 points, name this molecule that is incorporated into gasoline as a biofuel, often produced from corn.
ANSWER: **ethanol** [or **ethyl alcohol**. Prompt on "alcohol" or "biofuel". Since all of the clues relate to production of biofuel, accept bio**ethanol**]

16. This process can be simulated using the Kawano-Wagoner code. A nonstandard theory of this process by Kneller and Stiegman in which there is additional relativistic energy incorporates a "speedup factor". The timescale of this process limits the number of neutrino families to 3. Fermi and Turkevich determined that this process has "crevasses" at A equals 5 and A equals 8. The ratios of the precursors to this process were fixed to a 1 to 6 ratio by the freezing-out of weak interactions. The first product of this process is easily disrupted by high-energy photons because of its 2.2 MeV binding energy, leading to that product's namesake (*) bottleneck. The standard theory of this process, whose product distribution was posited to be dependent on neutron capture cross section rather than stability in the Alpher-Bethe-Gamow paper, predicts an exquisite dependence on the baryon-to-photon and neutron-to-proton ratios and predicts a mass abundance of around 25% for helium. For 10 points, name this process that occurred between 3 and 20 minutes after the start of the universe, in which light elements were created.
ANSWER: **big bang nucleosynthesis** [or **BBN**, or **primordial nucleosynthesis**; prompt on partial answer]

17. In a form of analysis of macromolecules named for *these things*, a mass-weighted Hessian matrix of second-order derivatives of the potential energy is computed, then diagonalized, then its largest eigenvalues are found. Wilson's GF method involves transforming from internal coordinates to a set of coordinates based on these phenomena, and in general the system of coordinates in which each of these has its own equation of motion is the one in which the mass tensor and A-tensor are diagonal. In one simple system, these things can be found by transforming the coordinates of the system to the sum and difference of the displacements, and that system has two of these, one with omega equal to square root of quantity k plus 2 k prime over m and one with (*) omega equal to square root of k over m. In general, these things can be found by solving the secular determinant of a system of equations of motion. Any motion of a given system can be decomposed into a linear combination of these modes, and they occur at resonant frequencies. For a vibrating string, these modes are called standing waves or harmonics. For 10 points, name these modes of a system in which all parts oscillate sinusoidally with a fixed phase relation.
ANSWER: **normal mode**s [accept **normal mode analysis**; prompt on "resonant modes" or "resonance" or "resonance modes" or "natural frequencies" or "natural modes" or "eigenmodes" or "eigenfrequencies"]

18. A theory of the formation of this substance was supported by Wells and Olinger's measurements of helium-3 levels in the Cima dome, and posited that it formed at the same time as a nearby lava flow. Another theory of its formation includes the expansion and contraction of clays due to precipitation, leading to the surfacing of this substance's components. The most popular theory of its formation says that it's what's left behind after (*) deflationary processes remove smaller particles. This substance is supported underneath by an A-type vesicular soil horizon and is covered by an orange or black clay coating forming a similarly-named varnish. For 10 points, name this layer of interlocking pebbles and cobblestones found underneath sand in a certain arid biome.
ANSWER: desert **pavement**

19. Mutation in a protein responsible for processing these proteins causes restrictive dermopathy in infants; that protein is the matrix metalloproteinase ZMPSTE24. An abnormal form of these proteins retains the farnesyl group on its C-terminus after processing. One isoform of these proteins interacts with emerin, mutations in which cause Emery-Dreifuss Muscular Dystrophy. The A and C types of these proteins are alternatively spliced from the same gene. Activation of a cryptic splice site at glycine-608 on one of these proteins is a cause of (*) Hutchinson-Gilford progeria. These proteins' rod domains bind to S/MAR regions, which contain AT-rich patches. These proteins are phosphorylated by MPF during the cell cycle in order to disassemble a certain organelle. For 10 points, name these intermediate filaments that form a meshwork on the inner surface of the nucleus.
ANSWER: nuclear **lamin**s [prompt on "intermediate **filaments**", "nuclear **lamina**", "nuclear **matrix**"]

20. Dialkylbiaryl phospine ligands are used as pre-catalysts containing this metal and include the BrettPhos line. An alternative to the Ullmann reaction in synthesizing aryl ethers can use those catalysts, as can a reaction to produce aryl amines. This metal is re-oxidized using copper in a reaction to convert ethylene to acetaldehyde, and it can also be used for allylation of nucleophiles. Both of those reactions are co-named for Jiro Tsuji. Either nickel or this metal can be used to catalyze a reaction between (*) organohalides and organozinc compounds that allows synthesis of non-symmetric biaryl compounds. This metal can be used to catalyze the reaction of aryl halides and an organoboronic acid, and along with lead it can be used to reduce alkynes to alkenes without further reduction. For 10 points, name this metal used in the Negishi and Suzuki couplings as well as Lindlar's Catalyst.
ANSWER: **Palladium**