Topic 3 - data-based questions

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1. (Non-smokers without the cancer are controls in this study as they do not have the risk factor of smoking, or the cancer.)
A is more common; as the percentage with A and G or A and A is much higher than the percentage with G and G (the Hardy Weinberg equation could be used to predict the base frequencies: frequency of G is $\sqrt{0.126} = 0.355$; frequency of A is $1 - 0.355 = 0.645$);

2. **a)** patients with cancer = 43.7 + 9.8 = 54%; without cancer = 35.6 + 9.4 = 45%;

b) a higher percentage of those with the cancer were smokers than those who did not have the cancer, suggesting that smoking increases the risk of the cancer / gastric adenocarcinoma;

3. the base A is associated with a higher risk; 19.3% GG total for those with the cancer versus 22.0% for those without the cancer; 83.7% AG plus AA total for those with cancer versus 78% for those without cancer;

4. increased more in smokers who have the A allele; proportion of smokers with AG or AA is $\frac{43.7}{(43.7 + 9.8)} = 0.82$; proportion of non-smokers with AG or AA is $\frac{35.6}{(35.6 + 9.4)} = 0.79$;

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1. 20 in mice (or 21 if the X and Y chromosomes are considered to be separate types); 23 in humans (or 24 if the X and Y chromosomes are considered to be separate types);

2. X, 1, 14;

3. 1 and 13;

4. common evolutionary history / common mammal ancestor; evolutionary divergence was relatively recent; rate of mutation / change is low; conserved function / roles of genes;

5. duplication of some chromosomes; fission of some chromosomes; fusion of some chromosomes; translocation of parts of chromosomes to a different chromosome;

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1. such an organism would be sterile; meiosis requires synapsis/chromosome splitting; odd number means meiosis;

2. not supported when considering plants; meaning of complex needs to be established as all are multicellular; no difference in complexity of cat and dog yet dog has more chromosomes etc; threadworm is least complex so possible; would need to see chromosome number of prokaryotes etc;

3. some chromosomes may be long/fused;

4. chimpanzee and human have different chromosome numbers (48 versus 46); chimpanzee and human have a common ancestor so either chimp number increased by fission / duplication or human number decreased by fusion of chromosomes;

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1. **a)** chromosome 1;

b) chromosome 21;

2. **a)** chromosome 2 is longer; chromosome 2 has the centromere nearer the middle of the chromosome; banding pattern is different suggesting differences in structure;

b) the X chromosome is significantly longer; the banding pattern differs; the centromere of the X chromosome is nearer to the middle of the chromosome and is toward one end in the Y chromosome;

3. male; has an X and Y chromosome;

4. it has three chromosomes #21; the child will have Down's syndrome;

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1. similarities between the life cycle of a moss and of a human include:
both have haploid sperm and egg; both have an 'n' stage; both have a '2n' stage; both have mitosis, meiosis and fertilization; both have a zygote stage;

2. in humans the zygote gives rise to either male or female in individuals but in moss, the zygote gives rise to sporophyte; in moss sporophyte gives rise to spores whereas diploid human gives rise to gametes; eggs and sperm created by mitosis in moss but meiosis in humans; moss plant can give rise to male or female, but separate genders create gametes in humans; in moss, there is a gametophyte and a sporophyte, but we don't have this in humans; meiosis gives rise to gametes in humans, but to spores in moss;

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1. limited change in incidence until mid-30s; exponential increase after mid-30s;

2. **a)** 1% +/− 0.5%;

b) 1.7−1.0; 0.7%;

3. chromosome 21 is one of the smallest of the human chromosomes; trisomies of other chromosomes have more serious effects; causing death of the zygote / embryo / fetus before birth; missing chromosomes / chromosome mutations also too harmful for the individual to survive;

4. data doesn't discuss risk of advanced age of father; before age of 40, risk of non-disjunction is still relatively small; other possible complications besides chromosomal abnormalities; risk might be balanced by other benefits of postponed parenthood;

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1. 198 grey: 72 albino; 2.75 grey: 1 albino;

2. albino is recessive; the presence of the albino is masked by the grey allele; in a cross of heterozygotes, approximately 25% are albino;

3. GG / homozygous dominant is grey; Gg / heterozygous is grey; gg / homozygous recessive is albino;

4. the parental phenotypes are grey and albino; the parental genotypes are GG and gg; the alleles in the gametes are G and g; the hybrid phenotype is grey; the hybrid genotype is Gg; the alleles in the gametes are G and g;

	G	g
G	GG	Gg
g	Gg	gg

5. white fur and red eyes due to lack of the same pigment / melanin; due to a single mutation in gene for an enzyme needed to make the pigment;

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1. both typical and annulata have black and red colouration; both have spots; annulata has more black pigmentation;

2. in both cases, they are pure breeding strains; homozygous for the gene influencing coloration;

3. larger black spots than typica; black in more parts of the wing cases than typica; less black than annulata; do not have the rear black strip crossing from left to right side that annulata has;

4. **a)** key to alleles with A^T as allele for typical and A^A as allele for annulata (or other suitable symbols); F_1 genotypes are A^TA^A ; gametes produced by F_1 are A^T and A^A ; F_2 genotypes are A^TA^T, A^TA^A , A^AA^T, A^AA^A; corresponding phenotypes are typical, hybrid, hybrid, annulata; Punnett grid used as the genetic diagram;

b) 1: 2: 1; typical: hybrid: annulata;

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1. a) Bb × Bb;

	B	b
B	BB	Bb
B	Bb	Bb

prediction is: 3 bilateral: 1 radial; observed is: 2.38 bilateral: 1 radial;

b) fewer bilateral than expected, but close enough to support the prediction;

c) lack of success in pollination/attracting pollinators; reducing the number of recessive alleles;

2. a) LL' × LL';

	L	L'
L	LL	LL'
L'	LL'	L'L'

b) predict ratio of 1 light: 2 bluff: 1 ringed; actual observed 1.1: 2.1: 1.0; within sampling error, these results are close to predicted results;

3. a) do not fit Mendelian ratio; different results from wild type × poky crosses are different depending on which the female parent is; wild type × wild type gives some poky offspring, but not 3 : 1 ratio;

b) due to a mutation in a mitochondrial gene; mitochondria are inherited from female parent;

c) mutations to produce the poky allele of the mitochondrial gene;

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1. it is recessive as unaffected parents in generation I produce affected children;

2. a) 100% that they will be homozygous recessive;

b) 0%;

c) 0%;

3. a) Dd; the mother is dd;

b) Dd or DD; most likely DD as condition is rare and person is marrying into family with history of disease;

4. cystic fibrosis; sickle cell anemia; other example of autosomal genetic disease caused by a recessive allele;

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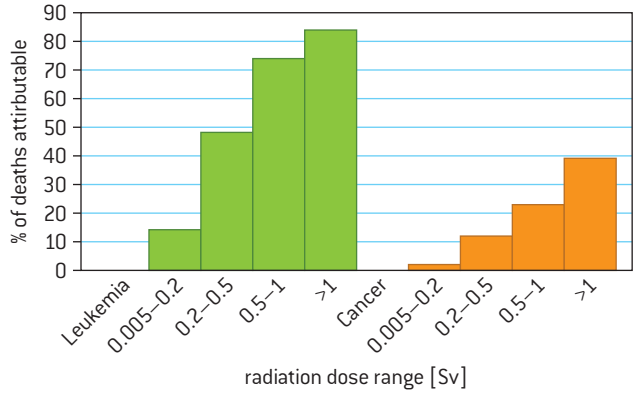
1. a) 10/70*100% = 14.3%

b) 47/56*100% = 83.9%

2.



3. higher doses increase deaths in both cases; more deaths due to leukemia than cancer; nearly quadruple at 0.5–1/double at >1;
4. less than 0.0005 Sv; as this level gives 14% increase in leukemia; and 2% increase in cancer; which is unacceptably high;

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1. 7;
2. data suggests Neanderthals more closely related to humans; because of the fewer differences in bases between humans and Neanderthals; minimum difference in human-Neanderthal exceeds maximum human-human difference, therefore humans and Neanderthals not the same species;
3. based on the bones of a single Neanderthal/limited support;

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1. **a)** type of leaf; equal misting; all in same type of tube; same method of applying pollen; same number of larvae on each leaf; same length of time of monitoring; time at which larvae were weighed;

   b) to ensure that the only variable was genetic modification; so the effects of this variable could be isolated from other variables;
2. **a)** 5 larvae per leaf x 5 replicates x 3 treatment groups = 75 larvae;

   b) to be able to identify anomalous results; to assess the reliability / variability of the results; to ensure that differences are not due to sampling error / variability between larvae;
3. error bars provide an indication of variability of data; if error bars overlap, likely to be no difference if difference in means exist;
4. mortality is only seen in group where leaves were dusted with GMO pollen; difference is significant suggesting an effect of GM pollen;
5. larvae may find leaves dusted with pollen unpalatable; pollen may provide nutrients and reduce the need for consumption of leaves; consumption of pollen/GM pollen may affect the health of larvae and reduce appetite;
6. 0.26 (g) / mid-way between other treatment groups; because leaf consumption is mid-way between them;
7. whether the larvae would consume leaves dusted in pollen; leaves still connected to plants in wild; density of caterpillars on one leaf affecting how much of one leaf they eat; whether mortality rates in the wild are normally this high.