

**KEEP IT SIMPLE SCIENCE****Genetics & Evolution****Year 10 Biological Sciences**

KISS topic number → Year level designation in Nat. Curriculum

Topic 19.10B

Science Understanding Strand
 B = Biological Sciences
 C = Chemical Sciences
 E = Earth & Space Sciences
 P = Physical Sciences

WORKSHEETSAttention Teachers

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2. In both the "PhotoMaster" and "OnScreen" resources, an information box (as shown) indicates the appropriate point for each worksheet to be completed.

Please complete Worksheets 1 & 2 before going on.
3. KISS Worksheets are formatted for photocopying so that they may be used as in-class paper exercises, quiz tests or homework assignments.

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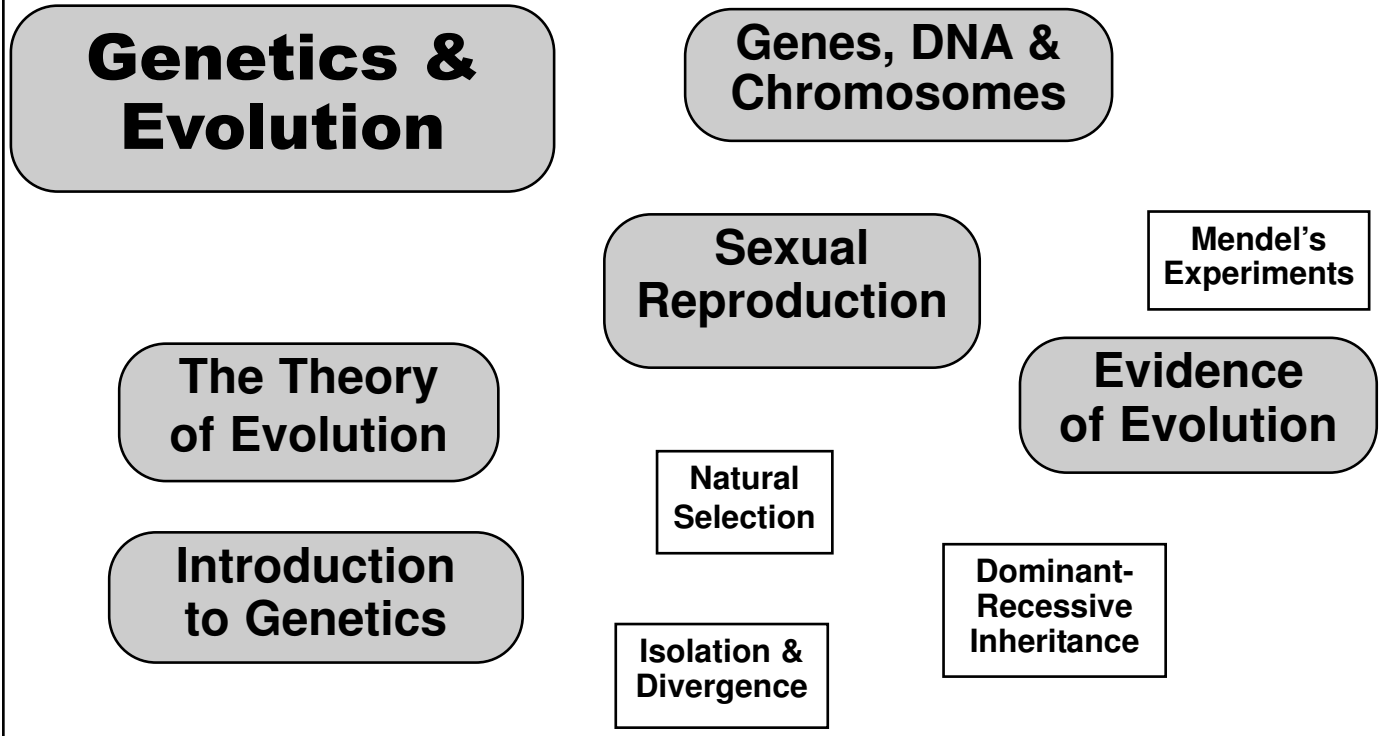
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Answer Section begins on p14

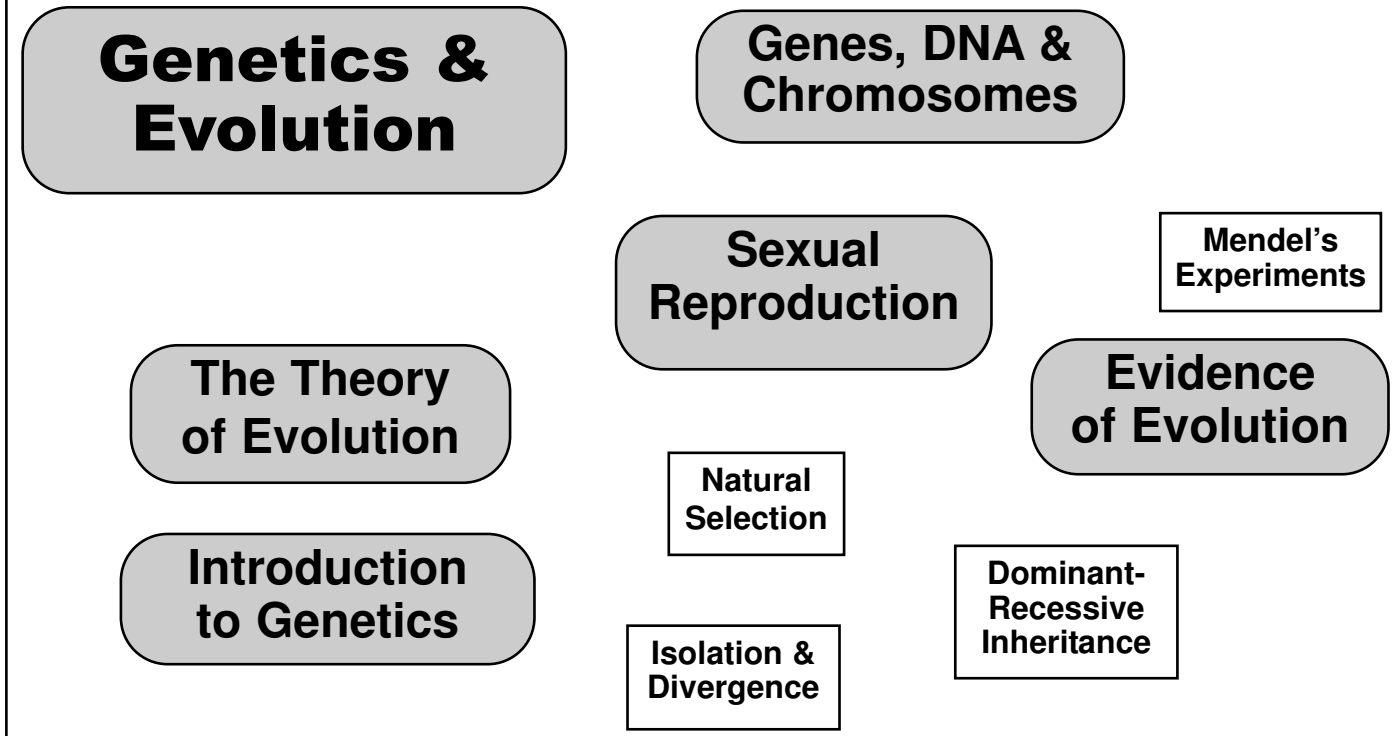
Suggested answers to the "Discussion / Activity" pages ("OnScreen" resources) are in a separate file in the folder for this topic.



Make your own "Mind-Map" TITLE PAGE.
 Cut out the boxes. Sort them into an appropriate
 lay-out on a page of your workbook, then glue them down.
 Add connecting arrows and colour in.



Make your own "Mind-Map" TITLE PAGE.
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Worksheet 1

DNA & Cell Division

Student Name.....

Fill in the blank spaces.

Living things reproduce their own kind according to the a)..... information stored in the chemical b)..... which is found in the c)..... of every living cell.

DNA molecules are huge, but are very simple in structure. They are made from just d)..... (number) different chemicals called "e)....." joined together in thousands. The precise sequence of these is a f)..... which cells can use to build g)..... and make cell parts, new cells, etc.

Every cell in your body has the complete set of h)..... molecules to specify every part of you. However, each cell only uses i)..... of the information.

In an early embryo, the cells are all the same. Later, they begin to specialise or "j).....". Each cell has all the DNA, but only follows k)..... of the instructions, so it becomes a l)..... cell, or a m)..... cell, etc.

Simple cell division is called "n).....". In unicellular organisms, this is how they o)..... In p)..... organisms it is used for q)..... and to r)..... worn-out or damaged cells.

The first step in cell division is to make s)..... of the DNA. Next these copies are t)..... so the cell now has 2 u)..... The cell now divides into two cells, each one only about v)..... Finally, both new cells w)..... to full size before the process starts again.

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Worksheet 2 Mitosis

The process of cell division by Mitosis is all jumbled up in these diagrams and captions. Cut them out and re-arrange into correct order. Connect with arrows.

Each new cell grows to full size.

2 half-size cells with identical genetic information.

DNA duplicated.

Cell divides.

DNA copies are separated. 2 nuclei form.

Nucleus
DNA
Original cell.



Worksheet 3

Student Name.....

Sexual & Asexual Reproduction

Unicellular organisms reproduce by simply a).....
 Many multicellular organisms can reproduce b)..... as well.
 Fungi (such as c).....) produce special cells called d)..... which can grow into a new organism.
 Many plants can reproduce by sending out "e)....." which grow into a new plant.

Regardless of the details, asexual reproduction always:

- involves only f)..... parent.
- involves g)..... cell division.
- results in offspring which are genetically h)..... to each other and to their i).....

Sexual reproduction always involves j)..... parents and a special cell division called "k).....".

During this division, the number of chromosomes is reduced to l)..... of the number in a body cell. The special cells are known generally as "m).....", being n)..... cells in males and o)..... in females.

During sexual reproduction, the 2 gametes join together ("p).....") to form a new offspring cell called a "q).....". It then grows by r)..... cell division into an embryo. The number of s)..... in the offspring is restored by the joining of the t)..... at u).....

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Worksheet 4 Comparing Processes

Complete each table of comparison

Student Name.....

Table 1	Asexual Reproduction	Sexual Reproduction
No. of Parents	a)	b)
Type of Cell Div. involved	c)	d)
Are offspring same as each other? (genetically)	e)	f)
Are offspring same as parent(s)? (genetically)	g)	h)

Table 2	Mitosis	Meiosis
No. of cells produced	a)	b)
No. of chromosomes in new cells (compared to original)	c)	d)
Are new cells the same as each other? (genetically)	e)	f)
Are new cells the same as parent cell? (genetically)	g)	h)
Type of Reproduction	i)	j)



Worksheet 5

Student name.....

Genes & Chromosomes

Fill in the blank spaces.

A unit of inheritance is called a "a).....".
Each simple characteristic of every organism is controlled by a gene inherited from the parent(s).

Each gene is actually a molecule of b)..... These molecules are huge, but are simple in structure. They are composed of only c)..... (number) chemical units called "d)....." joined in thousands in long, coiled chains. The exact e)..... of these is a f)..... which the cell can "read" to build g)..... molecules to make cell parts, or to develop in a certain way.

The DNA molecules are packed into structures called h)..... visible during cell division.

Each i)..... may contain 1000's of j)..... packed with protective proteins in structures that are often k).....-shaped.

In humans, a body cell contains l)..... chromosomes, arranged in 23 m)..... One pair are the "n)..... chromosomes" which determine if you are o)..... or Females have a matching pair described as p)..... Each egg passes on q)..... from each pair, so all eggs contain one r).....

Males have sex chromosomes s)..... Sperm cells contain either t)..... or Which type of sperm cell u)..... the egg determines the v)..... of the baby.

Worksheet 6

Replication & Mutations

Student Name.....

Answer the following questions.

1. What is "DNA replication" and when does it occur?

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2. Why is it important that DNA replication is done accurately?

3. What is a "mutation"?

4. What things can cause mutations?

5. a) If mutation occurs in a body cell, and the cell dies, is this a problem for the organism?

b) If the mutated cell does not die, what might happen?

c) When can a mutation affect every cell in an organism?

6. In general terms:

a) is mutation usually good or bad for an individual?

b) is mutation good or bad for the survival of a species?



Worksheet 7

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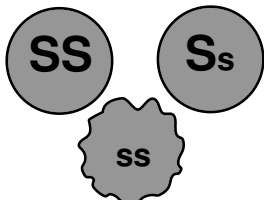
Genetic Crosses

1. Fill in the blank spaces.

Another characteristic that Mendel studied was seed shape. He found that there are 2 alleles:

Gene "S" causes smooth seeds.

Gene "s" causes wrinkled seeds.



Smooth is a)..... over wrinkled, which is b).....

Possible Genotypes & Phenotypes

c)..... = wrinkled

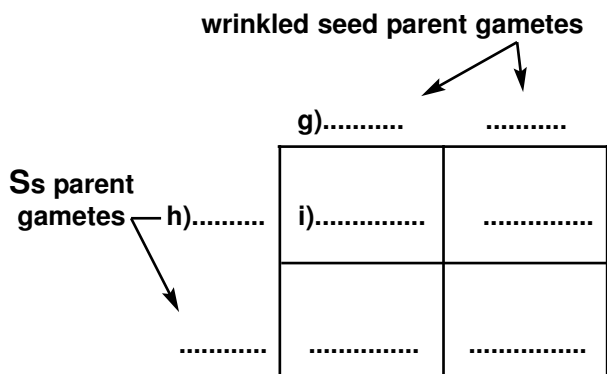
Ss = d).....

SS = e).....

A plant with genotype Ss was crossed with a plant with wrinkled seeds.

f) Genotypes of these plants? x

Complete the Punnett Square by filling in the blank spaces.



Phenotypes of Offspring

Smooth : wrinkled seeds

j) percentages% :%

k) ratio :

2. Some fruit-flies have bodies covered in hairs, some are "hairless".



hairless

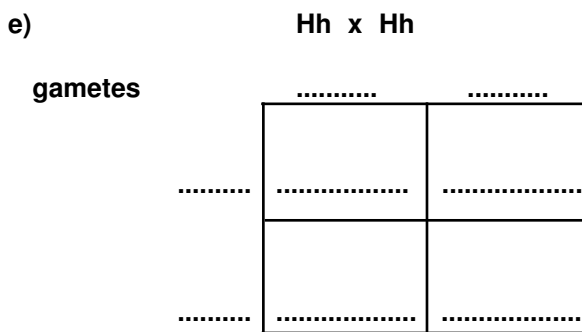


hairy

If you cross "pure-breeding" hairy flies with "pure-breeding" hairless flies, the offspring are 100% hairy.

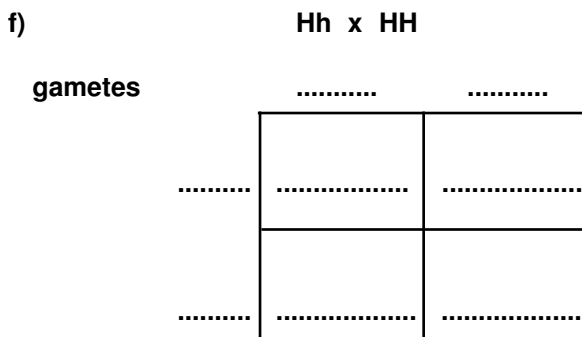
- a) Which characteristic is dominant?
- b) Suggest a suitable symbol for this gene.
- c) Which characteristic is recessive?
- d) Suggest a suitable symbol for this gene.

Complete the Punnett Squares for the following crosses.



Offspring Phenotypes Hairy : hairless

ratio :



Offspring Phenotypes Hairy : hairless

percent :



Worksheet 8

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Student Name.....

Genetics Problems

For each genetic cross described, fill in:
 a) the genotypes of parents (if not given)
 b) the genes passed on in gametes.
 c) the genotypes of offspring (in the body of the Punnet Square table).
 d) the phenotypes of the offspring, as percentages, fractions or a ratio, as instructed.

1. In mice, black fur (B) is dominant to albino (b). ("albino" produces white fur).

- a) Show the details of crossing a pure-breeding black mouse (BB) with an albino.
- b) The offspring from this cross were allowed to mate among themselves. Work out the result in the F₂ generation.

Parents: X

gametes

.....		
.....		

Phenotypes of Offspring Black : Albino

percentages :

Parents: X

gametes

.....		
.....		

Phenotypes of Offspring Black : Albino

ratio :

2. In fruit flies, a gene "H" causes hairs to grow on the body. Gene "h" causes no hair to grow.



Work out the details of the cross:

Parents: Hh x hh

gametes

.....		
.....		

Phenotypes of Offspring hairy : hairless

percentages :

3. Another set of alleles in fruit flies controls wing shape. A gene "N" produces normal wing shape, while "n" causes "vestigial wing" which is short, stubby and useless for flying. (insects with vestigial wings are not called flies... they are "walks")

Normal wing fly Vestigial wing



Work out the outcome of this cross.

Parents: Nn x Nn

gametes

.....		
.....		

Phenotypes of Offspring Normal : vestigial

ratio :

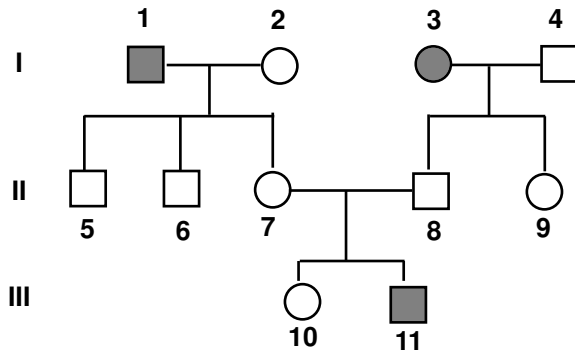


Worksheet 9

Pedigrees

In humans, some people have little fingers that are straight, while others have curved little fingers. This characteristic is inherited by simple Mendelian inheritance. Study the pedigree diagram, then answer the questions which follow.

Shaded shapes represent curved little fingers.



1. Is the curved little fingers trait dominant or recessive? Explain your answer referring to specific individuals above.

2. Assign the letters "S" and "s" appropriately to the 2 alleles operating in this pedigree.

3. Extra information: individuals 2 & 4 are homozygous.

Using the symbols chosen, work out the genotypes of everyone in the pedigree, as far as is possible.

Student Name.....

4. Couple 1 & 2 had children who all have straight fingers. Was there any chance they might have had a child with curved little fingers? Explain your answer.

5. Person 5 later married a girl with curved little fingers. Use a punnett square to predict the finger shapes of their children.

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6. In fact, person 5 and his wife had 2 beautiful little girls both with straight fingers. Is this possible? Is your prediction wrong?



Worksheet 10

Student Name.....

Fossils & Earth History

Fill in the blank spaces.

A fossil is the a)..... or of a b)..... from ages past. Fossils are usually found in c)..... rocks. They may be actual remains, such a d)..... or just an imprint or even a e)..... from an animal walking through mud.

The study of fossils is called f).....

Older fossils are always g)..... in the rock layers because younger sediments always settle h)..... This allows fossils to be placed in i)..... time order. Actual age can be measured by the j)..... in some rocks.

When fossils are arranged in time order, a pattern emerges: recent fossils are k)..... to modern living things. Older fossils are l)..... like modern life. Very old fossils are all m)..... and creatures.

It seems that life began almost 4 n)..... years ago. For most of this time, all life was o).....-celled and lived in the p)..... More complex life appeared only about q)..... million years ago.

Scientists have given names to different periods of Earth history according to the different r)..... which lived then. There is evidence of sudden s)..... extinctions in the past. These are always followed by the appearance of many t)..... in the fossil record.

Worksheet 11 Relative Dating of Fossils

The diagrams represent sedimentary rock profiles from 3 different areas.

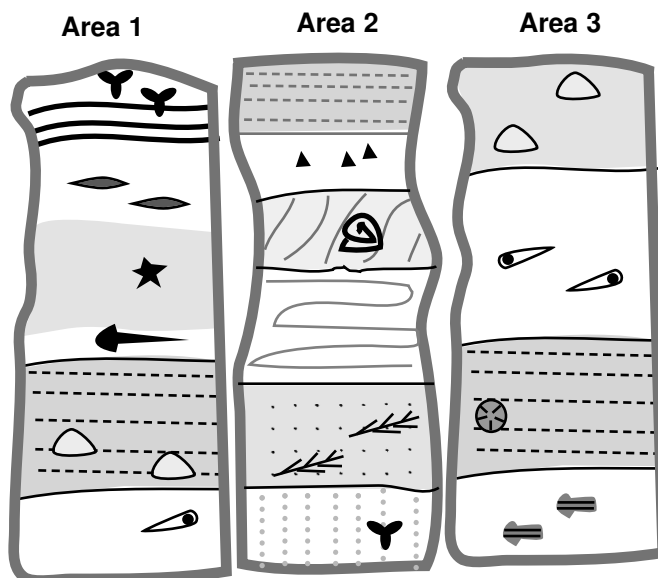
Student Name.....

1. What is the youngest fossil in each area? area 1 area 2 area 3

2. What is the oldest fossil in each area? area 1 area 2 area 3

3. Cut out each profile diagram and slide them vertically to correlate any fossils that match up.

4. From your correlated profiles, write the names of all the fossils in age order. Start with the oldest.



Key to Fossils	Shark tooth ▲	Coral ◊
Trilobite ≡	Fern leaf ≡	Moss leaf ◊
Graptolite ≡	Jawless fish ←	Ammonite ◊
Starfish ★	Sea urchin ⊗	Cone scale ▼

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Worksheet 12

Student Name.....

Evidence for Evolution

In Science, a “theory” is an

- a)..... for a set of observed
- b)..... Every scientific theory can (in principle) be proven
- c)..... Evolutionary theory could be proven false by finding a
- d)..... which is “out of place”.

The main sets of evidence supporting the idea of Evolution are:

- 1. The fossil record, which shows that life has changed from e)..... to and that life-forms have become more and more similar to f).....
- 2. “g)..... fossils” such as the dinosaur-bird “h).....”.

These give us a glimpse of one type of life i)..... into another.

3. Selective Breeding proves that a species j)..... by selection of which ones k)..... the next generation.

4. l)..... Anatomy often reveals evidence that different organisms evolved from a m).....

5. The study of various cell n)....., such as DNA, reveals many similarities between quite different life-forms. This gives further evidence of descent from a o).....

Worksheet 13

- 1. Place these Earth history events in correct time order.
Age of dinosaurs, first land plants, first birds, mammals take over, first land animals, first fish.

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- 2.
 - a) Describe the animal “archaeopteryx”.
 - b) What is the significance of fossils such as archaeopteryx?
- 3. Humans have carried out selective breeding on many species such as dogs. What does this prove?

Practice Questions

Student Name.....

- 4. a) What does “pentadactyl” mean?
- b) The bone structure of a dog’s paw, a seal’s flipper and a frog’s leg are all the same. What does this suggest about their evolution?
- 5. Describe some chemical evidence that suggests a common ancestor for all living things.
- 6. A human embryo has structures that are the same as the gill arches in a fish. (These later develop into the bones of the inner ear.) What does this suggest?



Worksheet 14

Theory of Evolution

Student Name.....

A. List the 5 points of Darwin's Theory of Evolution by completing each statement.

1. All organisms produce

.....

2.

In every species there is

3. Nature (environmental factors) selects

.....

4.

The survivors

and pass on their

5. Each generation is

because there has been selection of who

..... As these changes

accumulate, the species

B. List 3 "environmental factors" which might contribute to natural selection.

C. "Survival of the fittest" doesn't just mean to survive. What does it mean?

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D.

i) When a species evolves, does any individual change during its life time?

ii) When do differences appear?

Worksheet 15

Evolution Questions

1. a) Why is variation important in a population?

Student Name.....

3. a) List 3 environmental changes that might result in extinction of a species.

b) What might happen to a species with no variations at all?

c) What may cause a "mass extinction"?

2. a) Where do new variations originally come from?

4. Explain how one species, which is living in 2 or more isolated groups, might evolve to become several different species.

b) How does sexual reproduction contribute to variation?



Topic Test

Student Name.....

Score = / 42

Genetics & Evolution

Answer all questions in the spaces provided.

1. (5 marks)

Match each description to an item from the list. To answer, write the letter (A,B,C, etc) of the list item beside the description.

<u>Description</u>	matches with	<u>List Item</u>
a) Part of a cell where DNA is located
b) Cell division which produces gametes.
c) Thread-like structure containing genes.
d) Cell division involved in asexual reproduction.
e) Change to DNA during replication.

List Items Not all will be used. Some may be used more than once.

- | | |
|------------|---------------|
| A. mitosis | D. mutation |
| B. meiosis | E. gene |
| C. nucleus | F. chromosome |

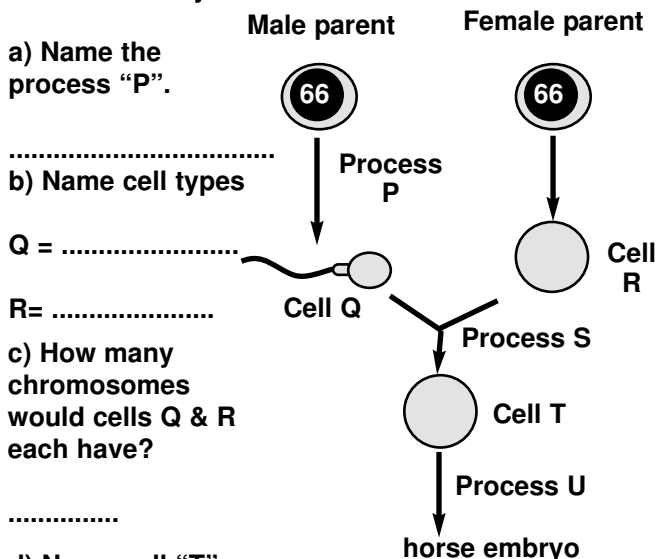
2. (3 marks)

- a) What is cell "differentiation"?
- b) For cells to take different roles, does this mean each cell has different genetic "instructions"?

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3. (8 marks)

This diagram summarises the process of sexual reproduction in a horse. The circle shapes represent various cells. The number of chromosomes in a horse body cell is 66.



a) Name the process "P".

b) Name cell types

Q =

R =

c) How many chromosomes would cells Q & R each have?

.....

d) Name cell "T" and state how many chromosomes it has.

.....

e) Name process "S"

f) Name process "U"

4. (5 marks)

In Mendel's pea plants a gene for purple flowers (P) is dominant to white flowers (p). A plant with genotype Pp was crossed with a white flowering plant.

Predict the outcome by filling in the Punnet Square.

Parents: X

gametes

Phenotypes of Offspring

Purple : White
ratio :



5. (5 marks)

Match each description to an item from the list. To answer, write the letter (A,B,C, etc) of the list item beside the description.

Description matches with List Item

- | | |
|---|-------|
| a) Traces of a living thing from long ago. | |
| b) When a species no longer exists. | |
| c) Fossil which is “in-between” in evolution of a new type. | |
| d) Process of environment choosing who survives or dies. | |
| e) 5-finger limb structure, common to most vertebrates. | |

List Items Not all will be used.
Some may be used more than once.

- | | |
|----------------|----------------------|
| A. extinct | D. transitional |
| B. fossil | E. natural selection |
| C. pentadactyl | F. diprotodon |

6. (4 marks)

a) In what general type of rock are fossils most commonly found?

b) In a particular cliff-face containing fossils, how do you tell which are older and younger?

c) When fossils representing the whole of the history of life on Earth are compared, what general pattern or trend is apparent?

d) How does modern Science explain that pattern or trend?

7. (4 marks)

a) Name a “transitional fossil”, and describe it.

b) What is the significance of transitional fossils to the Theory of Evolution?

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8. (2 marks)

Give an outline of a piece of evidence which suggests “descent from a common ancestor”.

9. (6 marks)

a) List the 2 (unrelated) facts about living things which are the starting point for Darwin’s theory.

b) Give an outline of what is meant by “natural selection”.

c) It is often said that evolution is all about “survival of the fittest”. What is “survival” really all about?

d) Why is it important for a species to have a lot of “variation”?



Answer Section

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Worksheet 1

- | | |
|---------------------|------------------|
| a) genetic | b) DNA |
| c) nucleus | d) 4 |
| e) nucleotides | f) code |
| g) proteins | h) DNA |
| i) part | j) differentiate |
| k) part | l) muscle |
| m) nerve | n) mitosis |
| o) reproduce | p) multicellular |
| q) growth | r) replace |
| s) a duplicate copy | |
| t) separated | u) nuclei |
| v) half-size | w) grow |

Worksheet 2

Refer to the original diagram on p4 (photo-copy) or slide 8 (OnScreen)

Worksheet 3

- | | |
|------------------|------------------|
| a) dividing in 2 | b) asexually |
| c) mushrooms | d) spores |
| e) runners | f) one |
| g) mitosis | h) identical |
| i) parent | j) two |
| k) meiosis | l) half |
| m) gametes | n) sperm |
| o) eggs | p) fertilisation |
| q) zygote | r) mitosis |
| s) chromosomes | t) gametes |
| u) fertilisation | |

Worksheet 4

Table 1

- | | |
|------------|------------|
| a) 1 | b) 2 |
| c) mitosis | d) meiosis |
| e) yes | f) no |
| g) yes | h) no |

Table 2

- | | |
|------------|-----------|
| a) 2 | b) 4 |
| c) same | d) half |
| e) yes | f) no |
| g) yes | h) no |
| i) asexual | j) sexual |

Worksheet 5

- | | |
|------------------------------|-------------------|
| a) gene | b) DNA |
| c) 4 | d) nucleotides |
| e) sequence | f) code |
| g) protein | h) chromosomes |
| i) chromosome | |
| j) genes or DNA molecules | |
| k) thread-shaped or X-shaped | |
| l) 46 | m) pairs |
| n) sex | o) male or female |
| p) XX | q) one chromosome |
| r) X-chromosome | s) Xy |
| t) X or y | u) fertilises |
| v) sex | |

Worksheet 6

1. It is the copying of the DNA which occurs just before a cell division.
2. It must be accurate or else the "daughter cells" would receive altered DNA instructions which might make them act abnormally, or be unable to function.
3. An accidental change to DNA (a gene) or to a chromosome.
4. Some chemicals or radiation (or they just happen by accident)
5. a) Usually not. A single dead cell in a multicellular organism is totally insignificant and happens all the time.
b) It may develop into a cancer cell and become life-threatening.
c) If it occurs in a gamete, which then is involved in fertilisation, it can affect the whole offspring.
6. a) Generally bad, because if there is any effect it usually is detrimental.
b) Good. Mutations create new variations which contribute to species survival and evolution.



Worksheet 7

- dominant
 - recessive
 - ss
 - smooth
 - smooth
 - Ss x ss
 - s, s
 - S, s
 - Ss, Ss,ss,ss
 - 50% : 50%
 - 1 : 1

- hairy
 - H
 - hairless
 - h
 -

Parents: Hh x Hh
gametes

	H	h
H	HH	Hh
h	Hh	hh

Phenotypes of Offspring
hairy : hairless
3 : 1

- Hh x HH

	H	h
H	HH	Hh
H	HH	Hh

Offspring
hairy : hairless
100% : 0

Worksheet 8

- a) BB x bb

	b	b
B	Bb	Bb
B	Bb	Bb

Offspring
Black : albino
100% : 0

- Bb x Bb

	B	b
B	BB	Bb
b	Bb	bb

Offspring
Black : albino
3 : 1

- Hh x hh

	h	h
H	Hh	Hh
h	hh	hh

Offspring
hairy : hairless
50% : 50%

- Nn x Nn

	N	n
N	NN	Nn
n	Nn	nn

Offspring
Normal : vestigial
3 : 1

Worksheet 9

1. Recessive. Couple 7 & 8 have straight fingers, but had a child (11) with curved little fingers. This can only happen if both parents are carrying a "hidden" gene... therefore it must be recessive.

2. S = Straight, s = curved.

3.
1=ss, 2=SS, 3=ss, 4=SS, 5=Ss, 6=Ss, 7=Ss, 8=Ss, 9=Ss, 10=SS or Ss(uncertain), 11=ss

4. No chance of curved-finger children, because all children must receive a "S" gene from mother who is "SS".



Worksheet 9 (cont.)

5. Ss x ss

	s	s
S	Ss	Ss
s	ss	ss

Children

straight : curved
50% : 50%

6.
It is quite possible. Prediction is not wrong.
In a large sample of offspring there should be approximately 50-50. However, in small samples, random chance can result in ratios that are not in agreement with the prediction.

Worksheet 10

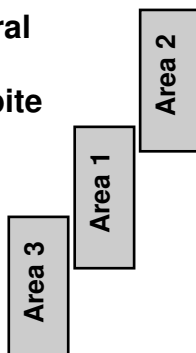
- a) remains or trace b) living thing
c) sedimentary d) bone / shell / tooth
e) footprint f) Palaeontology
g) lower h) on top
i) relative j) radio-activity
k) more similar l) less
m) small & simple n) billion
o) single-celled p) sea
q) 600 million r) life-forms
s) mass extinctions
t) new species

Worksheet 11

1. Cone scale, shark tooth, coral

2. Graptolite, cone scale, trilobite

3.
They need to be arranged as suggested by this diagram.



4.
Trilobite, sea urchin, graptolite, coral, jawless fish, starfish, moss leaf, cone scale, fern leaf, ammonite, shark tooth.

Worksheet 12

- a) explanation b) facts
c) false d) fossil
e) simple to complex
f) modern life-forms
g) Transitional h) archaeopteryx
i) evolving j) can be changed
k) breed l) Comparative
m) common ancestor
n) chemicals o) common ancestor

Worksheet 13

1.
first fish, first land plants, first land animals, Age of dinosaurs, first birds, mammals take over
2.
a) A dinosaur-bird, a dinosaur with feathers.
b) They give us a fossil glimpse of a stage in the evolution of one type of life into another.
3.
It proves that a species can change when there is selection of which individuals are allowed to breed.
4.
a) Literally, "5 fingers".
b) That they all evolved from a common ancestor which had that structure.
5.
All living things use the same genetic code in their DNA.
6.
Common ancestry. We still retain some features of our remote ancestors.



Worksheet 14

- A.
- All organisms produce more offspring than can possibly survive.
 - In every species there is variation.
 - Nature selects which individuals survive
 - The survivors breed and pass on their survival traits.
 - Each generation is different because there has been selection of who survived to breed. As these changes accumulate, the species evolves.
- B. Climate, predators, disease.
- C. It means to survive and breed.
- D. i) No.
ii) In the next generation, which receive a slightly different proportion of each "variation".

Worksheet 15

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- Variations increase the chance that some individuals might survive a change in the environment.
 - Without variations, all individuals could be wiped out in a changed environment, so the species becomes extinct.
- Mutations
 - It mixes genes from 2 parents to produce new combinations of features.
- Change of climate, a new predator, a new disease.
 - World-wide climate change is the most likely cause.
- Each isolated group may be acted on by different environmental factors. Natural selection chooses different "survival features" in each place, so each group evolves differently. Eventually each group may become a different species.

Topic Test

- C
 - B
 - F
 - A
 - D
- Differentiation is when cells specialise and take on different functions. e.g. muscle cell or nerve cell, etc.
 - No, all body cells have the same DNA instructions. To specialise, each one follows a different part of the total DNA.
- meiosis
 - Q = sperm, R = egg
 - 33
 - zygote, 66
 - fertilisation
 - mitosis (or growth)
- Pp x pp

	p	p
P	Pp	Pp
p	pp	pp

Offspring Purple : white
 1 : 1

- B
 - A
 - D
 - E
 - C
- Sedimentary
 - Older fossils lower down, younger fossils above.
 - There is a trend from simple to more complex, or from less like modern types to more and more resembling modern life.
 - Life changes by a process of evolution. This constantly causes living things to change to become better able to survive their environment.



Topic Test (cont.)

7.

- a) Archaeopteryx was a dinosaur-bird.
- b) Transitional fossils show us a fossil glimpse of a stage in the evolution of one type into another.

8.

The “pentadactyl” limb structure is common to most vertebrates even though various animals might use them as legs, flippers or wings. The same bone structure used in such different ways suggests that all types descended from a common ancestor which had that structure.

9. a)

1. All species produce more offspring than can possibly survive.
2. All species have variations among individuals.

b) The factors of the environment (“nature”) select which individuals survive and which don’t.

c) Those individuals with better “survival features” are the ones who survive to breed. It’s all about reproduction.

d) So that when the environment changes there is a better chance that some will survive to breed, rather than the species becoming extinct.

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