ADAPTATIONS

SUBJECT AREAS:
Sciences

DURATION/TIME:
Activity 1: 10 min
Activity 2: 30 minutes
Activity 3: 45 minutes
Experiment: 30 minutes

RECOMMENDED PREPARATION:
Activity 2: Gather supplies needed and make photocopies

Activity 3: Gather materials, insects (all the same kind), make photocopies and prepare your answer sheet.

MATERIALS NEEDED:
Activity 1:
Background sheet

Activity 2:
All supplies listed under 'build a cheetah' and photocopies of worksheet

Activity 3:
Insects for pair use
Materials listed
Backyard adaptations worksheet copied (2 pages)

Experiment:
Photocopy experiment worksheet

LOCATION:
Classroom

KEY WORDS TO REVIEW:
Adaptation
Endoskeleton
Exoskeleton
Semi-retractable
Rudder
Variables
Manipulate
Investigate

OBJECTIVE:

Learners will understand and investigate animal adaptations.

LESSON ACTIVITIES:

ACTIVITY 1:
Discussion: what is adaptation? (use 'background' sheet on pg. 38)

ACTIVITY 2:
'Build-a-cheetah' hands-on discussion and worksheet on cheetah adaptations

ACTIVITY 3:
Backyard adaptations: learners investigate insects and complete a worksheet on their findings

EXPERIMENT:
Using the backyard adaptations information, learners form a hypothesis

Learning Outcomes

In this activity learners will learn about the adaptations of animals and the role these adaptations play in their survival. Cheetah adaptations are discussed using analogous objects and learners are given the opportunity to discover adaptations of backyard insects.

Teaching the Lesson

Activity 1 – Discussion on adaptations

Animals come in all different shapes, sizes and colours. These differences make each species or individual member of a species especially adapted for success in a different habitat or place within the habitat.

Use the following activity to begin a discussion with the learners on adaptations. To help learners understand the great diversity of life forms found in nature, generate a list of species with the colours and shapes listed below. Ask learners to come up with as many species as possible. Some examples are listed. Ask the learners why they think the animals have these adaptations. Try to draw a link to habitat.

Black (penguins, black wildebeest)
Green (plants, grasshoppers)
Striped (tiger, zebra)
Fur (mammals)
Short tail (hyena, wild dog)
Short legs (warthog)
No legs (snakes, whales)

Grey (elephant)
Spotted (cheetah, leopard, giraffe)
Wings (birds)
Gills (fish)
Long tail (cheetah, lion)
Long legs (giraffe, antelope)

What is an adaptation?
Animals are designed to survive in particular habitats. Just as we might try to guess where people of different cultures are from by observing the way they dress, talk and behave, we can tell a lot about an animal's habitat by observing its behaviours and appearance. Simply explained, an adaptation is a physical or behavioural characteristic that helps an animal survive in its habitat. Those best adapted to the conditions in which they live are more likely to survive and reproduce. For example, take a cheetah with solid black spots. The spots help to hide them in the shade of bushes and trees, making it harder for other predators, which are a threat to the survival of the cheetah, to see them.

Use the following lesson to teach learners the significance and benefit of adaptations using the cheetah and its adaptations.

Activity 2 - Build-A-Cheetah: built for speed

Explore with your learners the special body parts and adaptations cheetahs have that allow them to run so fast. Using supplies listed below and the adaptation fact sheets and diagrams, discuss with the learners the various adaptations of the cheetah. Next to each of the supplies listed is the body part and adaptation it represents. Go through items one by one and explain why each is an important piece to include in the cheetah. You may want to put up a picture of the cheetah to help learners visualise each part.

Supplies	Body Part	Adaptations	Function
Paper airplane	Long, thin body	Aerodynamic build	Speed
Running shoe / takkie	Paws	Semi-retractable claws	Better traction for running
Long, medium, short sticks	Legs	Long legs	Bigger stride
Piece of wire	Spine	Flexible spine	Increased stride length
Picture of a cheetah	Body / skeleton	Thin and light	Increased speed
Long piece of string	Tail	Long and narrow	Balance and steering
Paper heart	Heart	Strong, enlarged heart	Increased oxygen supply to muscles
Binoculars (two toilet rolls tied together can substitute)	Eyes	Enhanced vision	Vision of 5 km
Sunglasses	Face markings	Tear marks on eyes	Protect eyes from sun's glare

Paper airplane:

Throw it into the air and watch it fly. The cheetah has a long, thin body to create less resistance to wind while running, just as a paper airplane flies easily through the air. Now crumple the paper and throw it; it will not fly like the airplane. Animals that move quickly through the air like birds or through the water like fish are streamlined. Cheetahs' long, thin bodies help them to run so fast.

Running Shoe/takkie:

What type of shoe? *(Running shoe / takkie / sneaker)*
When do we wear these shoes? *(Running / sport / exercise)*
Why do we wear these shoes for these activities and not other shoes? *(Rough sole with grooves. Can slip easily with a smooth sole. The rough sole provides better grip decreasing the chances of slipping and falling)*
Do you think it will aid a cheetah to have such an adaptation providing grip?
(A cheetah's paw has two adaptations to grip: the non-retractable claws, which can dig into the ground and the grooves on the pads which work similar to the treads on a car tyre)

Sticks:

Ask learners which sticks they would use for a cheetah's legs. Long legs increase the stride of a cheetah, allowing it to cover a greater distance in less time.

Wire:

Bend and straighten the wire to show how flexible it is. This represents the cheetah's spine. The cheetah has a very flexible spine, which allows the body to stretch out in a run. Together with the long legs, this gives the cheetah a stride of 8 metres (pace out 8m).

String:

What is a rudder? The cheetah's tail acts like a rudder helping the cheetah turn while running. The cheetah uses its tail like we use handle bars on a bike to steer.

Heart:

What is the function of your heart? *(Pump blood with oxygen to your muscles)*
When you are active, would you need more to keep muscles working? *(Yes)*
Why do you get tired when active? *(Not enough oxygen getting to the muscles.)*
Do you think it will take a lot of oxygen to run at 120km/h? *(Yes)*
Therefore the cheetah has an enlarged heart to help it run that fast.

Binoculars:

If you are a springbok, are you going to live near a cheetah or far away? *(Far away)*
What do we use to see things that are far away from us? *(Binoculars)*
Do you think that it would be an advantage to a cheetah to be able to see far? *(Yes, will be able to see where food is / other predators are)*
Cheetahs' eyes work like a pair of binoculars (binocular vision), allowing the cheetah to see very far (5 km). Use a landmark 5 km from the school that the learners all recognise to explain to them just how far 5km is. Cheetahs will be able to see a bird at that distance.

Sunglasses:

Due to its speed a cheetah has to hunt by day in order to clearly see where it is going. At a cheetahs active times, early morning / late afternoon, the sun is low on the horizon, often resulting in the cheetah looking directly into the sun. When you look into the sun can you see clearly? Do you think this would be good for the cheetah while hunting and running fast? What do we use to protect our eyes from the sun? *(Sunglasses)* What do you think are the cheetah's sunglasses? *(Tear marks)*
The colour black absorbs light, attracting the glare of the sun below the eyes, not directly into the eyes.

Assessment:

Using both of the following activities, you can assess the learners' understanding of the lesson as well as their ability to access information from a variety of sources.

Worksheet – built for speed

Name: _____ Date: _____

Using the paragraph and diagram on the adaptations of a cheetah and what you have learned from the previous activity, fill in the blanks to show the relationships between structure, adaptation and function.

STRUCTURE	ADAPTATION	FUNCTION
Tail		
Body		
Paws		
Spine		
Heart		

Adaptations of a Cheetah for Speed:

The cheetah is the fastest animal on land, with a maximum speed of 110-120 km per hour. Running is the cheetah's main form of defence; its speed allows it to hunt and escape from danger.

The cheetah has many adaptations, which help it to run so fast. The cheetah has a very light skeleton and does not have a lot of muscles. The cheetah's body is thin and streamlined. The leg bones are longer than other cats and cheetahs run on the tips of their toes, giving them a bigger step. The cheetah's spine also can bend a lot more than other cats; this also allows them to increase the size of their steps by stretching their body out. Their hip bones can turn where they are attached to the rest of the skeleton; this allows them to stretch their hind legs out further. All these adaptations give the cheetah a stride of 8 metres while running at full speed. The cheetah's long, narrow tail helps it to keep its balance and steer around corners. The feet give them better grip on the ground to stop the cheetah from slipping while it is running. This grip is provided by grooves on the cushions of the feet as well as the claws which cannot be pulled into the paw completely (we say that they are semi-retractable). It takes a lot of energy for the cheetah to run that fast. It is the oxygen in their blood that provides that energy. The cheetahs have a very big heart and lungs to make sure that they get enough oxygen to their muscles while running to keep up their energy.

Answer Key for worksheet – built for speed

STRUCTURE	ADAPTATION	FUNCTION
Tail	Long and narrow	Balance and steering
Body	Slender, long-legged, streamlined, light	Less wild resistance, and longer stride, therefore increased speed
Paws	Semi-retractable claws Grooves in pad	Better traction for acceleration and faster movement
Spine	Flexible	Increases the stride by allowing the body to stretch out further
Heart	Enlarged	Increased oxygen supply to muscles

Activity 3 – backyard adaptations

Procedure:

In this activity, learners will investigate adaptations using a specimen (insect) from the school's backyard and apply the knowledge previously attained through the cheetah adaptations to give an informed opinion as to the purpose of these adaptations. The learners will also practice their skills at scientific drawing.

Select your insect or other invertebrate in advance of this lesson and research its traits and behaviours. This will become the answer key to the learner worksheet.

Materials:

Be sure to have enough insects (or other invertebrates) for the learners to investigate, one each or in groups of two to three, collected from the pupils' backyard or the schoolyard.

- Container for the insect to be kept in for easy observation (A small transparent bag, plastic container with a clear top, or a plastic Petri dish)
- One piece of white paper
- A spoon and small paintbrush or stick
- A metric ruler
- A hand lens if available

The lesson can be easily adapted to use other equipment if any of the above is not available, or simply make sure the learners collect large enough insects for easy observation by the naked eye. If time allows, it is encouraged that learners spend many days on this activity, which will enable them to create a sound and beneficial experiment.

Name: _____ Date: _____

Name of Insect: _____

Introduction Activity:

In this activity, you will learn some important things about the anatomy and behaviour of your insect. You will also learn how to handle it and that it will not harm you.

The knowledge and skills you acquire in this activity will be of help to you when you design and conduct your investigation in the second part of this activity.

Procedure:

Using the spoon and the brush, place two or three insects in the container. Gently work with the insects in order to answer the following questions.

1. What is the length in millimetres of the shortest insect? _____ mm
   How long is the longest? _____ mm

2. How many pairs of legs do they have? _____
   Do all of them have the same number of legs? _____

3. How many antennae does one have? _____
   What functions do you think the antennae may have?
   _____
   _____

4. How many eyes do they have? _____
   Are the eyes simple (with one lens on the outside) or compound (each eye is made of multiple sections of the lens)? _____

5. Do they have wings? _____ If so, how many? _____

6. Draw a sketch of your insect below. Label all of the parts you can clearly recognise.

7. Touch the back of the insect to determine if it has an endoskeleton (like yours) or an exoskeleton. If it seems hard and stiff, it has an exoskeleton; if it's soft and fleshy, it has an endoskeleton. Which type of skeleton does it have?

   _____

8. Place the insect on its back on the piece of paper. Describe how it turns over and what it does next.

   _____

   _____

   Describe what it does when it comes to an edge where there is a drop-off.

   _____

   Can it climb on steep, smooth surfaces like the edges of the Petri dish or container?

   _____

   Can it climb on your arm or another steep, rough surface? _____

9. How fast can it run/walk? (to measure, do the following)
   a. Mark a small X in the centre of your piece of paper.
   b. Place it on the X.
   c. After releasing it, record the time it takes for it to move off of the paper.
   d. Place another X where it left the paper.
   e. Measure the distance between the two X's in centimetres.
   f. Calculate the speed of the insect in centimetres per second (cm/sec) by dividing the distance travelled by the amount of time it took.
   g. The insect travelled _____ cm/sec.

Experiment – backyard adaptations

Now that you have become familiar with the insect's physical makeup, you are ready to design and perform a scientific investigation about the behaviour of your specimen. Also, you will record and report any observations you make about its behaviour.

1. Brainstorm with your partners about possible behaviour questions you would like to investigate. List at least three questions.

2. Select one of these questions to investigate and state it below. Make sure it is a question.

3. Write a hypothesis that relates to your problem question. Write your hypothesis in the form of an "if, then" statement.
   (For example, "**If** mopane worms are placed in a box where they can choose between light and dark surfaces, **then** they will choose dark surfaces.")

4. Give your project a descriptive title and write the title below.

5. Make a list of all of the variables that may influence your investigation.

6. Determine the variable that you will manipulate (it is the independent variable) and write it below. [Remember that you should manipulate only one independent variable at a time]. Also determine the variable that you will measure (the dependent variable), and the variables that will be consistent throughout the investigation (the controlled variables).
   Independent variable: _____
   Dependent variable: _____
   Controlled variables: _____

NOTE: The information above should help you in completing the investigation write up. Organise this information according to your teacher's instructions.

7. Develop a series of step-by-step instructions that you will follow to test the question in your problem. The instructions will be the design of your experiment. [Make sure that the design of the experiment will really do what it is supposed to do.] The design should include a way to answer the question in your problem.

8. Make a drawing to illustrate the design of your experiment.

9. Conduct the experiment that you designed.

10. Using a data table, record your data and summarise the results. Using the appropriate graph type (line or bar) supply a graph of your results. The graph should have a descriptive title and a label for each axis.

11. Write a paragraph that states your conclusions. It should include an answer to your problem question and state whether or not you confirmed your hypothesis and explain why. Also, discuss how the results of the experiment may relate to the ability of the insect to survive in its own natural environment.

Things to consider:

When designing your experiment, make sure that you can answer the following questions. [If you don't understand any of these questions, make sure to seek guidance from your teacher.]

- Have I identified all of the variables?
- How will the variables be controlled?
- How will variables be measured?
- How will variables be manipulated?
- What equipment and supplies do I need?
- Does my experimental design really do what it is supposed to do?
- Will my experiment answer my question?
- How many organisms will I use in my investigation?
- Is my experiment designed to avoid harming the organisms?
- How many times will I repeat the investigation to ensure that the results are valid?

Background – adaptations

As the fastest animal on land, with a maximum speed of 110-120 km per hour, the cheetah can accelerate from 0-80km in 3 seconds. Their top speed can only be maintained for between 400-500 metres resulting in a short burst of speed (20-30s). They then need to rest for about 30 min. Running is a cheetah's main form of defence; its speed allows it to hunt and escape from danger. Over generations the cheetah has evolved many adaptations to facilitate a specialisation for speed.

Speed consists of the distance one covers in a certain time; therefore by increasing the distance covered one can increase one's speed. The cheetah is aerodynamic (stream-lined) for decreased resistance while running. The leg bones are longer in comparison to the other cats and they run on their toes, giving them a longer stride. The cheetah also has a very flexible backbone, which allows it to stretch its body out further. The cheetah's shoulder blades are not connected to the collarbone, thus allowing the shoulders to move freely and help increase the length of the forelegs while running. The hip bones pivot in their sockets, allowing for greater length of the hind legs while running. All these adaptations result in a stride of 8 m at full speed. The lightened skeleton and reduced muscles mass aid the cheetah in running faster by decreasing the weight carried (the larger you are the slower you are).

The long tail helps the cheetah to balance and helps the cheetah make sharp turns when running, stabilises the body and acts as a rudder. A cheetah' foot shows several modifications, allowing for greater grip while running. The pads on the base of the foot bear longitudinal ridges, the function of which is equivalent to tire-treads. The cheetah has semi-retractable claws, which serve a function similar to cleats on a track/soccer shoe.

It takes a lot of energy to sustain the top speed of a cheetah, and therefore the cheetah has several adaptations to allow more effective delivery of oxygen to the muscles. In comparison to the other large cats, the cheetah's heart, lungs, nostrils and sinuses are enlarged to increase oxygen supply to the muscles.

Cheetah's adaptations for speed: