DAVID SHEPHERD WILDLIFE FOUNDATION

Activity Workbook

Elephant Rescue



Image credit: Matt Armstrong-Ford

The Art of Survival: FIGHT • PROTECT • ENGAGE

Disclaimer

This document is meant for educational purposes only. It is based on a simplified story of an orphaned elephant's rescue; it is not a guide of how to look after an orphaned elephant as that is a very complex issue and cannot be dealt within the context of this booklet. Should anyone be in contact with a possible orphaned elephant please seek help from an expert in your own country.



Image credit: Will Fortescue

Zambia is in Southern Africa. The Kafue National Park (highlighted on the map) is named after the river that runs through it and is very rural. It covers 22,400km^2, which is a similar size to Wales. It is not fenced so that wildlife can move freely in and out of the national park. The park is surrounded by game management areas (GMAs) which provides a buffer between the Park and the many farms in the same landscape. Most of these farms are subsistence farms. It can be a tough existence, as a failed crop, for whatever reason, means the farmer and their families cannot eat or provide for themselves. Most of these farms grow maize, also known as corn, which is a cereal crop that can be used as animal feed, and is used in many ways for human consumption.



This is Gideon. He is a farmer on the edge of Kafue National Park in Zambia. Gideon has found a baby elephant alone on his land. Due to a local conservation radio show broadcast every Thursday, he knew who to call: Game Rangers International, who could help to rescue the orphaned elephant.



Q.1

Using any previous knowledge (and information sheet 1) on conservation issues with elephants, what is likely to be the cause of this elephant being alone at such a young age?

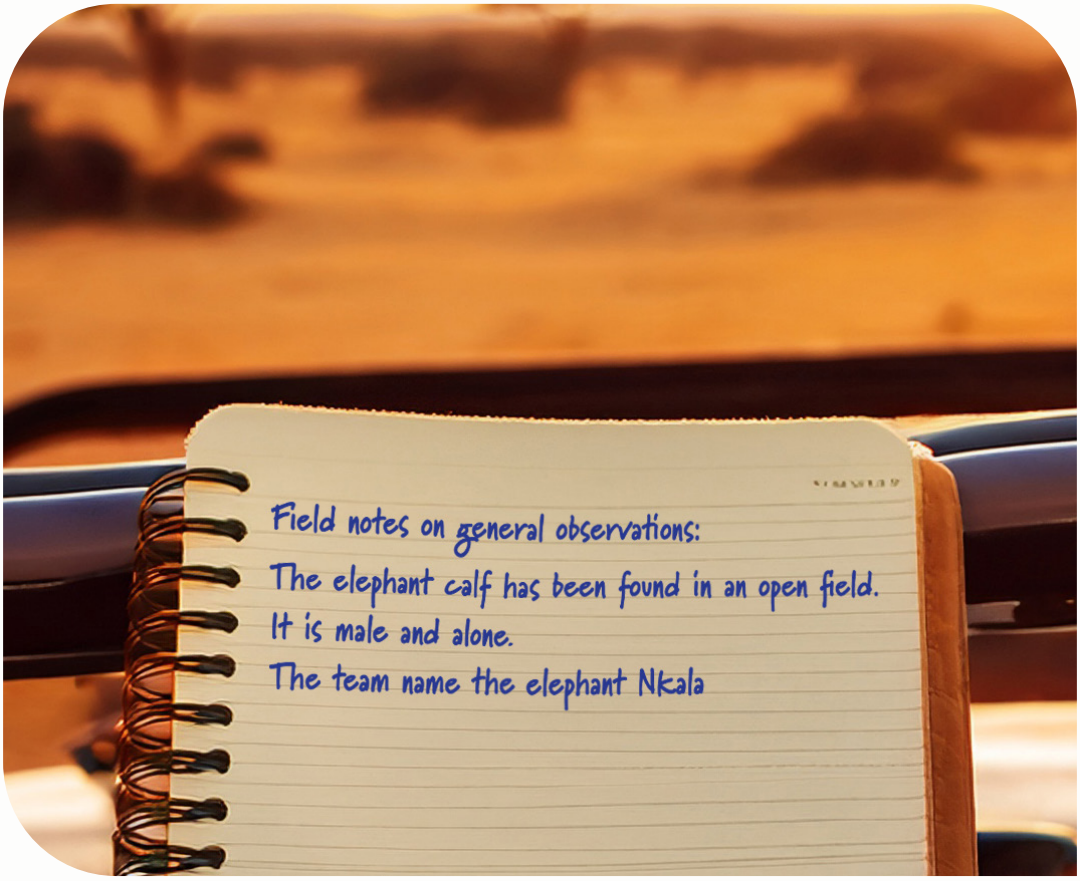
Q.2

Prior to the local conservation radio show, baby elephants (calves) would have been unlikely to survive if found alone on farmland as farmers would most likely have killed them for revenge or food. Most local farms grow maize to eat and about 40% of it is sold to make money. A herd of elephants can eat through a field of maize in one night leaving the family with nothing to eat or sell that year. This is an example of human/wildlife conflict. The radio show has started to offer other solutions for the farmers. Why is the local community important in the conservation of elephants? Discuss below.

GAME RANGERS INTERNATIONAL

You are the newest member of Game Rangers International, and it is your first wildlife rescue. You have been called in to try to save this orphaned elephant on Gideon's land.

As this is your first elephant rescue you have been provided with Information sheets 1-4, which will help you collect the information needed to give this infant a chance of survival, with the long-term goal being to rehabilitate and finally release the elephant back into the wild. This is in-situ conservation in action. You join the team on the car ride to Gideon's farm. It's quite a drive; the cars have been packed by the rest of the team with all the equipment you will need. As you pull up, Gideon takes you to where the elephant calf is. Luckily, he found the elephant quickly and called Game Rangers International straight away. The elephant is in an open field which can be accessed by the cars.



Time is of the essence. Key information needs to be gathered about this young elephant to fill in as much of the table below (Table 1) as possible. Use the key information sheets provided in this booklet to help you fill out this table, as well as the field observation information (in the boxes) gathered by another member of your team.

Now that you have collected the key information for the age of Nkala, as well as information on his stress levels and dehydration levels to complete Table 1, you can start taking actions to save his life.

Table 1. Key information to be gathered for Nkala. To be filled in.

Elephant Name: Nkala

	Elephant details	**Key features** e.g. height in metres
Sex of Elephant if possible to identify (Male/Female)		This can be very difficult to identify in young elephants the sex won't affect the first response.
Estimated age (thus % of milk dependence) Information sheet 2		e.g. Was the calf found next to its dead mother? Was the mother euthanised? Local accounts of how long the calf has been alone.
If known, time away from its mother (especially if under 2 years old)		
Observed Condition Information sheet 3		
Dehydration estimate Information sheet 4		
Key notes		

Q.3

Although it is still morning, it is a hot day and it is unknown for how long this elephant has been without its mother, herd and milk. Which of the following is the biggest concern for the team? Which of the following would you prioritize giving to the elephant first?

Read each of the three paragraphs in Information sheet 4 and Table 3, to make an informed decision on the next step and circle your answer. Time is of the essence and this decision can determine whether the elephant lives or dies.

A Electrolytes in water

B A bottle of plain water

C Protein boost

D Injection of insulin

E Bottle of milk formula

Q.4

Which option did you pick as your immediate action? Explain why you picked it and how your choice will help the young elephant.

Elephants, like humans, are highly social and being away from their family/herd at such a young age causes them extreme stress. Young elephants are often traumatised by either witnessing their herd's death or being isolated from other elephants. Highly stressed elephants release two hormones: adrenaline and cortisol. Their behaviour can be unpredictable, ranging from scared and aggressive to withdrawn.



Image credit: Surya Ramachandran

Q.5

What are the impacts of this stress on the elephant? Are there any actions the team could take to reduce Nkala's stress levels? (Information sheet 3)

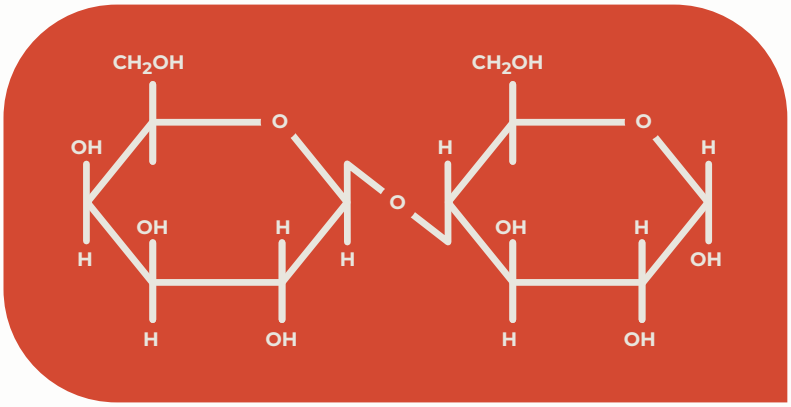
Q.6

Name the gland that produces adrenaline, and where it is located within the body of the elephant.

Most mammals milk is high in fats and carbohydrates, most of which are normally short chains for easy digestion for the young animals consuming them. Different animal milks have different compositions e.g. cow's milk is high in lactose. Elephant's milk is high in lactose when the calf is born, but the levels decrease quickly and remain low after this. Lactose is a disaccharide molecule, once this is broken down glucose is released into the blood stream at this point insulin is released by the pancreas to deal with the glucose. Lactose needs the digestive enzymes to break it down via hydrolysis to get the glucose into the blood stream. Elephant milk is also high in fats and protein and its chemical constituency changes throughout the two years of lactation. This is why the age and how long it's been away from its mum is important. Simply feeding elephant calves a bottle of cow's milk could lead to complications. Different protein, fat and lactose levels, along with potential insulin spikes which interfere with electrolyte balances could lead to a possible of cardiac arrest (Information Sheet 4). Older elephants still require milk as they get older, at this stage there are lower amounts of lactose in the elephant milk but is replaced by longer carbohydrate chains compared to other mammals.

Q.7

a) In the diagram below is the disaccharide molecule found in milk, which young animals are reliant on. It is made of the monosaccharides Galactose and Glucose.
Name this disaccharide molecule.



b) Name the enzyme that breaks down the disaccharide named in Q7a.

Q.8 The disaccharide molecule can be broken into two monosaccharides with the addition of a water molecule. What is the name of this reaction?

Glucose and oxygen are needed by all cells as they are vital in cellular respiration to produce energy that the cells can use.

Q.9 Where in the cell does cellular respiration take place?

Which option did you pick? The team picked introducing electrolytes, if you selected this choice- Well Done!

For Nkala, the team decide they need to correct his dehydration whilst ensuring the electrolyte balance is maintained. This is done using a premade rehydration solution given by a bottle, which he drinks. Over the next 24 hours, 10 litres of electrolyte solution will be given. The rescue kit contains 5 litres of premade solution, the rest will be made up using a sugar, salt and water mix as included in information sheet 4. The electrolytes are given with water, but plain water without electrolytes could mess with the osmotic pressure, leading to red blood cells bursting as the ion levels in the blood plasma and red blood cells differ. It could also prevent chemical reactions from occurring as the ions are not available in high enough concentrations such as for muscle contraction. Coconut will also be given to increase his energy levels without increasing the carbohydrate levels too high (beware of insulin spikes), before any milk is given. Protein is also added to the formula in the form of whey powder. Cow's milk has been found to be indigestible in elephant calves, often causing GI inflammation, so either horse milk or human milk formula is used as a base for the calves' milk. The concentration of the formula will depend on the calf's ability to drink based on their age and stomach size.

Just feeding Nkala plain water will not replace the missing electrolytes (potassium, calcium and magnesium) the body will still require these for vital chemical reactions to take place. Adding electrolytes to the water would help prevent this. In the field we can use either a premade rehydration solution or make our own using one litre of water, a teaspoon of salt (5grams) and a tablespoon of sugar (15grams). Both could be given orally or by a rectal enema to go into the blood stream if the elephant is too weak to drink. Elephants, like horses, are hindgut fermenters. Hindgut fermenters have a single stomach, but a large caecum and large colon. The large caecum is where most of the breakdown of food takes place. It is in the colon that most of the absorption of nutrients occurs meaning that rectal enemas can be very effective at absorbing not only the water but the salts and sugars (electrolytes) to help correctly hydrate the elephant again.

The electrolytes could be given to Nkala by bottle as he is still alert. If the elephant is unconscious then using the enema to help get a balanced rehydration solution into the body is the best course of action. It is also possible to rehydrate using intravenous fluid therapy if blood albumin levels are within normal ranges.

While milk is a great source of water for rehydration it can also be high in lactose. This sounds like a good thing for a weak calf needing energy, but going from very low lactose levels in the elephant calf's body, to a carbohydrate serge could cause an insulin spike which in turn can cause the electrolyte levels to go out of balance. A major example of this would be the reduction of potassium efficiency, which could have a negative effect on heartbeat regulation. Re-read the paragraph on electrolytes role in the body, then answer questions 10 and 11.

Q.10 The disaccharide molecule can be broken into two monosaccharides with the addition of a water molecule. What is the name of this reaction?

Q.11 Where in the cell does cellular respiration take place?

Whilst rehydrating the elephant is very important, care must be taken not to overhydrate as this might disrupt both osmotic pressure and electrolyte balance. If the elephant has diarrhoea solely due to changes in diet it is usually ok to assume that, as long as more water and nutrients are going in than are coming out, a gradual return to normal digestion will occur.

Antibiotics

In the past antibiotics used to be given as a routine part of an elephant rescue. In light of new findings the elephant will now only be treated with antibiotics if there is a sound clinical reason for doing so. This could be if they are rescued from wells or stuck in other dirty standing water. In this scenario it is possible that as the elephants have been moving around in the dirty water, they may have aspirated contaminated liquid into their lungs (breathing in) which can result in a bacterial pneumonia. Elephants can get gut infections, but these will be treated with antibiotics only if clinical symptoms indicating bacterial infection are seen. Elephants rely on gut flora including bacteria to break down the cellulose which is their only source of food in the dry season.



Image credit: Andrew White

It's our job to stabilise the young elephant to prepare them for the journey to the elephant orphanage. It's a seven-hour drive to the elephant orphanage and the elephant calf is weak and hungry. Where possible, the elephant will be treated, cared and stabilised for in the place where they were found, before attempting to move them. The elephant needs to be strong enough to make it through the long journey and have lower stress levels.

Once at the orphanage there is still a chance that their health and unseen factors could still result in death. For example, their adrenaline levels do not decrease quickly enough, which means blood lactate levels remain high, putting potentially fatal physical stress on the internal organs (See information sheet 3). For Nkala it's a long road to recovery, as most elephants in Zambia aren't fully released until they are large enough not to be hunted by predators. This is a minimum 10 year commitment.

But for now, Nkala is in safe hands and we have successfully rescued an elephant calf. Congratulations on your first rescue as part of Game Rangers international! Elephant conservation is complex, with a range of threats including loss of habitat. Elephant numbers are decreasing, so each young elephant saved will help with their conservation for the future.

Q.12 Using your knowledge of antibiotics, why do you think antibiotics are no longer routinely given without signs of infection?

Information Sheet 1

Background information on African Savannah Elephants

African Savannah Elephants: Loxodonta Africana

Geography: Found within 37 African countries, mostly in Southern and Eastern Africa. Due to their migratory lifestyle can cross wide ranges of habitats during their lifespan.

Conservation Status: Endangered. 90% decrease in population size in the last 100 years. 100 elephants estimated killed in Africa every day.

Conservation threats include:

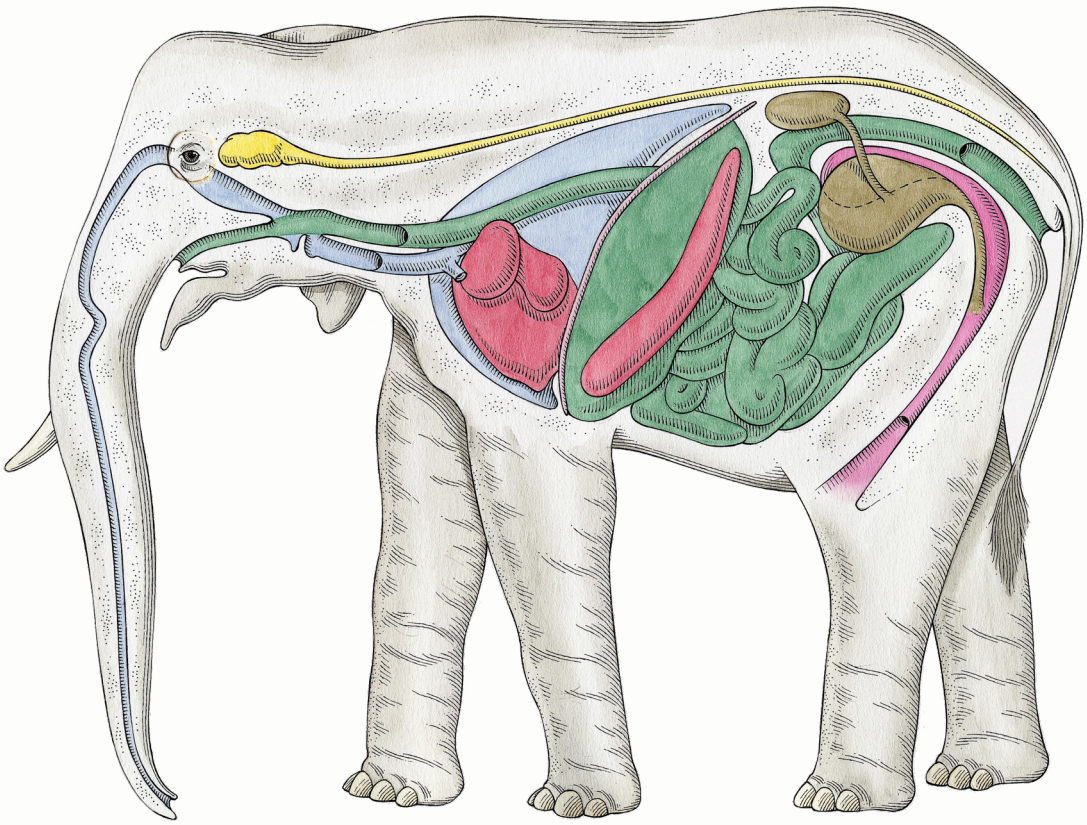
- Illegal wildlife Trade for Ivory from the elephant tusks. These threats have changed the genetics of populations and affected the behaviour of elephants. The tusks are very valuable on the black market.

- Human/wildlife Conflict is adding increasing pressure to elephant numbers. As the human population increases, the farms and villages have put humans and elephants into increased contact. Elephants raid the farms and the humans attack the elephants to protect their food. Elephants can also kill humans, further increasing the conflict.

- Habitat loss links with this. As farms and roads increase in number the habitats that elephants live in shrink in size but also get fragmented, with them having to cross farms, villages and roads on their migration routes. This puts elephants in contact with increasing numbers of humans and decreases the amount of viable habitat that provides natural food sources. Humans are moving into areas reserved for wildlife such as the game management areas further increasing the problem.

Size: Male elephants are larger than females and can grow up to four meters tall and weigh between 4,500- 6,100kg.

Lifestyle and Behaviour: Elephants live in large matriarchal groups of all females and their young - these are often family groups. The oldest and often the largest female is the matriarch and leads the herd. Pregnancy is 22 months long and, once born, the calf is raised by the whole herd. Bull (male) elephants are solitary and only associate with females for mating when they are in season and fertile. Young males tend to leave the herd at around the age of 10- 12 years and form small groups of young males, by 14 years old they start to live alone.



Diet: Elephants are herbivores and require over 200kg (2% of the elephant's body weight) of food and 190 litres of water a day. They eat grass, plants, fruit, roots and tree bark and supplement their diet with sodium from soil. Elephants are herbivores, which means they only eat plants and are hindgut fermenters. This means they have a single stomach, a large caecum for most of the digestion of food, and a very large colon where most of the nutrient absorption takes place. Look at the diagram of the elephant's digestive system and see if you can identify the stomach and the colon.

Information Sheet 2

Aging a young elephant

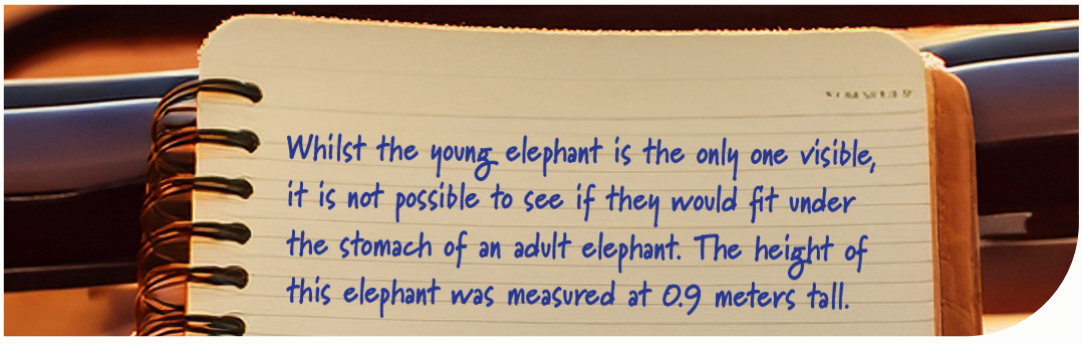
Aging elephants is a rough estimate done using height in meters. Elephants are slow to grow, but just like in humans we can only estimate, as some children are taller than their peers despite being the same age. Also included in the table is how much milk is required for these age groups, which will be vital in coming up with a nutritional plan for them later on.

Table 2: Using height as an age estimate for young elephants

Height (m)	Estimated age	Diet
0.7 - 1 (fits under the stomach of an adult elephant)	0-6 months old	100% milk dependent
1.1 - 1.2	6- 15 months	Mostly milk dependent but increasingly plays with food and attempts to eat some of it. Cannot use its trunk properly until 12 months old.
1.2 - 1.3 (fits under the stomach of an adult elephant)	15+ months	20% milk from mother and 80% from the surroundings.

After 24 months plus a young elephant who has lost its mother but is still with the rest of its herd can survive. As the rescue team, it is best to leave it with those other elephants, who will help protect it from predators.

Field observations on the age of the calf



Information Sheet 3

Observed condition and assessments

Stress and post-traumatic stress are major causes for concern when rescuing orphan elephant calves. These young elephants have often witnessed their mother's death and have then been alone for a period of time before being found by a farmer or a member of the team. This is very distressing for them as they are a herd animal and very social. We can look for signs of distress which can include touching their cheek with their trunk and trunk sucking (like thumb sucking in children). As well as this mental stress, during times of duress, the body can undergo physical stresses which have negative impacts on internal organs and systems. These are not always visible to the eye.

One such stress-induced condition is the production of a large adrenaline boost. Adrenaline is known as the 'flight or fight' hormone. It is designed to act quickly for a short period of time to enable the body to cope with the immediate stress. It works by increasing cardiac output, glucose levels in the blood and respiration.

Running on adrenaline is ok for a short period, but over a longer period the elephant's adrenaline will run out, causing them to crash and then have very low glucose levels, as the prolonged adrenaline production had caused the liver and muscle cells to convert the stored glycogen to glucose as a quick energy source. When there is no more glycogen left in the elephant's cells then no more glucose can be released. Glycose is important for cellular respiration to convert into ATP, which is the energy that cells can use. This can be especially problematic for muscle cells including cardiac muscle.

At the same time as the adrenaline overload, the calf may be dealing with a lack of protein in its diet which mean its body will also start to breakdown internal structures such as muscle to try and provide the protein the body needs. This breakdown can include cardiac muscles, which can be fatal for elephants. Malnutrition or starvation may also be a factor with levels of essential electrolytes such as Potassium reaching critical low levels. Potassium is responsible for proving the electrical charge that stimulates the heartbeat, without it arrythmias and defibrillations can occur. If all these things are happening at the same time it is possible for cardiac failure to occur.
These kinds of myopathy are an issue with young elephants as it is not uncommon for very high adrenaline levels to remain for days at the time of capture and rescue. Measuring levels of cortisol, which is the stress hormone, can help identify the degree of stress, but measuring lactate levels, (which are expected to be high at point of capture but should start to reduce after 24 hours) is a better indicator in the field. The blood test should be repeated 24 hours after the original blood test. If the levels of lactate remain high, it is a cause for concern as recovery of the normal internal organ function is often unsuccessful.

Tranquilisers are often used to help sedate and calm the elephants if they are extremely stressed or aggressive. The aim of sedation is to make it easier for them to be handled or receive medical help. All sedation carries a risk, and the elephants must be correctly assessed as to whether they are able to benefit from being sedated.

Field observations for the stress levels of the calf



Information Sheet 4

Body needs and Dehydration



Image credit: Luke Phillips (DSWF)

Assess its condition using the photo of this baby elephant above.
Does it have sunken cheeks?
Can you see the pin bone easily?
Is this elephant healthy? Explain your answer.

A) Electrolytes

Electrolytes are substances that dissociate in water into charged particles known as ions. Simply put, they are minerals in the blood that carry an electrical charge. They help regulate chemical reactions within the elephant's body and maintain the water balance from inside and outside their cells. An electrolyte solution can be given to not only increase the water levels in a dehydrated elephant but to also help with maintaining the correct balance of these charged minerals. They are especially important to maintain electrical balance and to generate action potentials for neurons within the brain and muscles. They include: sodium, potassium, chloride, magnesium, calcium, phosphate, and bicarbonates. If only plain water is used to rehydrate the levels of electrolytes can drop to dangerously low levels. Whilst all electrolytes have a important role to play potassium is vital as it regulates the heartbeat; Very low potassium levels prevent the action potentials from being generated, meaning muscle tissue can't fire, including cardiac muscles, which could lead to a problem with ventricular fibrillation and potentially cause cardiac arrest.

B) Protein and fat

Elephants get most of their protein needs from the huge range of plants they eat as an adult, however, they need extra protein as growing babies, and this comes from mother's milk. Elephant milk has high levels of casein, so the replacement milk formula should aim to include this as the preferred choice of protein. Protein is also key for muscle function for both skeletal muscles as well as cardiac muscles. One protein that is particularly important for elephants is Albumin which is made in the elephant's liver. Albumin acts like a sponge in the blood, drawing fluid into the blood vessels when needed. Low levels can lead to fluid being drawn out of the blood vessels into the surrounding tissue leading to oedema. This can put added pressure on the pulmonary, cardiac and abdominal areas. If dehydration is severe and electrolyte levels are low there will not be enough water for the albumin to absorb, preventing it from working correctly.

Adult elephants rarely eat fat but a young, distressed elephant with low protein levels may require a ball of coconut fat, with added whey powder as protein, to eat to help raise their energy levels without providing too much glucose (see below).

Definitions
Oncotic pressure: Force that is exerted by proteins in the blood that draws water into the blood vessels. For example, albumen causing a pulling fluid back into capillaries.
Osmotic pressure: - Drives water from low solute to high solute, to maintain the equilibrium.

C) Glucose and Insulin

Glucose is needed by all cells with oxygen so that cellular respiration can take place, to make ATP and carbon dioxide and water. ATP is how cells can use energy to enable them to function. This makes glucose vital for cellular processes to take place. After consuming large amounts of carbohydrates that gets broken down into glucose, the body tries to bring the glucose back within its ideal blood glucose range, using homeostasis and the hormone insulin. Insulin is produced by the pancreas in the islets of Langerhans beta cells and causes glucose to be stored as glycogen by the liver and muscle cells for later use when blood glucose levels drop. High glucose intake can cause insulin, which spikes can cause the elephant's electrolyte levels to spiral out of balance. Stable levels of electrolytes are needed before higher levels of carbohydrates can be given to prevent cardiac arrest.

Field observation for hydration and in the field blood test

To ensure the team have correctly identified the most urgent need for Nkala, they carry out an in the field blood test and compare the results for Nkala to that of a healthy elephant.

Table 3: Blood Results for Nkala

Blood Test	Average or range for a healthy elephant	Results for Nkala
Potassium level	6.24 millimoles per litre	3.5
Glucose level	60 - 116 millimoles per litre	71
Total Protein and Albumin levels)	6.2 - 9 grams per decilitre	6

Q.13 Using your knowledge of antibiotics, why do you think antibiotics are no longer routinely given without signs of infection?



Image credit: Matt Armstrong-Ford

This will give us a baseline for Nkala highlighting possible problems and to help with diagnosis of any illness, to be accurate we should retest in one to two weeks.

Q.14 Why would we want to retest Nkala in one to two weeks' time? What are the benefits of retest since we have the in-field results already.

Image credit: Matt Armstrong-Ford

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The Art of Survival: FIGHT • PROTECT • ENGAGE

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