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Muskauer Faltenbogen
UNESCO Global Geopark

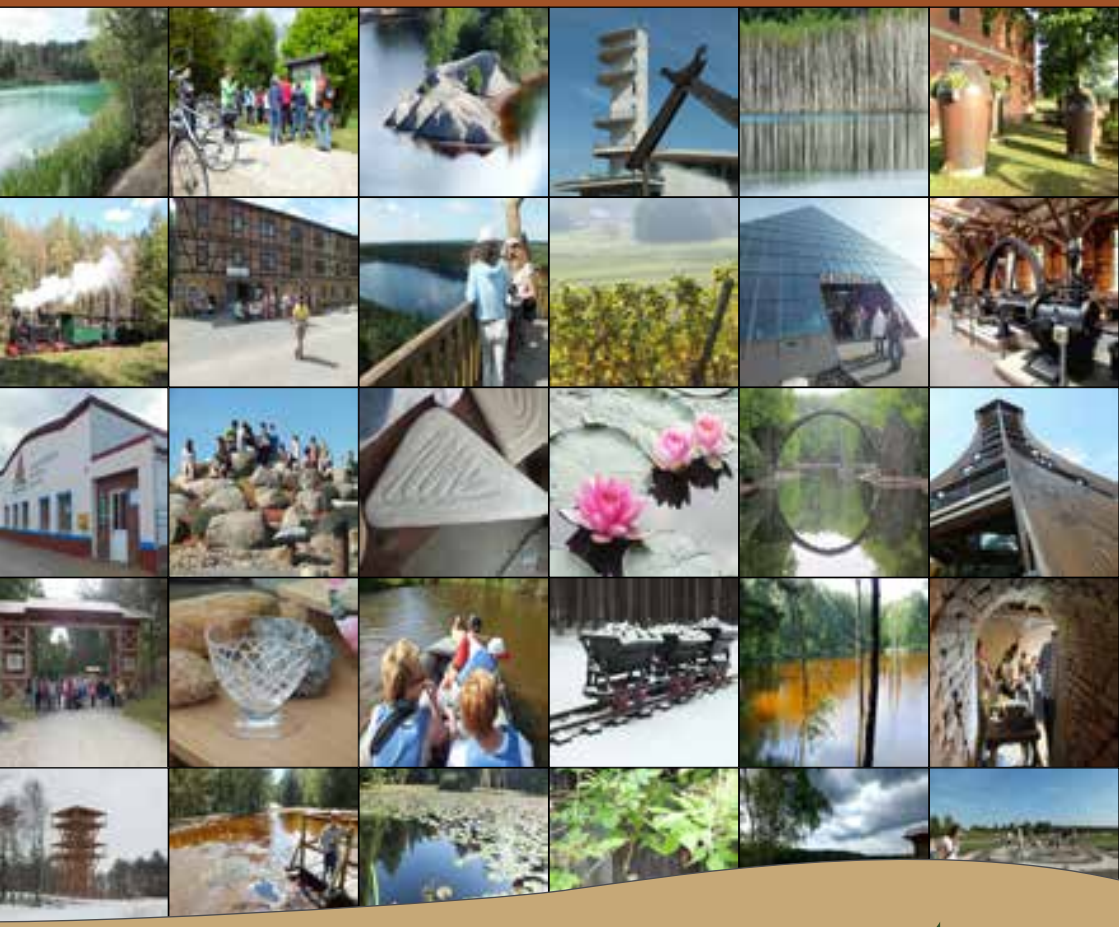
Łuk Mużakowa
Światowy Geopark UNESCO

Geopark
MUSKAUER FALTENBOGEN
ŁUK MUŻAKOWA

GEO

discovery book

... hiking in the footsteps of raw materials in the Muskauer Faltenbogen / Łuk Mużakowa UNESCO Global Geopark



imprint

publisher:
Spree-Neisse district, Heinrich-Heine-Straße 1, 03149 Forst (Lausitz)

editing:
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translation:
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printing: Colours Factory Sp. z o.o.
2. edition, October 2018

contents

I am Susi Stoßzahn („Susie Tusk"), a young mammoth found in the year 1903 by geologists and archeologists deep under the ground, in a clay pit between Forst and Cottbus. They prepared me for the Natural History Museum in Berlin, but you won't be able to see me at that museum. But you can find a duplicate of me in Forst (Lausitz) – a sort of three dimensional copy. That's where I got my name – Susi Stoßzahn.

It's a bit boring sometimes, just standing around and being looked at. But I like the children who visit me. So why not do something with them? Thank goodness the UNESCO Global Geopark Muskau Arch „adopted" me. Now, on behalf of the Geopark, I can go on excursions with you, explore the surroundings, and do many other cool things. Do you want to? Then let's set out together into the exciting world of the geosciences – and because that can be quite tricky, we'll take Flint Feuerstein („Flint Flintstone") with us. Flint knows a whole lot about rocks and minerals, and can certainly tell us a lot about them! Flint came to us from the chalk cliffs on the coast of the Baltic Sea. The mass of ice that dug him out and carried him here crossed over our region several times – that is, during the Elster, the Saale or the Weichselian Ice Ages. With the melting of the ice, he was deposited here, and was buried under the ground for a long time. But the wind and the weather uncovered him, little by little, and then we met during a walk in the forest. We've been inseparable ever since! Flint was also excited, right away, when I told him about our explorer's book. He has lots of great ideas and he knows so much – I think you like him too, right?

The best thing, from the start, would be for us to go on an expedition in the geopark! That way you'll learn a lot of interesting things about ancient times, and you can discover the exceptional world of natural resources and rocks. We will encounter colorful lakes, sunken forests and learn a lot about the lives of people 150 years ago!

Before you go...

Dear explorers,

Welcome to the UNESCO Global Geopark Muskauer Faltenbogen / Łuk Mużakowa / Muskau Arch! The Muskau Arch is considered one of the most beautiful legacies of the Ice Age in Central Europe. The gigantic, horse-shoe shaped wall – a push end moraine – was created about 340,000 years ago by an ice advance, which pushed up a huge wall, and compressed and deformed the ground underneath to a depth of around 300 meters. Even today, the Muskau Arch is constantly changing, because there are geological processes active here that continuously change the landscape, endlessly. But humans have a hand in the game now too – entire regions have been turned "upside down" by the extraction of raw materials.

Do you know what a geopark is? Geoparks are designated areas that exhibit particularly interesting geological and landscape features, and reveal the history of our planet especially well. Since 2015, there has even been a UNESCO title for such places – and only incredibly valuable geoparks receive it. By the way, our geopark is nearly 580 km² in size, and stretches over the Neisse River into both Germany and Poland. Yes, you read that correctly – Muskau Arch is actually a geopark that extends across borders, because geology knows no borders! That's pretty amazing!

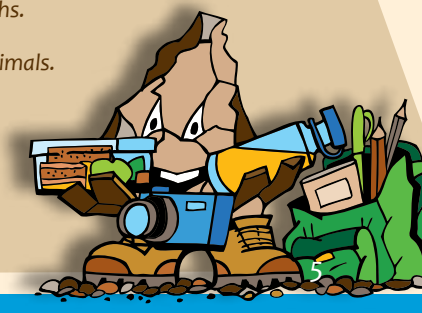
In Muskau Arch, so-called geotopes give us a glimpse into the development of the Earth. You can find them in geoparks very often, and in many variations! Human-made geotopes include artificial outcrops of rocks such as gravel pits, but even stone walls or churches made of boulders, for example, can also be human-made geotopes. Natural geotopes are for example dunes, marshes, giant boulders or springs and fossils, and even entire parts of the landscape, such as a moraine.

With this explorer's book, we want to invite you to get to know our UNESCO Global Geopark Muskauer Faltenbogen / Łuk Mużakowa / Muskau Arch! And in order to see how geology and the landscape are interconnected, we will introduce every discovery tour with a natural resource that is important for our region. If you want to know more about our geopark, or want to do other cycling or hiking tours, we are at your disposal! Our office and GeoAdventure–Center is located at Muskauer Straße 14, 03159 Döbern!

More information can also be found at www.muskauer-faltenbogen.de or on facebook!

Are you ready? But wait! I have to give you some instructions first – and they're very important!

- *Never go without supervision or without checking in with an adult first. Pay attention to other children and adults, and stay on the paths.*
- *Don't make unnecessary noise or disturb the plants and animals.*
- *Watch out for cyclists! Someone could also approach your group from behind!*
- *Dispose of your waste in the appropriate rubbish bins, or take it back home with you!*



I. Lignite (brown coal)

Do you still remember it – the coldness of night at Grandma‘s house, that lingers in the early morning and only gradually leaves the room because of the furnace? The smell that hangs over a village on a cool autumn day, when the ovens are fired up for the first time? Those are scents that are inescapably linked to autumn and winter – and coal. Do you actually know how it was created? And what else coal can do? Why adults nowadays – primarily politicians and environmentalists, but perhaps even your parents – sometimes argue about how long we will still need coal in our everyday lives?

The truth is, we don‘t only need coal for heating. Also the electricity in Germany, for computers and TVs, for cooking and warming water, often comes from lignite (also known as brown coal) power plants. Coal is still an important source of energy, but it doesn‘t simply „grow back“. That‘s why it‘s also known as not renewable energy source.

The lignite of this region originated in the Tertiary, a geological period that began millions of years ago. During the Tertiary, Lusatia was situated on the edge of a vast sea. The climate was very humid and very warm, and there were huge virgin forests with horsetail plants, ferns and club-mosses. Fluctuations in sea levels – triggered by the rising and falling of continents, by the formation of mountains or the forming and thawing of ice masses – created marshes in the shore areas. Unimaginable amounts of plants grew there.

Dead plants and trees fell and sank. Since they were sealed there, airtight, they couldn‘t rot. A layer of peat was formed – plant masses stacked on top of each other, compressed and compacted by their own weight. Over time, that is, over thousands and millions of years, our homeland was flooded by the sea, again and again. Rubble, mud, sand and clay were deposited on top of the peat layer. As soon as the sea withdrew again, new plants settled in the fertile ground, and the process started over. With every new lay-

In Germany there are many areas where lignite or hard coal can be found. The deposits are, of course, only common in northern regions, where we find sand and clay under the ground, rather than solid rock. Apart from the Ruhr region, the most well-known area is the Lusatian „Revier“ – which is what miners in Germany call a mining district. Almost 80 billion tones of lignite are buried in Germany, of which only about half can be mined. Currently, 170 - 180 million tons are excavated per year. Since lignite doesn‘t „grow back“ under today‘s climactic conditions, at some point it will run out. For this reason, we also refer to it as a non-renewable resource.
Since the burning of coal releases a lot of carbon dioxide, it‘s use is not uncontroversial. Additionally, land usage for the mining of coal in an opencast mine is enormous – and goes hand in hand with the destruction of landscapes and, in some cases, settlements. But many people also work in the lignite industry, may-be even your mom or dad, and that‘s how they make their living. And of course, energy is something we cannot do without – it‘s just too important for our everyday lives. That leads to debates. However, work on a way out of this dilemma has already begun - the production and use of so-called alternative energy sources is expanding and offers new perspectives, in the medium term.

er that was deposited, the pressure on the ground underneath became greater. The weight of the various soil layers pressed the liquid and gaseous components out of the plants – that was mainly water and oxygen, but also methane.

The peat turned into lignite over an enormous time period of millions of years. The volume decreased by more than half – 40 m of dead plant matter were converted by pressure and heat into about 15 – 20 m of coal! The technical term for this, by the way, is „coalification“. The layers of lignite are referred to as „seams“. There are four of them in Lusatia, each one up to about 20 m thick. If the pressure of the overlying layers were to become even greater, hard coal would be created. Our coal is still „too young“ for that. But in the Ruhr region and near Chemnitz there‘s a lot of hard coal, which is about 250 – 300 million years old.

discovery tour 1 Old Mine „Hermann“

Start & finish	*train station at the Waldeisenbahn („forest railway“) Teichstraße **in** Weißwasser*
Time	*3 hours*
Distance	*5.5 km*

ILignite excavation began in Hermann Mine about 140 years ago. Simultaneously, in several open pit mines, or so-called Abbaumulden („mining troughs“), coal was dug with picks and shovels and transported in carts. It was a hard job and took a lot of energy. It wasn‘t until much later that it was possible to use horse-drawn carriages, or so-called „Hunte“. The horses had to work really hard, too. The surroundings were black from the coal, and coal dust hung in the air. Later, they used rope winches or small steam locomotives. The raw lignite was collected at a central place and then brought to its destination, namely, to the brick factories, glass factories and textile mills, to make bricks, melt glass or drive steam engines. Houses were heated as well. Later still, briquettes replaced raw lignite. They were made from it, but had a higher heating value, so they burned longer – and were much cleaner. By the way: the mine was named „Hermann“ in honor of the nobleman, Hermann, Count von Pückler!

Well, are you excited to see how it looks there? Then let‘s go! Take the map in your hand and follow the red line. From the

„Waldeisenbahn“ railway station in Weißwasser, walk along the train tracks in the direction of Bad Muskau, past the museum station, to the large railroad switch. If you were to go straight ahead, it would take you to Bad Muskau. But turn left here, and after a few meters you‘ll enter the forest. Continue following the tracks, but keep to the right of the rails. Watch out for the train, which sometimes blows by here! To the right of the path, lakes should begin to appear. There are quite a lot of them here in Muskau Arch: geopark managers estimate that there are around 400! All of them are legacies of the opencast mining of lignite, clay, glass sand or other raw materials. So that‘s where we find the lakes today. Large or small, long or short, narrow or – rarer still – round, green, yellow, rusty, brown, black, turquoise-colored...lakes. It‘s exciting to see!

Let‘s continue along the tracks. After about 2 km from your starting point, you will come to a crossroads. To the right, the way leads to Kromlau, the left will take you back to Weißwasser. There you can already see the first houses and gardens! Compare it to the map. What is the name of the trail?

Turn right at the crossroads now. You‘ll continue on an old connecting route between Weißwasser and Gablenz. That‘s why it‘s called Gablenzer Weg („Gablenz Way“). Such small roads used to connect the villages to each other. A hundred years ago that was enough, since ordinary people didn‘t have any cars yet. They walked long distances on foot. Even the pit miners, who brought the lignite out of the mines via hard manual work, went to work on foot. Some of them lived 5 or more kilometers away – often with a working time of more than 10 hours! Most of them had no choice, because the region around Döbern and Weißwasser was a poor section of the country. Working in agriculture often didn‘t provide enough to feed one‘s family. That‘s why many farm workers were engaged in mining during the autumn and winter. We‘ve already explained how that it was no luxury. But they only got a small pittance for their work, too. And that work was dangerous as well. Pit fires or floods happened often, which claimed a lot of lives.

Explorer‘s Assignment *Do you know the cardinal directions? Draw them on the map!*

Solution *Most land maps, also known as topographic maps, are oriented to the north, or northward. That means the upper edge of the map points to the north, and the lower edge to the south. It makes reading maps much easier! And where that isn‘t the case, there‘s usually a north arrow, whose point shows the direction of north.*

Just after 100 m you will come to a small dam between two lakes. Try looking through the trees here. Do you see the sunken trees? Looks pretty creepy, right?

They don‘t grow there, of course, but they‘re the result of a huge rupture in the ground, over deep, mined-out chambers. The masses of soil that fell in were immediately enclosed in water – and with them, the forests that were standing on top. The trees died out, and now they present this

mystical impression. Pay attention: is it the same at the following lakes?

Now you've almost made it to Gablenz. Shortly before the right-hand curve you come to a crossroads. Turn right here and walk towards Waldsee. Look to the left. There's a rusty lake shimmering behind the conifers. One might think the devil himself lives there! Now pass by a barrier on an asphalt road, which forks after about 100 m. Keep to the right here and continue along the narrow path. Look very closely, it's not always easy to see! It's an old chain conveyor embankment, which will take you back to Weißwasser.

Until about 60 years ago, small wagons transported coal and clay on it. At the beginning of the 1950s, Hermann Mine was closed. In its „lifetime", it supplied many power plants and factories with lignite, and provided large numbers of people with work. Today, the total of approximately 20 mining pits have become 30 lakes. Nature has reclaimed the landscape, which now invites us to relax and take a walk, to do research and take photographs. There's no longer much trace of a pit, is there?

RESEARCHER'S ASSIGNEMENT

Take water samples from different bodies of water, with the help of your adult companions. Choose them carefully, because they should differ in color and clarity. Take the samples at an easily accessible area and put them in numbered glass jars. Write down the date and the weather, but also what you noticed about every single lake: How big is it? What color is it? Is there vegetation at the sides? What specific features are there? Take a picture as well, so you can remember what the lake looks like. Store everything well and bring the jars home safely. When you get back, measure the pH values of the different samples. What do you notice?

discovery tour 2 Around Lake Felix

Start and finish	Parking area at Lake Felix in Bohsdorf
Time	approx. 2 ½ hours
Distance	approx. 3.5 km

Lake Felix is an old lignite mining pit, just like „Hermann“. It‘s named after one of the oldest mines in Muskau Arch. It was opened in 1851. Lignite was mined here in several troughs – something like individual smaller mines that together formed one large pit. They had names like Border Trough, Felix Trough or Fox Trough. In the largest trough, the lignite didn‘t vanish under the ground in a nearly perpendicular seam, but rather formed a large arch. The upper part of the arch was flat - here, because of the damp ground, a small bog had established itself: the „Drogiske-Luch“. Lake Felix is the remnant of that large open-cast mine. By the way, Felix Mine was closed in 1930.

From the parking area, follow the asphalt path to the lookout tower. It is an imposing 36 meters high and „towers over“ its surroundings by a few meters.

The fancy wooden tower was dedicated in October 2004. From three platforms, you can see far into the countryside. On the lower platform, you can learn a few things about the Muskau Arch and what there is to see here. When you climb to the second platform, you are already almost 8 m above the ground on which the tower was built. The third platform – and to reach it you‘ll have to tackle a whole lot of steps – is at a height of 30 m. From here, a fantastic

view opens up in all directions. Did you know that you are now about 190 m above sea level, and are therefore at the highest point in the entire Muskau Arch? No hill in the region here reaches this height! Pretty intense. Take some time now to look around before you descend again.

Explorer‘s assignment *Have you already discovered the tower at Lake Felix on the geotourist overview map? Find out which symbol is typical for such a viewing point. Are there any more – and if so, how many can you find? Where are they located?*

Solution *In the area of this geopark, there are six beautiful viewing points, each one marked by a symbol on the map that looks like a half-opened pink flower. Two of them are located in Brandenburg, two in the Polish side, two in Saxony. From them, you can not only observe huge forest landscapes or lakes, but also have a view into gigantic open-cast mines with huge machine monsters, or admire wonderful park landscapes and cities from above.*

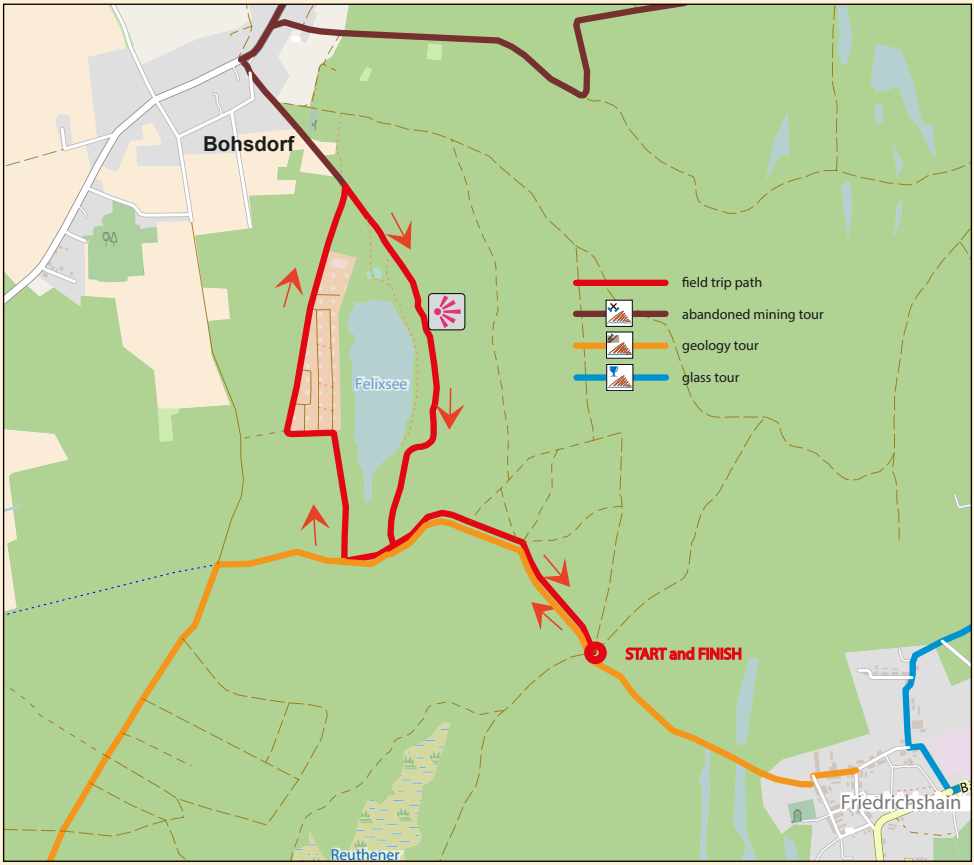
At the bottom, continue following the cycling path. It winds between the forest and the lake shore, and then meets up with another cycling path. Turn left here,

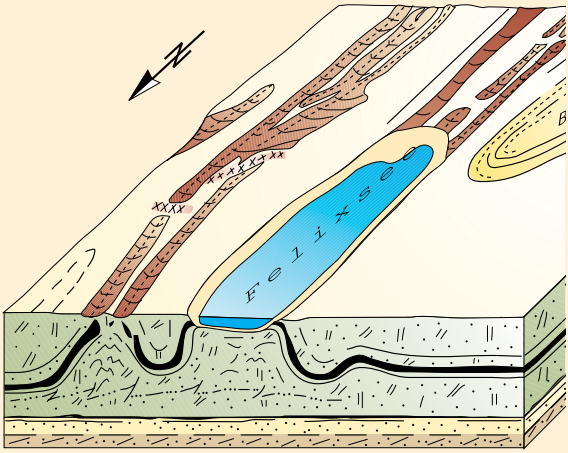
towards Friedrichshain. There you will soon encounter a so-called „outcrop“. Geologists and Geoscientists dug a gieser here, in order to reach the coal-bearing layer.

You don‘t know what a „gieser“ is? Well, it‘s an elongated depression in the ground, almost like a ditch, that‘s usually only a few meters wide, but is several hundred or even a few kilometers long. Giesers are not man-made, however. The formation of these small valleys with no drainage is caused by the lignite under the ground. It simply shrinks away when it comes into contact with oxygen, and it creates a sort of valley, or: a gieser. And indeed: the dark, nearly black material here in this outcrop is lignite! If you want to look at it closely, be careful: the ground is damp and slippery.

Now let‘s continue on towards Friedrichshain. After a few hundred meters you will come to an information panel. It tells you about Eulenschlucht („Owl Gorge“), one of the longest giesers in Muskau Arch. You‘ll be amazed at how large these elements of the landscape can be, which are typical for Muskau Arch and pretty unique worldwide!

At this point, let‘s turn around. Go back to Lake Felix, but don‘t turn onto the path





geological cross-section through the underground around the Felix Lake

viewing tower on the Felix Lake

RESEARCHER'S ASSIGNEMENT

Away from the paths, a variety of different species of moss grows in the moister parts of the forest. Mosses are wet-dry plants. That means they can't control their own water balance. They are dependent on a good mix of sun and rain.

For our research assignment, take a handball-sized piece of moss with you, preferably from a place where you find a lot of moss. That way your impact on nature will be minimal, and the moss can regenerate quickly. Pack it carefully into the bag you brought with you, so that it stays moist for now. When you get home, unpack it and let it dry out at room temperature. When it's fully dry, weigh it on a kitchen scale and record its weight. Now leave the dry moss, overnight if possible, completely submersed in a bowl of water. Take the moss out the next morning and weigh it again on the kitchen scale. Then compare the two weights. How do you interpret the results?

back to the tower. Instead, walk about 100 m further. This way you can also get to know Lake Felix from the other side. Check out the tower from here, how it reflects in the water! It looks fantastic. The best way to do this is along the shore path. Just follow one of the many paths down to the shoreline. At the „upper end", the northern tip of Lake Felix, stay to the left and go back to the parking area via the cottage settlement. The hike is over at this point. If you want, you can go to the lookout tower again. The benches and seats at the foot of the tower are perfect for a picnic!

TIP!

Experience and enjoy the „chocolates side" of Lusatia!

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discovery tour 3 Old Mine „Babina“ Łęknica

Start and finish	Parking area P1 in Łęknica (PL)
Time	approx. 3 ½ hours
Distance	approx. 8 km

You‘ve probably already guessed it: Babina Mine is also a former lignite mine! Like Hermann Mine, it was one of the largest mines in Muskau Arch, and it was the last one to be closed. And there are some special features here that you won‘t find in any of the other mines! Get ready to be surprised!

From the parking area, start along the well-constructed path, directly into the mining area. Lignite, and also clay, was mined here from 1920 to 1973. The word Babina probably comes from the Sorbian language – in any case, it‘s a very lovely name for the mine. Lignite was taken from the ground in several pits at the mining site, as usual in Muskau Arch. They were differentiated by letters and numbers, including Roman numerals, for example Tagebau („open-cast mine“) A, Open-Cast Mine B2, Schuppe („rock slice“) IV, Rock Slice V, Rock Slice C, Rock Slice E… And as you know, today these are now – well? Lakes, correct. You can already recognize the first one on the right side of the path.

After about 600 m you‘ll come to a right-hand curve. Turn left here onto the smaller path. In front of you, after a few meters, a stunning view will open up - of an azure/turquoise/what-do-I-know-colored lake. Uniquely beautiful in any case. You can‘t tell by looking, that the lake is very acidic. The pH here is reportedly 3.3. That means that even fish don‘t live in it, which is a shame because it seems rather inviting for swimmers.

KNOWLEDGE! pH Value

With pH, you can determine whether an aqueous solution – in other words, a liquid – is acidic or basic. By the way, the „pH“ stands for pondus Hydrogenii, which basically means „hydrogen weight“. Hydrogen is labeled with an „H“. The more particles of hydrogen there are in a solution, the more acidic the liquid will be. The pH scale goes from 0 to 14. The lower the pH value, the more acidic the solution will be; the larger the pH, the more basic. Solutions with a pH of 7 are called „neutral solutions“. Lemon juice, for example, has a pH of about 2, the pH of human skin is 5.5!

Explorer‘s assignment *The hiking map for Babina Mine contains a wealth of information. Among other things, it shows the location of information panels, which provide many exciting explanations in both Polish and German. Can you figure out which panel, marked with a letter, talks about springs?*

Solution It‘s panel H. This information panel is located next to the Great Babina Springs, which are also marked with a typical symbol on the map. The panel stands at the end of a trail, where the-re is also a platform. From there, you‘ll have a great spot for admiring the large karst springs, out of which acidic, iron-rich water strongly flows.

After the short excursion to the lake, go back to the main path. On the left, a small picnicking site will come into view. Behind it, many dark tree trunks emerge from a red lake. They look like Mikado sticks, abandoned in the water. The trees once stood on solid ground. Since lignite was excavated underground, however, large hollow cavities were created, and at some point, a large section of the surface slumped downward. The trees remained standing, but were flooded and gradually died off. In many other post-mining lakes you can also see such „sunken forests".

When you're done counting the Mikado sticks, let's go on. To the left and to the right, many more colorful lakes will appear. But wait! What's that? You have arrived at a large white-gray surfaced area, which has a depression in its center. Inside of it is a shimmering… well, let's say „large puddle", since we can't really call it a lake. Do you see, on the northern slope – on the right side, when looking from the path – a thick gray-brown stripe in the ground? That's coal! Geologists call that an „outcrop", because here, at the surface, a piece of the otherwise buried coal layer is sticking out, or „cropping out". It's ok to get a bit closer, but for those who don't dare to, there's an information panel where you can learn about how this came to be.

Something very special is waiting for you at the next station. Here you will find real springs to marvel at! That is, places where water flows out of the ground. Because

view tower in the former mine Babina

the loose masses of rock under the ground contain a lot of iron, iron particles also dissolve in the ground water and are carried to the surface with the spring water. These settle at the edge of the spring and form what in German are called Quelltöpfe („spring pots“ - or karst springs in English). They look like the rings of a small well, but are completely natural. The areas around them are rusty and orange-brown. That is also completely natural. Back on the main path, you are now approaching the lake „Afryka“. You can approach the water here at several places and see large erosion forms. Use the information panels and follow the side trails that head off the left. You'll see why the lake has that name, after you've gone halfway around it climbed up the lookout tower: it actually has the shape of Africa! This is also a great place to have your picnic, before you start on the last stage of the excursion.

Freshly energized, let's continue on northwards, past the tower. The large lake opening up on your right-hand side is a really exciting one. You'll glimpse it a total of three times – and each time, it will change

its color! At the first point you can only see a small corner of it. The water here usually appears brownish. It's the southern end of Open-Cast Mine B2, in which clay and lignite was excavated at the same time, from 1957 – 1959. Follow the main path now and then turn right and go down the steps. Here you'll come to a mostly green-colored section. The color is especially fantastic in the sunshine! This part seems like it's been pinched off from the larger lake to the northeast, with a belt. This is where you come to the end point.

Just before the gate, another path heads off to the right. It leads you to a viewing platform above the lake. Its color here depends on the weather – sometimes it's turquoise, sometimes emerald green, sometimes dark blue! Now you've reached the end of the geological trail. If you head out of gate 1 and follow the paved

Along the way...

In Babina Mine there are many different sorts of plants. I've already discovered St. John's wort, tansy, various ferns, shepherd's purse and club moss. The last one, for example, is strictly protected and is not allowed to be picked or dug up. All of these plants are not only beautiful to look at but also show tell us something. To find out what that is, write down where you found each plant: at the edge of the path, in a ditch, in dry sand, etc. Describe the location of the plant exactly, paying particular attention to the characteristics of the ground (sandy, earthy, clayey, dry, moist, wet), the site (forest, meadow, edge of a path, in a ditch, on a slope) and the sun exposure (very sunny, semi-shady, shady). Take a picture of the plant and, if you want, you can mark the location on the map. Think about what the plants indicate to you. Well, have you got an idea? This much is certain: the same plants don't grow everywhere!

Typical indicator plants!

- Sand indicator (nutrient-poor grassland): meadow-grass, pale poppy
- Clay indicator! coltsfoot, dandelion
- Moisture indicator! bulrush, horsetail
- Dryness indicator! broom, heather
- Sunshine indicator! thrift
- Shade indicator! wood-sorrel

Plants don't grow everywhere. Most flowers and grasses, mosses and herbs, bushes and trees prefer locations that are particularly adapted to their needs. Mosses, for example, like it moist and semi-shady, and they especially love acidic soil. That's why you'll rarely find moss in a dry meadow!

When plants display very specific soil and habitat characteristics, experts call them „indicator plants". There are some that can be found nearly everywhere, and they reliably indicate certain living conditions. And you found some of them, for sure, in Old Mine Babina! So let's have a look: Who likes to live where?

- at the edge of the path in dry sand, sunny: mullein, St. John's wort
- at the edge of the path in dry sand, shady: blueberries
- in a ditch at the path's edge, moist or wet, semi-shady: wood-horsetail, ferns
- in nutrient-rich soil, semi-shady: stinging nettles
- in the undergrowth of the forest, moist and shady: wood-sorrel

road, you'll come to the village of Nowe Czaple. Here you'll find a street that turns right, directly at the paved road. Look around carefully and you'll discover the cycling path that used to be a railway line connecting Bad Muskau to Żary. Nowadays it's a lovely place to go cycling – or walking too. Turn left here, or southwest, and head back to the town of Łęknica.

You'll reach it in about 20 minutes, and there you'll find the high street and, after passing under it, gate 3, where you left your car. Now that was a really long hike, wasn't it? Did you make all the way? Great! And so much happened along the way!

wind and weather leave their traces in the former mine Babina

GeoSites
Springs – Origins of Life

Springs are places where ground water naturally leaks out onto the Earth's surface. Depending on the characteristics of the surroundings, spring water can have a high mineral content and is often used as a medicinal water for curative drinks.

In Muskau Arch you can find many different springs due to the impact of glaciers, which thoroughly jumbled the layers of earth under the ground. Certainly the most famous and most beautiful spring is the one in the former Babina Mine in Poland. Its water is rich in iron, which is recognizable by its reddish color. Iron-containing sludge is deposited at the edges, which harden with time and form striking shapes. If you look very closely, you should also notice the small bubbles that rise to the surface from time to time. That means that new water is flowing out from inside the Earth. When flowing out of the spring, it sometimes looks as if oil is spilling onto the surface of the water, because the water's surface is shining in bright rainbow colors. This is not environmental pollution, however, but rather a very natural process caused by iron-loving bacteria. These tiny bacteria, which cannot be seen with the naked eye, feed on the dissolved iron. If you were to touch the „oil spot", you'd find that it doesn't flow away, but breaks into tiny platelets.

You can find springs that were once used for healing treatments at the Badepark („ba-

thing park“) in Bad Muskau. They are responsible for the town‘s development into a recognized health resort. There‘s iron in the water here too, which gives it its reddish color. Additionally, the water contains sulphur, and perhaps you‘ve noticed that it smells a bit like rotten eggs. These waters were attributed with healing powers. That‘s why Prince Pückler opened a public bath here in 1823, in which curative drinks and herbal and steam baths were offered. In the wells of the nearby (former) alum plant, special sweat baths were conducted.

The Grenzerquelle („border spring“) near Pusack is also very impressive, as well as the springs at the „Lachberge“, which flow out in the Brandenburg part of Muskau Arch. They are located on the slopes of the Neisse River valley. The Neisse has dug more than 30 m into the end moraine there. The springs themselves are not so easy to spot, because they‘re often heavily overgrown.

Springs are special habitats for many kinds of unique plants and animals. They are rare biotopes with particular properties. For one thing, they carry very clear and pure water, which has been filtered by underground layers. Secondly, the water has a more or less constant temperature, which means in winter they are always free of ice, since the water flowing out usually has a temperature between 6 and 10 °C, and in the hot summer they act as a „cooling island“.


big Babina source

II. GLASS SAND (QUARTZ SAND)

An exceptional natural resource that you can discover in Muskau Arch is fine, white quartz sand. This special sand was formed a long time ago in the Tertiary, when our homeland was still at the edge of a large, shallow sea. Over the course of millions of years, it was covered by many other layers, so that today we'd normally have to dig very deeply to be able to get to it. But due to the glacial advances that impacted our area so decisively, these sand layers, together with other useful raw materials like clay and lignite, were returned to the Earth's surface. If you follow the „Altbergbautour" trail near Döbern, you'll even find a place where you can see glass sand.

People realized early on that something useful could be made out of this bright sand. The ancient Egyptians already mastered the art of glass production 4000 years ago. Glass is therefore one of the oldest artificially produced materials of humankind.

White quartz sand is the main component in glass production. Additionally, potash, soda, lime and usually broken glass shards are also added. Depending on which color the finished glass is supposed to have, metal oxides are also included in the mixture. By the way: do you know what would happen if you used normal yellow sand in the production of glass? The glass would turn green. The reason for this is the little iron particles that can be found on grains of sand, that make it look yellow. In the melting process, these iron particles are discolored and become green.

The white quartz sand and the other components are processed in so-called glassworks. There used to be quite a lot of these glassworks in the region of Weißwasser and Döbern, since the coveted raw material could practically be found on their doorstep. But the work at the glass factories was very exhausting. For sand to be made into glass, it has to melted first, and that only works at very high temperatures of 1,445 °C. A glassblower then takes a small drop of the molten glass out of the furnace, gently blows it open and steadily turns the long blowpipe. With a lot of skill, glasses, vases and many other things can be shaped out of that drop of molten glass.

The finished glass product can later be refined by sanding or painting it. Traditional craftsmen usually do their work by hand. If you're lucky, you'll get the chance to look over the shoulder of a glassblower at his work, or even get to try it yourselves.

TIP!

Glass industry in Weißwasser

The history of glass in Weißwasser goes back to 1873, when glass was melted here for the first time. Within 30 years, many glass factories were established, as well as the municipality of Weißwasser/O.L., which got its town charter in 1937. For about the next 80 years, it was one of the most important glass producers in the world – around 100 years ago it was even the largest and most famous!
Today you can admire a collection of various glass products at the glass museum in Weißwasser. In addition to Lusatian glass from the 19th and 20th centuries, as well as glass made for science and technology, you can also see historical workshops and tools that were used in the production, processing and finishing of glass.

Glasmuseum Weißwasser
Forster Straße 12
02943 Weißwasser/O.L.
opening hours: mo, tue, thu 8.00 - 15.00, wed 8.00 - 17.00, sa 13.00 - 17.00, sun + on public holidays 14.00 - 17.00
www.glasmuseum-weisswasser.de

the glass maker fountain in Weißwasser/O.L.

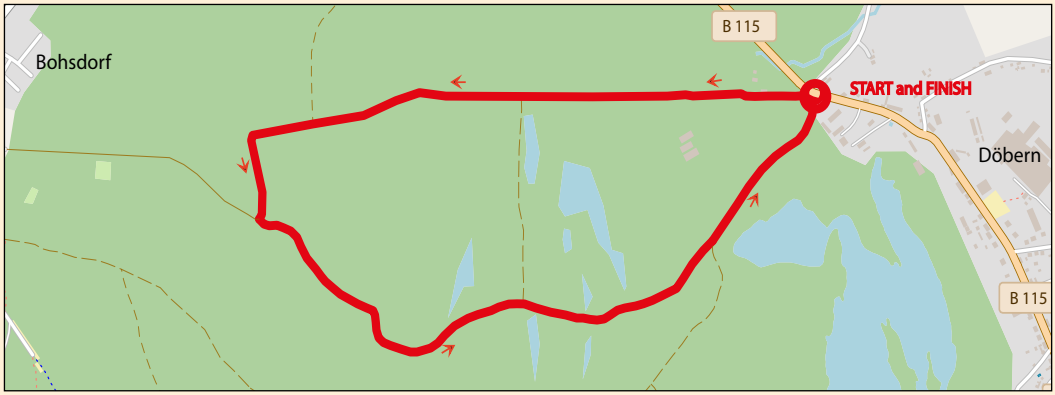
discovery tour 4 Altbergbau („Abandoned Mines“)

Start and finish	Rest stop of the Altberg bautour in Döbern (opposite the company „Garten- und Landschaftsbau GmbH“, Hedwigshütte street 12)
Time	approx. 3 ½ hours
Distance	approx. 5 km

The Altbergbautour („abandoned mines tour“) is actually a themed cycling route and a round trip at the same time. The complete tour is 22 km long. We are now in the old Conrad Mine. The coal that was excavated here, from 1860 to 1959, was converted to briquettes at briquette factories. This coal was important for the glass industry, because large amounts of it were needed to heat the furnaces and produce the glass.

You are standing, by the way, on a former Seilbahnweg („cable railway“). Of course it didn‘t used to be so nicely paved. A hundred years ago you would have got very black feet if you had walked here. There was coal dust everywhere. And it was certainly not as green as it is today. On the edges of the path, you can still discover the relics of mining activity. Why is the cable railway called a cable railway? Well, the coal used to be carried in so-called Hunte (coal wagons), which were pulled by cables. The word „Hunt“ was used by miners to refer to an open, box-shaped trolley on rails. It transported the excavated lignite. At the start of our hike, you may have already noticed these black „things“. After about 1 km you will reach the foundations of a mining tower and mining shafts. These are where the miners used to go underground and the lignite was transported to the surface. Fresh air, for the miners to breathe, also came through such shafts.

On we go! Pay attention – look to your left – under a tree there you can still find real pieces of lignite. If you continue along the „Altbergbautour“ trail, you‘ll come to a bend, which leads you to the left. You are now approaching the old Felix Mine, which belongs to the community of Bohsdorf. On the left side of the path you might discover beautiful white sand. This



is so-called glass or quartz sand. Let if trickle through your fingers. You certainly already know that glass is made from quartz sand. The quality of the sand also determines the quality of the glass. The sand here is of very high quality and has a high degree of purity. That means hardly any additions of other minerals can be found in the quartz sand. That gives it its consistent, nearly white color. Additionally, the tiny grains of sand have a consistent roundness and size. Look at them through a magnifying glass or a microscope. Then you'll see what we mean!

Picnic area on the Abandoned Mine Tour

This valuable glass was used for producing Einweckgläser („canning jars") in nearby Friedrichshain. They are known all over the world as „Weck" jars! Actually, in 1880, a chemist named Rudolf Rempel invented this method of preserving vegetables and fruit. He even patented the process. However, in 1895, the patent was bought by Johann Carl Weck. He and his business partner Georg van Eyck made the process famous worldwide. Now imagine if Mr. Rempel had done that himself. Then German-speaking grandmothers and moms today would not refer to canning as „einwecken", but rather „einrempeln"!

Now you've made it half-way through the tour. Walk about 100 meters and then turn left onto the unpaved forest path. (If you continued straight ahead, you'd come to Bohsdorf). If you're doing this tour in summer or autumn, you can fill your bellies with blueberries and cranberries. You are now walking parallel to the cable railway again, towards the starting point.

Back in the glass-making town of Döbern, you can continue following the traces of glass history. Not far from here, for example, there's a glass pyramid. Production began in the accompa-


glass sand outcrop along the foodpath

nying factory in 1968. Döbern's history as a glass-making town, however, began much earlier, in 1867. Since that year, one glassworks after another shot up from the ground, making the town, as well as Weißwasser/O.L., well-known worldwide. By the way, it was the glass industry that actually made Döbern into a town. After the opening of the first glassworks in 1867, the place only had 450 inhabitants! Notice the many lovely villas made of yellow brick – they all date back to a time when large numbers of glassmakers poured into this little Lower Lusatian village, building factory after factory. Names like Gebrüder Hirsch („Hirsch Brothers") or Fettke & Ziegler are still well-known!

If you have some strength and energy left, then go over and check out Adamskristall („Adam's crystal")! If you're lucky, you'll be able to look over a glass cutters shoulder while he is grinding glass – or even try it out yourselves! After learning about such exciting stories, Nothing is cooler than a small souvenir that you worked on by yourself. But you will have to have a very steady hand and good stamina. Give it your best!

glass grinding in the Hedwigshütte Döbern

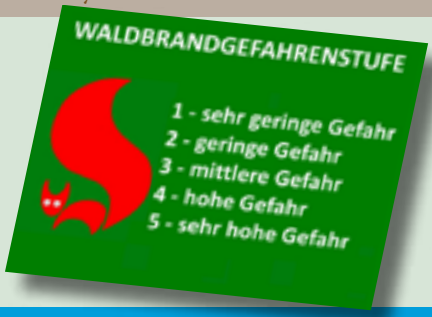
Glass manufactory Hedwigshütte

TIP!

Forster Straße 49
03159 Döbern
Tel. +49 35600-358530
Mobil +49 172-3670200
opening hours: Mo - Fr 10.00 - 12.00 Uhr + 13.00 - 18.00 Uhr, Sa. 10.00 - 12.00 Uhr

KNOWLEDGE! Forest Fire Warning Levels

Forests are very important for all of us. They're not called the „lungs of nature" for nothing. Many animals live in the forest. It offers us peace and relaxation. That's why everyone who visits the forest should observe certain rules. That includes being informed about current forest fire warning levels – especially if it's a long hot summer without much rain. The risk of forest fires is indicated by warning levels. There are 5 levels. At levels 4 and 5, you shouldn't enter the forest any more.



RESEARCHER'S ASSIGNEMENT
You are certainly observant hikers. Count how many „Hunte" (coal wagons) you find on our tour.

SOLUTION
Along the way you will find a total of 13 small black wagons, on rails.

III. ALUM

artificial alum crystals

Alum is a funny word. Translated from the Latin „alumen“, it means „bitter clay salt“. Doesn‘t sound very edible, doesn‘t it? But table salt, for example – in other words sodium chloride – is essential for life!

In fact, Alum - a sulphuric double salt - resembles table salt, but serves a completely different purpose! So you shouldn‘t eat it. It‘s even harmful in large amounts. Nevertheless, Alum used to be found in almost every household. Men used it to stop the bleeding of small cuts after shaving, and the ancient Romans already knew about its astringent and disinfecting properties, and used it as a deodorant. It was also an important raw material for dyeing factories, tanneries and paper mills.

alum mine in the today‘s Pückler-Hill Park

Large deposits of this double salt were found in Bad Muskau. Muskau Alum was also sold outside of Lusatia, in Bohemia and even as far as Russia. It was found very often in the layers of clay above the lignite seams, and until 1864 it was excavated in the hills of today‘s park in Bad Muskau. Processing took place in the adjoining Alum plant, where the clay was first washed and then dissolved in water. This water solution was ultimately evaporated, so that the coveted alum crystals would form.

Work in the alum mine was hard and the technology was not yet fully developed, so it wasn‘t possible to mine alum throughout the year. Large amounts of fuel were needed for the manufacturing process, so the area around Bad Muskau, post-mining, must have looked like a lunar landscape. Over the course of the expansion of Pückler Park, after the mining had stopped, the site was recultivated in the modern sense – in other words, fertile soil was put down and trees were planted. To this today however, traces of mining, in the form of spherical mounds, can still be recognized.

Even if alum is no longer very important in the present day, there are areas for which it is still very useful. It still plays a big role in gardening. Maybe in your garden you also have a plant with large, round white or pink flowers. Gardeners use a trick to „color“ these so-called hydrangeas. They are simply fertilized with a little alum, and soon they aren‘t blooming pink or white, but have blue flowers instead. That‘s pretty amazing, isn‘t it?

discovery tour 6
Through Prince Pückler Park in Bad Muskau

Start and finish	parking area (fee required) near the Sparkasse bank, Görlitzer Straße 7 in Bad Muskau
Time	2 ½ hours
Distance	approx. 6 km

Today you're going to search for clues in a very special park, namely, the Fürst-Pückler-Park („Prince Pückler Park") in the idyllic little town of Bad Muskau. You certainly know that most countries used to be ruled by kings and princes. And that's how it was here, too. Prince Hermann von Pückler-Muskau lived in this town from 1811 - 1840, and wanted to create something very special here. He liked the thought of creating a park according to his own imagination and ideas, while still maintaining a natural appearance. And he and his successors have done such a fine job that the park and castle are even recognized by UNESCO as a World Cultural Heritage site.

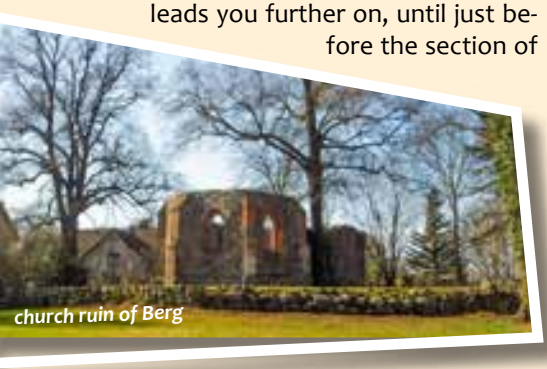
new castle of Bad Muskau

But one thing at a time. You begin your tour in the so-called Badepark („bathing park"). This area is so named, because there used to be springs here that were especially mineral-rich and used for healing treatments. After you pass the „Villa Bellevue", take the former Alaunhüttenweg („Alum Hut Way"). A large part of today's bathing park still belonged, at that time, to a graduation tower, whereby the salt alum was prepared and processed before it was used in the dyeing factories and paper mills. Back then, there were hardly any trees, rather only meter-high

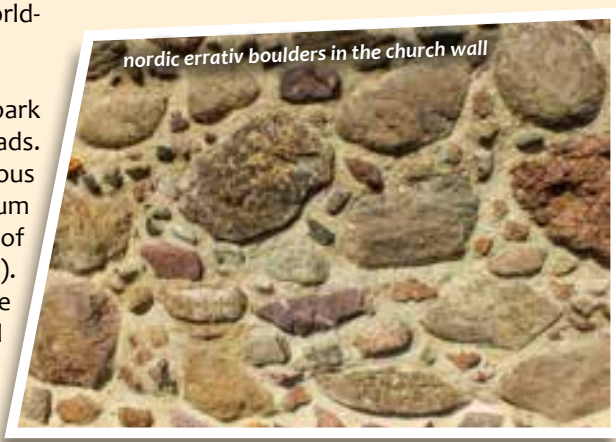
waste mounds. These consisted of the unused material that had to be removed and deposited somewhere else, in order to reach the clay seams. This part of the park was only incorporated into Pückler's design concept in 1864, after the alum mining had ended – and is the oldest known recultivation of a mining landscape worldwide! Nearly record-breaking, isn't it?

Continue on through the bathing park and turn right at the next two crossroads. On this path, after a somewhat strenuous climb, you'll pass by Alaunberg („Alum Hill"). Now you know why this part of the park is called Bergpark („Hill Park"). Appearing on your left now is Maiwiese („May Meadow"), from which you'll have a great view of the Neisse River valley. Apparently, in good weather you should be able to see all the way to the Riesengebirge („Giant") Mountains in Poland.

Look deep down into the valley. It's quite young, geologically speaking, at about 20,000 years old. After the inland ice masses melted, the Neisse was a large river, which channeled it's way powerfully through the end moraine that today we refer to as Muskau Arch. It's hard to imagine that the Neisse, as we know it today, once created this huge valley! The trail leads you further on, until just before the section of


church ruin of Berg

town called Berg. Here you turn right and walk along the top of the hill, high above the roofs of the town, to the next overlook, the Berg´sche Kirchenruine („Hilly Church Ruins"). It's worth a rest here. The small church was built around 1200 and is considered the oldest church in


nordic errativ boulders in the church wall

northeast Upper Lusatia. Take a closer look at the walls of the church! They are made of many small and large „field stones", which the builders used to find in the fields. That's where a common surname, Feldstein („field stone"), comes from. However, these stones are properly known as Nordic drift. In 2006 the wooden bell tower was erected next to the church, and on special occasions the „Bell

RESEARCHER'S ASSIGNEMENT
To reach the town from the „Bergpark", you'll have to go down the „Berg´sche Kirchgasse" alley. Count the number steps from the bridge to the bottom.

SOLUTION On your tour through Muskau Park you'll have to conquer 120 steps down "Berg´sche Kirchgasse", before you get to Bad Muskau.

of Reconciliation“ is rung.

Now go back to the white sandy trail, and soon you‘ll come to a little, stonewall bridge with railing made of bricks. Turn left here and take the path that passes under the bridge. Over the stairs, you‘ll finally reach the town via the winding Berg´sche Kirchgasse („Hilly Church Alley“). Cross the street carefully and go left, until you come to the market place. From here, you can go straight on to the old castle. Above the entrance, you can already see the coat of arms of Count Dohna-Callenberg, one of the former owners of the castle. In front of the old castle, where the tourist information office is located today, turn left and you‘ll come to a large meadow, which extends to the new castle. At the other end of the meadow, you‘ll see a viewing pavilion, the so-called „Gloriette“.

chuch lane in Berg

Along the way...

This meadow is also called the „Field of Tears“. According to legend, the simple huts of poor inhabitants once stood here. But a cruel burgravine (countess of the castle) wanted to have the space for an extension of her garden, so she ordered the inhabitants to leave their huts in the middle of cold January, without providing anything for them in return. Only one of the huts was allowed to remain, at first. A family lived there, and the mother had just brought a child into the world. They were only allowed to remain after an old servant had put in a good word about them to the burgravine. The burgravine allowed them to postpone moving out until the 1st of February, but even then the desperate father of the family still couldn‘t find a new home. Enraged, the burgravine ordered the hut to be set on fire in a quarter of an hour. Begging, pleading and crying didn‘t help. The burgravine did not relent. So the family, with their newborn, had to leave their little home on a cold and icy winter evening. The hut was set ablaze, and the mother looked back to where their children‘s cradle had stood, and now flames were falling like rain upon the ground. In her despair, she cried out a curse: „Never shall there be a first harvest in this place! Like the flames, which now rain down upon it, it shall meet destruction from above!“ And indeed, almost regularly, when the grass is mowed for the first time, it starts to rain, so that the hay harvest gets spoiled. Back then, those poor people cried many tears. And since then, this meadow has been called the „Field of Tears“.

double bridge in the Park of Muskau

On the other side you can see a huge bottlebrush buckeye shrub. Go ahead and check it out. Did you find the little paths that disappear into the shrub? Follow them, and you will be amazed where you come out again! If you continue along the large trail, you'll come across another stream. That's the so-called Hermannsneiße („Hermann's Neisse"). It was artificially created by Prince Hermann von Pückler-Muskau. In other words, he had it dug out, for the design of his landscape garden. Pretty bold, right? Turn right here, and you'll enter the Herrengarten („Lord's Garden") and go over the Fuchsienbrücke („Fuchsia Bridge") to the New Castle. They used to have lively parties here, and lots of noble families were invited. From the castle ramp, you'll get a marvelous view over the park. Prince Pückler deliberately created such vistas in his plans, places from which one could view large areas of the park.

Directly at the foot of the ramp in front of the castle, you'll walk by the stump of an over 200-year-old copper beech tree. A new tree is already sprouting from it, which was pulled from the venerable mother plant. Keep to the left at the next fork in the path, until you finally reach the Neisse River.

By the way, it has been the border between Germany and Poland since the end of the second World War. Since 1990, Germans and Poles have been working together to re-create the park as one unit, as it was intended by its creator Prince Pückler. The results of this work are revealed by the UNESCO World Cultural Heritage title, which was awarded in 2004.

The white double bridge, which connects both sections of the park, was rebuilt in 2003, based on the historical model. You can take a short break here and listen to the sound of the water. On the way back, you'll see a large, white building, the so-called „Orangery". Today it is used for events and serves as the winter residence of large potted plants. The path continues along the Neisse up to the Postbrücke („Post Bridge"), the border crossing. Cross the street carefully here and follow the avenue, before you turn right and arrive back at the parking area.

Explorer's assignment *While hiking, pay attention to the left and right sides of the paths. You'll see bizarre and strange looking trees again and again. Take a picture of each of these special trees with your camera.*

IV. WATER

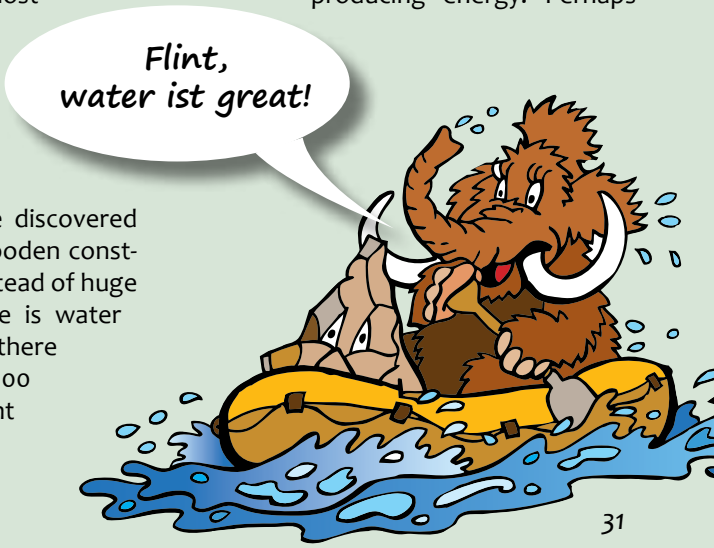
They say that water is life. Do you agree? Ask your friends what they think about it. Without water there would be no plants, so that means no food, either. Animals and humans also couldn‘t survive without water. We bath in it, wash our clothes in it – but it‘s also aesthetically important, because viewing water has a calming effect on us. To this day, water is utilized in large factories. Because of its high evaporation heat, water, in the form of steam, is used for driving steam engines and steam turbines, as well as heating chemical production plants.

Water is a chemical compound of oxygen (O) and hydrogen (H) elements in a liquid form. It is, by the way, also the only combination of elements, which exits in three different conditions. But only the liquid state is called water. Do you have any idea, what the other are called? – Correct: the solid form we call ice, the gaseous state is called simply water vapour Pure water is an almost colourless and odourless liquid. Only the solubilization of traces elements in the water brings taste and colour.

Its versatile properties were discovered long ago, at a time when wooden constructions were being built, instead of huge machines. The best example is water mills. Did you know that there were already water mills 2,000 years ago? The most important component of a mill was the waterwheel, which was designed to be driven by the natural flow of water. The energy required for grinding grain into flower was generated by the rotational movement.

mill in Döbern

Mills were later used for other tasks; so they paved the way, for example, for producing energy! Perhaps



you've notice an old water mill or two, while driving through little villages?

So you can see that water isn't just the lake, river or sea that's refreshing on warm summer days. Water is THE element, without which it would be impossible to sustain life.

In our region, too, you can retrace the history of the milling trade. In Döbern, for example, there's an approximately 250-year-old mill that made commercial use of the power of the Malxe River, a tributary of the Spree or Lusatian Neisse. Today you can take a little tour there. There is also a water mill in Noßdorf, about 30 km from Cottbus, which was built in 1903. A new mill wheel, which for about 100 years has been the „heart of the mill", was installed in 2012. A well-preserved piece of the original wheel served as a template.

South of Łęknica, directly on the border to the geopark, on a meandering creek named Skroda (Schrot), you can find the ruins of the former Kutschigmühle mill. The mill used to be a popular meeting place, with its own park and restaurant. Perhaps you've already discovered the ruins of the mill? Today it is situated in the middle of a quiet nature reserve called „Nad Młyńską Strugą". You could spend all of your time here listening to the chirping of the birds and the babbling of the Skroda (Schrot), which in those days was the driving force of the Kutschig Mill...

discovery tour 6
Nad Młyńską Strugą („At Mill Creek") nature reserve

Start and finish	Parking area of gate 3 at the entrance to Babina Mine, access via the town of Łęknica, un der the bypass road
Time	approx. 3 ½ hours
Distance	approx. 8 km

Wir beginnen unsere Fahrradtour am Tor
We start our cycling tour at gate number 3 of the „Alte Grube Babina" geological trail, on the outskirts of Łęknica. Right next to the wooden gate, you'll find a panel with information about the history of lignite mining in the push end moraine area of Muskau Arch. The gate and parking area are located in an excavated part of a small sand and gravel hill. From here, continue along the yellow hiking trail until you reach a green-colored lake. This is the so-called „Jedynka Lake", a water basin that was created after ceramic clay was excavated. The raw material was used for the production of bricks, rood tiles and stoneware goods. A little further on you'll see the next lake (Dwójka Lake), on the left side in a lowland area. In the summer, you can admire the many beautiful water lilies on its surface.

All of these lakes that you pass by along the way were not created naturally, but are so-called Bergbaufolgeseen („post-mining lakes"), which originated after the underground mining of lignite had stop-


START and
FINISH

ped. In a lake to the left of the trail, you may have already noticed the tree stumps in the water – an extraordinary sight. The water contains a lot of iron, which is why the water has a rusty-orange color. Additionally, the water here has a very low, acidic pH value, which hinders the development of life in the water.

At the next crossroads, you can already see the sign showing you the way to the „Nad Młyńską Strugą" nature reserve. Follow the signposting, and on the left side of the path you can admire the flat, orange-colored surface of the water, which ultimately drains into the Lusatian Neisse, over several natural steps. When you come to the next crossroads, leave the old mining area and the paved trail. Now you'll go along a forest path, in a completely different type of landscape. Here you will find a natural forest reserve with large, old trees and cutoff lakes, which are waterholes that were filled during a flood and remained full after the flood receded. This area is a nature reserve. „Nad Młyńską Strugą" means „At Mill Creek". Soon you will come to an old, overturned, hollow oak stump. If you make a small detour to the right, in about 100 meters you'll reach the banks of the Neisse River.

Back on the trail, continue riding through the beautiful, pristine forest. You can find traces of animals everywhere. Wild boars, for example, dig into the forest floor, searching for little bugs or other food. Red and roe deer leave gnawing marks on the young trees. And then, of course, there are the beavers, who are very busy with their work. The chewed-up tree trunks, with which they build their dams and so-called beaver lodges, are a clear sign of their presence. Be especially quiet in this area, because we don't want to disturb the beavers, or the stillness of the forest. The quieter you are, the sooner you'll be able to hear the sounds of the forest. When was the last time you really took the time to listen to the birds singing or the whistling of the wind in the old tree tops?

RESEARCHER'S ASSIGNEMENT

Try to guess the age of the old oak tree trunk! If you want to know it more precisely, you'll need some measuring tape, to measure the circumference of the trunk. For every species, there's a different age factor (0.8 for oaks), which you have to multiply by the tree's circumference (in cm). Then you will get the approximate age of your tree!

Skroda mouth in the river Neiße

At the next left-hand curve, you can turn right at the information panel and go to the mouth of the Skroda River. Maybe along the way, you've noticed the many ditches that you have to jump over. Those are old trenches dug during the second World War, when there was heavy fighting in this region. The Skroda is a lovely little river that winds through a gorge of its own making. As you ride further north, you'll find several tree stumps that rise above the river as natural bridges. In the summertime, you can observe the nests of a rare inhabitant here, the kingfisher, in the banks of the Skroda. This area is also home to many old trees, in particular maples, oaks and larches, that have been specially designated as natural monuments.

The last section of your tour will lead you up to a sandy path. When you get to the top, stay to the right until you reach a clearing, where you'll find the old remains of a border guard building. Continuing on, you'll see a meander of the Skroda on your left. A meander is a course of a river with lots of beds and loops. A mill with a hotel and restaurant stood here before the second World War, the so-called Kutschig Mill. Today this is a popular destination for German and Polish visitors, who go on long hikes and cycling excursions here.

Now you'll leave the nature reserve and follow the green-marked hiking trail until you reach the asphalt road. From here, turn left towards Przewoźniki and, at gate number 2, follow the „Alte Grube Babina" geological trail, until you arrive at your starting point – the parking area at gate number 3.

V. SAND AND GRAVEL

Sand and gravel have been indispensible in everyday human life for thousands of years. Some of you are probably thinking, what's so exciting about sand and gravel? Well, let's have a look at what these raw materials can do - and then you'll find out how versatile and interesting they really are.

But where does sand come from and how is it created? Sand is, basically, nothing more than a mixture of small grains of stone. The stones from which sand was created were exposed to the forces of nature - water, ice or even wind - over millions of years. Small pieces of rock gradually broke off, or weathered, and were then transported away and deposited. The individual grains of sand got their lovely roundness during this transportation process, where they were repeatedly pushed and rubbed against each other or the substrate. The longer or further the grains of stone were transported, the rounder they became.

Gravel, gravel sand, and sand are the most common loose rock sediments in this region. These materials are of great importance to regional industries. That includes the glass, ceramics, foundry and chemical industries, as well as transportation, water management and even recreation and art (e.g. playground sand, sand sculptures, beach volleyball). But even products that you probably haven't thought about yet contain sand: for example, tiles and also your smart phones and computers! As you can see, sand has certain characteristics that make it incredibly valuable for us humans.

SAND – 2016 Rock of the Year

The „Gestein des Jahres“ (Rock of the Year in Germany) is selected by a panel of experts. The goal is to increase public awareness of rocks, which are significant due to their geological origins and economic importance.

But what is the difference between sand and gravel?

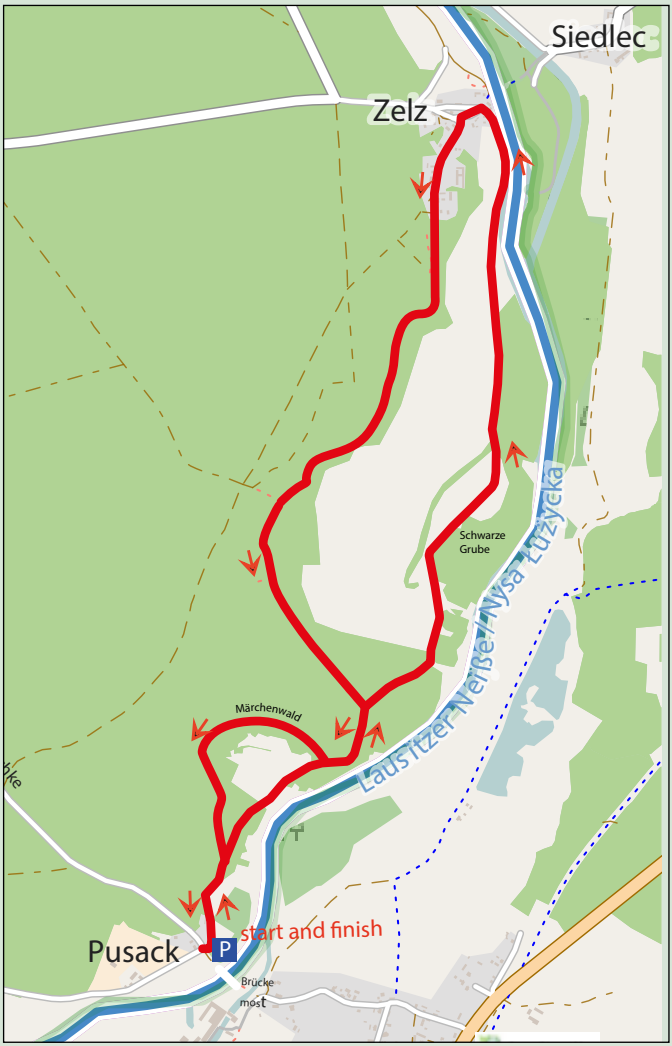
At first glance, you can see that gravel is larger than sand. If you want to measure it more accurately, take a ruler, some sand from a sand box or the beach, and compare it with gravel. What did you read on your ruler? Grains between 0.063 mm – 2 mm large are called sand. Gravel is at least 2 mm long or wide. But there‘s also gravel that is much larger – up to 63 mm! Anything larger than that, which means at least as big as a chicken egg, is considered a „stone“. But that‘s another topic. – So, the next time you go to a sandy beach, you can tell your parents exactly what the difference is!

discovery tour 7 Märchenwald („Fairy Tale Forest“)

Start and finish	Pusack – Alte Neißebrücke („Old Neisse Bridge“)
Time	2 ½ hours
Distance	approx. 7.5 km

Arrival by car is recommended.

Your hike begins at the Old Neisse River Bridge in Pusack. From there, you can see the ruins of an old paper mill on the Polish side of the Neisse River. Follow the „Oder-Neiße-Radweg“ cycling trail in the direction of the Ziegenhof „Zur Wolfsschlucht“ (Goat Farm „At Wolf Gorge“) shop and restaurant. The hike is marked with a green dot. After a short stretch of the trail, you'll enter the Schwarze Grube („Black Pit“) nature reserve, with rare silver fir trees, high beech trees, birches and alders. Many of the trees are very old, some with over 100 years „on the clock“. Through the dense foliage and vegetation, the area looks very dark – like in a pit. That's how the „Schwarze Grube“ got its name! On the left side of the cycling trail, by the way, you can find the „headwaters on the slopes of the Neisse valley“ – a moist, swampy terrain, where small waterways first see the light of day.



This is a good place for observing how the Neisse carved its way through Muskau Arch around 20,000 years ago. At that time, the push end moraine presented a huge obstacle for rivers

coming from the south. That's why the Neisse didn't flow, at first, into the bed that we know today, but instead searched for a path that was south of Weißwasser, towards the west. This is proven by findings of Neisse gravel near Nochten und Mühlrose, which also gives the so-called „Nochten Neisse Run" its name. How do we know that the gravel found their once belonged to the Neisse? Now that's an exciting question – but it's relatively easy to answer. Every river carries small and large bits of rock along with it, from both its headwaters and the landscape over which it crosses. These rocks are a characteristic of the river, a genetic finger print, so to say. The Neisse originates in the Izera Mountains, whereas the Elbe, for example, begins in the Karkonosze Mountains. The composition of rocks from the Elbe is, therefore, different.

In any case, the differences in altitude between the low river valley and the high river terraces are impressive. You can sense that the Neisse must have once carried a lot more water here. And actually, that didn't just happen only once. Every time it grew colder, huge masses of water were bound up in glaciers and snowfields. The river carried little water, and therefore had a low rate of flow. It sought the path of least resistance and flowed around all obstacles – as geologists say: it meandered. Thus, the river created a very wide river bed. However, it had very little power for transporting stones, due to its low rate of flow, so sand and gravel deposits grew (accumulation). When the climate became warmer, ice and glaciers melted, water masses increased, and the river swelled. At that time, the water moved quite fast and dug deep into the landscape. Deposits were rare, because the river had a high rate of flow and could carry the rubble a long way. Sometimes, it even tore off layers of sediment and carried them far away (erosion). That happened several times, so that several river valleys were created – recognizable by their different terraces!

Take advantage of opportunities to treat yourselves to a rest on the many benches and in the many shelters you encounter along the way. Enjoy the nature around you, with its vibrant birdlife. Perhaps you've discovered a fallen tree „next door"? Examine it more closely, because most of them aren't without life! Here, insects such as ants and various species

of beetles, as well as mushrooms and mosses, find a home. They all make sure that the tree trunk decays and decomposes. The substances released by that process benefit the new, young plants: they contain many nutrients and fertilize the ground, so to speak. This humus, therefore, forms the basis for new plant growth – a clever cycle of nature!

Continue following the cycling trail northward. To your right, the Neißewiesen („Neisse meadows“) begin to open up, with the goats of Pusack goat farms grazing on them - a form of landscape management. Before you arrive in Zelz, there's a little technical wonder for you to admire: the Neißewehr („Neisse weir“). In Zelz, a lovely seating area invites you to rest. There's a lot of information here, and a bridge over the Neisse, on which you could cycle to neighboring Poland.

Your hike on the Märchenwald („Fairy Tale Forest“) trail continues via the „Gatehouse“, on the left. From there, you'll reach a fork in the trail: to the left, the „Märchenwald“ trail continues. To the right, the path will lead you to the Oberzelzer Weg („Upper Zelz Way“), towards Pusack, to the access road. Follow the „Märchenwald“ hiking trail to your left. Here, the entire river valley, with its pastures and meadows, opens up again. From this vantage point, you'll have a different perspective and you'll certainly discover things that you didn't see before. So pay attention when you're hiking along the terraced slopes!

Soon you'll return to the „Schwarze Grube“ nature reserve, and you'll have the cycling path under your feet again. From here, you'll be heading back towards Pusack, but this time, follow the sign for „Märchenwald“, on the right hand side, which will take you slightly uphill. With its majestic fir trees, the „Fairy Tale Forest“ looks truly enchanted, reminding you at once of Little Red Riding Hood or Hansel and Gretel. Get into the spirit and tell each other your favorite fairy tales! You're sure to find a place to sit and have a picnic here.

Then follow the trail until the sign for „Zur Wolfsschlucht“ (to Wolf Gorge). Here, you can decide if you want to tackle the climb up the gorge, and then go left at the road, towards Pusack again. But if you stay on the main trail, you'll return to the Ziegenhof „Zur Wolfsschlucht“ shop and restaurant. You can rest there with your companions, and let their tasty goat cheese melt in your mouth.

RESEARCHER'S ASSIGNEMENT

On your hike through the „Fairy Tale Forest“, on the way to Zelz, you encounter the „Neisse terraces“ many times. Can you figure out how many there are?

SOLUTION

Three terraces are visible. One of them, the youngest, is located directly on the river bed, and in some spots it's not visible at all. In general, it's only a few meters wide. It's followed by a small slope, which leads up to the second Neisse terrace. That one is much easier to see. Goats often graze there. The third and oldest terrace rises above it, sometimes at the level of the cycling trail or even further into the forest.

GeoSites
bogs – mysterious habitats

The first bogs emerged after the last ice age, about 12,000 years ago. They are a transition zone between solid land and water, and only develop in areas where there's plenty of water. Because of the large surfaces of water, the dead parts of plants can't fully decompose, and instead form what is known as peat. A layer of peat grows very slowly, only about 1 mm a year. This build-up of peat is what differentiates a bog from a swamp. Under certain conditions, peat can eventually become coal.

Due to the large amounts of water, bogs are quite inaccessible areas. You can easily sink in and your boots can get stuck. That's why, in the past, people considered bogs to be very dangerous and threatening places. It's how many legends came about - of things like will-o'-the-wisps, eerie apparitions and people disappearing in a bog. Today, we know that there are quite natural explanations for all of these phenomena. The so-called will-o'-the-wisps are highly combustible natural gases, which can ignite spontaneously and briefly flare up. Even the eerie figures that some people claim to see in a bog have nothing to do with ghosts and witchcraft, but rather with the fact that dense fog can develop rapidly over a bog. Some shrubs and gnarled trees may therefore seem to take on a sinister shape.

Because of the swampy and often untouched landscape, many endangered animal and plant species find an ideal habitat in a bog. Unfortunately, many bogs are threatened nowadays with drainage and their subsequent usage in agriculture and forestry. Water is the lifeblood of a bog. Without it, no new peat can form and the bog „dies". Only 5 % of the bogs in Germany are considered to be living bogs, in which new peat regularly develops. By artificial re-watering, a dead bog can be turned back into a living one.

And such living bogs have many beneficial properties. They're like a sponge that can absorb and store a lot of water during heavy rainfall. That prevents floods from occurring. Additionally, climate-damaging gases like methane and carbon dioxide, which would otherwise contribute to the warming of the planet, are bound-up in the peat below the water's surface. So bogs are also important for climate protection. Furthermore, water is filtered and purified by layers of peat.

Note: Be careful when you enter a bog! Stay on the paths! Watch out for protected plants, and it's best if you visit the area with an expert!

VI. CLAY

Do you have a favorite cup that you drink your milk or cocoa from every morning? Maybe it's made of ceramics, or in other words, made from clay? Surely you've also seen houses that are built with red, yellow or brown bricks. Maybe you even live in one. In Muskau Arch, there are particularly beautiful ones in Halbendorf, Döbern and Bad Muskau. Those bricks were fired from clay, by hand, which is strenuous and difficult work. How many bricks do you think it takes to make such a house?

Ceramic products are made from clay. Clay is a natural resource that can be found almost everywhere. It's formed by the weathering of the minerals feldspar and mica. Grains of clay are so small that they can't be seen with the naked eye. They are rather plate-like and stratified, like layers of paper, but that way they can absorb and hold a lot of water. This is, for example, very important for the quality of garden soil. Due to its plate-like structure, however, clay also has especially plastic properties, which means it can easily be shaped. Have you ever looked over the shoulder of a potter at work? There you can observe it really well! During the drying and subsequent firing process, water disappears and the clay is thereby hardened. Now the clay has become ceramic – and now you can drink from the cup!

Clay has been used as a raw material for pottery and ceramics for around 26,000 years. Clay figures made by mammoth hunters, for example, have

hand-made pottery

acid-proof ceramic tanks in Krauschwitz

been found in the Czech Republic. So pottery is an ancient form of craftsmanship - and for some it has become a popular hobby.

But clay is not only used for producing cups, plates, bowls, pots and other kitchenware. This raw material also has industrial uses, for example in the manufacturing of fireclays, which are then installed as an interior lining of ovens. You can take a look inside your own oven, and see if you discover something like that. And imagine this: in the production of paper, clay also serves as a filler material. It makes the paper softer and more flexible, giving it a smoother surface. Likewise, it has always been used as a building material - today, for example, in the sealing of dikes and landfills, to protect the soil.

As you probably already know, the glaciers of our Muskau Arch crumpled the ground underneath, and clay deposits found their way to the surface. The people of this region made use of those clay deposits. Over time, many small potter's workshops were built. So much so that, for example, the first potter's guild was formed in Bad Muskau in 1596, which is an association of professional potters that represented the interests of the potters. The „German Clay and Stoneware Factories" company was founded In 1904, which included a factory in Krauschwitz. At that time, there were numerous clay pits around Krauschwitz that produced high quality clays. Gigantic acid-proof containers were manufactured out of it, for example, which could hold up to 6,000 liters! By the way, in Krauschwitz, in front of the Gasthaus „Zur Linde" inn and restaurant, you can see three of these huge barrels.

In Klein Kölzig, however, you'll find the only ring furnace that's preserved in this region. Here, huge quantities of yellow brick, which was typical for Lusatia, were produced – without interruption for about 70 years, day and night, in summer and in winter, on both holidays and workdays. The clay pits weren't located very far from the brickworks, but today they are mostly fisheries. In addition to taking a tour of the brickworks, you can also take a ride on the clay railway. It used to transport clay - but today, you are the passenger! Also important, of course, was the lignite that was available in large amounts. Because firing large quantities of cups and plates, as well as bricks, takes temperatures over 1,000 C°, and that over a long period of time.

Since then, other materials, such as plastic, have displaced pottery in both industry and in the kitchen. There are only a few potteries left in our region, for example in Krauschwitz, Bad Muskau and Sagar.

TIP!

Crafts- and industrial technology museum Sagar

Skerbersdorfer Str. 68,
02957 Krauschwitz OT Sagar
opening hours: tue-fri 9.00 - 15.00, sa and sun 15.00 - 18.00
Tel. +49 35771 60896
www.museum-sagar.de

discovery tour 8 Drachenberge („Dragon Hills“)

Start and finish	„Zur Linde“ Gasthof (Inn), Bautzener Street 26 in Krauschwitz
Time	2 to 3 hours
Distance	approx. 5km

The Dragon Hills – sounds like an adventure, doesn‘t it? And in comparison to their South African namesake, the Drakensberg („Mountain of the Dragons“) near Lesotho, which is over 3,400 meters high, the Drachenberge near Krauschwitz are quite easy to reach! Even if they can‘t match the other in height, there are a few things here that will surprise you!

At the Gasthaus „zur Linde“ („Inn at the linden tree“), you‘ll find the first information panel. Take a closer look at the 3-D image: you‘ll be hiking through the landscape along the trail depicted in yellow. And this much is already revealed: the local „gieser“ ditches are among the largest of their kind in the UNESCO Geopark Muskau Arch!

Now follow the little dragon symbol and you‘ll first go along the cycling path, parallel to the road to Weißwasser. After about 700 meters, the geopath heads into the forest – pay attention so you don‘t miss the trail! It winds its way through fragrant heather and dives into the forest after another 200 m. A few steps in, the relatively flat trail starts to get hilly – you have now reached the first gieser ditch. Below, at the bottom of the gieser, there‘s still some lignite here, and beside it, the clay that our ancestors once valued so much.

The area around the Drachenberge is still preserved in its natural development, ever since the ice receded around 12,000 years ago. No mines, no roads, and no settlements have torn up this valuable geological terrain. Why is it so valuable? Well, the giesers are young geological formations – and they are continuing to sink deeper as the lignite shrinks. If you consider that the Earth is 4.6 billion years old, and that the Alps, for example, rose up around 135 million years ago, then 12,000 years is really no comparison, right? But those years are especially exciting, because Earth‘s recent history is directly related to the settlement of our region.

RESEARCHER‘S ASSIGNEMENT
The four rocks
On your hike, collect four different stones and examine them very carefully. How are they different? What typical characteristics do the stones have? And do you have any idea where they

came from and how they got here? One of their secrets is already known: they've all traveled a long way!

SOLUTION Amongst your stones, there are certainly some that are largely black with a few or a lot of white stripes. Those are LYDITE. Some also call it „flinty slate" (or siliceous shale). Lydite stones are composed of the pebbly remains of single-celled radiolarians (a type of protozoa). The remains were once deposited on the seabed, where they solidified and were transformed by high pressure and temperature. They came from the south, for example from the Schiefergebirge („Slate Mountains") near Görlitz, and were transported here by rivers.

And have you also found some stones that are very light-colored, with a glassy surface? They could be QUARTZITE, or quartz pebbles. They come from the clay and gravel layers of the Muskau Arch. Quartzites are always very hard and weather-resistant rocks, which consist primarily or even entirely of quartz.

Stones that are angular, or almost sharp, and exhibit a shell-like fracturing, could be FLINT. You can find them in different colors, in black with white „bark", in light or dark grey, in yellow or reddish hues. They all come from the Baltic Sea region and were brought to us by the unstoppable advancing inland ice mass, around 350,000 years ago.

And then there are the relatively small, round stones, that don't fit in with the others. They differ from each other because they have different colors, and consist of larger or smaller grain sizes, which are sometimes round, angular or even oblong. All of them are Nordic drift, better known as BOULDERS – only in miniature. All of these little stones come from the Scandinavian Mountains (basement rock) – that is, from Sweden, Norway, Finland or the Baltic Sea. They are granite, gneiss, porphyry, amphibolite, schist...

Maybe one of you found a stone that seems to have „stepped out of character". Does it look like caked together sand, perhaps with a bulbous or sort-of bowl shape – and is reddish or brownish in color? Then it could be BOG IRON ORE– the only rocks in this region that actually „grew up" here!

How do we know all of this, you ask? Well, in the geopark there's not a lot of solid rock. The subsoil here consists of loose rock – that is, sand, gravel and clay. No bedrock far and wide! The only exceptions are the rocks mentioned above. And there's a lot that we now know about them – so it's quite easy to identify their place of origin!

In the meantime, you've surely reached the next gieser ditch. Take a quick break and look around. It's a bit mystical here,

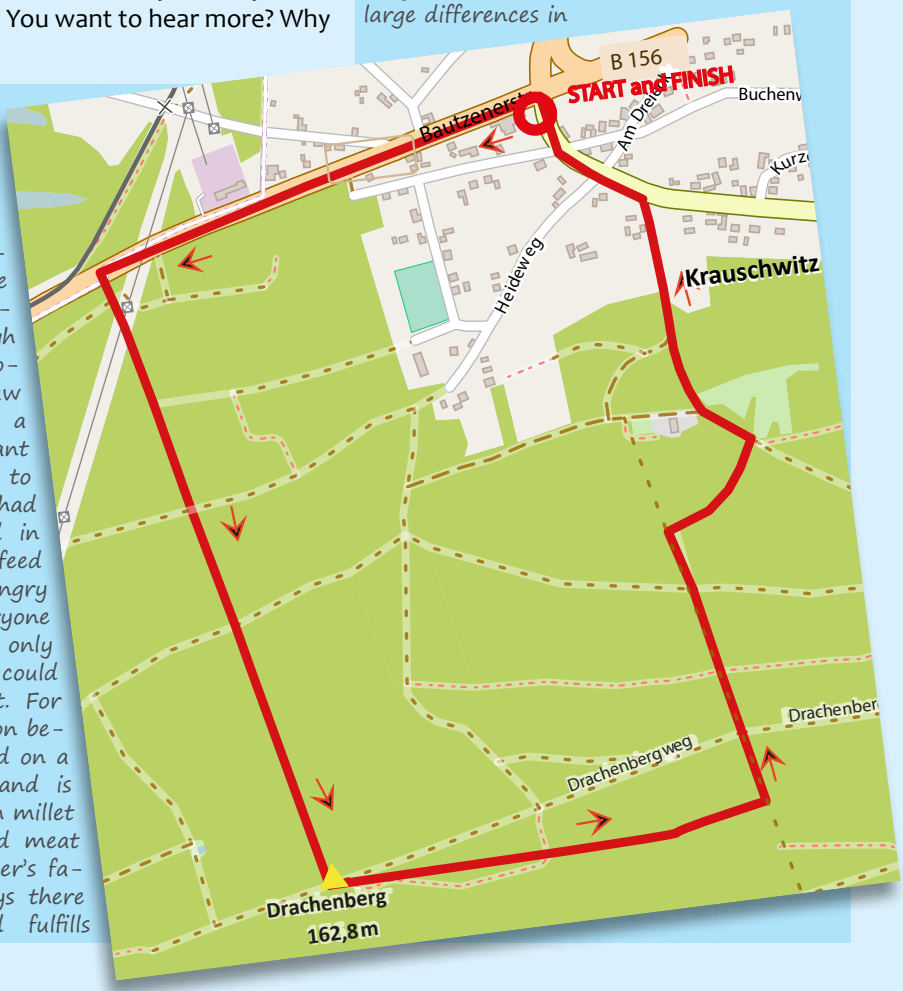
hiking tour through the dragon hills

these valleys and the constant ups and downs and the increasing differences in altitude. What stories must our ancestors have told each other, to make sense of the great power that shaped this area? Perhaps a dragon had a hand in it? Not entirely unthinkable. Today, there are still a lot of Sorbian legends about dragons. The Slavic tribes of the Sorbs settled in our region more than a thousand years ago, leaving us their place and field names, their traditions and also their stories, which contained many mystical elements. There are tales of water sprites, dragons – known as „Płon“ here, by the way – and snake kings. You want to hear more? Why not?

Along the way...

Many dragons once lived in Lusatia, though hardly anyone ever saw one. But if a poor peasant ever came to wealth, or had enough food in the house to feed every hungry mouth, everyone knew that only a dragon could be behind it. For once a dragon becomes settled on a farmstead, and is well fed with millet porridge and meat by the farmer's family, it stays there forever and fulfills the many wishes of its master.

Lucky is he who encounters an unowned dragon. All he has to do is stand underneath it and shout "Plon! Plon!", and the dragon will follow its new master. Bad luck comes to he who treats his dragon poorly. It will bring him misfortune, but at least it will leave him and begin looking for a new home. But many people were afraid of dragons and avoided them. So there were certainly ownerless dragons who withdrew to sleep during the day in inhospitable areas with impenetrable undergrowth. The mountains around Krauschwitz were also rarely entered because the way through them was troublesome, due to the large differences in



altitude, the boggy marshes in the "Gieser" valleys and the dense forests. An ideal dragon's lair!

So be very quiet and watch were you step! Listen – maybe you can hear snoring in the dense thicket, hidden before your eyes?

So now you're a bit out of breath, right? Such giesers can be quite big! Once you've made the last ascent, the summit logbook awaits you, at 162.8 meters. You've earned an entry in it, after such a slog! Take a quick breath and then follow the trail eastwards – it turns off the forest road and runs through heath and forest as a dirt trail again. Look to your right – can you spot the circular holes there, at the bottom of the gieser? There are actually still traces of mining here, which arose after the „brown gold" was taken from under the ground about 100 years ago, and the underground chambers then collapsed. Continue following the small trail and you'll reach a forest road that crosses your path. Just go straight past that one. You'll turn at the next forest road that you meet, continuing to follow the dragon symbol. The winding road leads you to a „T-junction". For the little ones among you, this was already a proper hike – you can continue following the signs until you reach the Gasthaus „zur Linde" again, where you can enjoy some tasty ice cream.

The older ones, or those of you who want to keep going, can take an extra excursion into a clay pit and a potter's shop. Stay to the right and soon you'll turn onto a road that disappears into the forest, on the left. Through the little birch tree forest, you'll come to another crossroads – turn left again here, and then follow the dirt trail that soon branches off to the right.

On this trail, you'll circle the clay pit, where the „white gold" was mined up until the end of the 20th century. Near the end of the trail, where you begin to see buildings again, a path leads down into the pit. When you reach the bottom, you'll be standing directly on top of the valuable resource that Krauschwitz once used for manufacturing numerous products for everyday life. In any case, stay in the front area of the clay pit, because in the back, a biotope has developed, where birds and amphibians have already found a home!

KNOWLEDGE! Finger test

The usefulness of the local clay is not the only thing worth admiring, but its color, too: it's almost white. A sample in your fingers can show you how tiny the particles of clay are: crush a small bit of clay between your pointer finger and thumb, and you will find that there are hardly any grains of sand, and the stuff feels like velvety flour. A lot of powdery, fine material sticks to the grooves in your fingers. Get the clay wet and you can roll it into sausages.

Leaving the clay pit, go to the paved road and turn right. After about 500 meters, you'll reach the Töpferei Najorka potter's workshop. It still produces beautiful ceramic products that you won't want to put down, as it has been doing for 100 years. Here, you're sure to find a new favorite cup for your morning chocolate milk – made out of clay from Muskau Arch! And they will answer your questions patiently, and in detail!

Then, go back down the small street until it meets Geschwister-Scholl Street, and go left on that street until you reach the Gasthaus „zur Linde" again. You can find a little refreshment there, or end your day with a tasty regional dish.

TIP!

Pottery Najorka

Waldweg 19, 02957 Krauschwitz, Tel. 03577164178, kathrinnajorka.blogspot.de

No regular opening hours, just passing and entering or ringing the bell at the door!

RESEARCHER'S ASSIGNEMENT Have a look at the Gieser valleys you're passing through. How do they differ from each other?

SOLUTION
There are indeed diverse Gieser types. Firstly, there is the so-called thrust sheet type, which is characterized by steeply tilted and linear seams. These Gieseres can run several kilometres long. In the diaper type, bulges of clay migrated upwards from a deeper sediment layer and carried the coal with it. The third type is a so-called seam fold type, a kind of a huge fold almost directly below the surface of the earth. This kind of lignite seams often form bogs.
What they will all be sharing is the fact that the lignite is near the surface – but which type you will find it decides the kind of origin.

cross-section through a Gieser

VII. Boulders

Boulders – experts here would say: Nordic drift - are a typical feature of landscapes shaped by glaciers. You've probably also wondered where all of these stones came from.

In the area around Döbern and Spremberg, there are fields that are „rich in stones". They used to be, and are partly still today, cleared away by hand. This process creates so-called Lesesteinhaufen („clearance cairns") - an important habitat for lizards and insects. For really big rocks there are special machines that are powerful enough to transport them away. In the walls of fieldstone churches, castles, in city walls or old houses, you'll also find field stones.

The big ones are also known as boulders. Here in the Muskau Arch, there are a few rather large specimens, for example the Teufelsstein („Devil's Stone") near Kamienica-Trzebiel in Poland. Its weight is estimated to be about 100 Tons. You certainly wouldn't be able to move it one millimeter from its spot. It's made of granite. Maybe you've also heard of the Finkenstein („finch stone") near Reuthen. At 20 Tons, it's also no lightweight.

Now you really have to be wondering where these chunks of rock came from, and how they got here. Many people were once puzzled by that. Such boulders were long ago referred to as „lost blocks of stone". Far and wide, there's no mountain to be seen, which pieces may have broken off from. Strange! People racked their brains for a long time about their arrival and transport. Fairy tales and legends developed about particular stones, for example that giants threw them so far during competitions. Scientists also had different theories. At first it was assumed that boulders were meteorites or volcanic in origin. Or they were deposited here during the Great Flood. A brilliant idea then came to the Swedish geologist Otto Martin Torell (1774-1853). He had been inspecting numerous glacial striations from formerly iced-over Scandinavia, and concluded that Middle Europe must have also at some point been largely iced-over. From that idea, he concluded that

devils stone near Kamienica/Trzebiel

glaciers had transported the stones.

And indeed: he was right! From the weight of that huge inland ice mass, which originated in Scandinavia and spread all the way down to Lusatia, and the pressure exerted by that huge mass, ice was constantly melting at the bottom of the glacier. That acted like a layer of lubricant on which the ice could slide. And so the whole thing was in motion.

The glaciers mostly came from Scandinavia and brought lots of Scandinavian rock material, so-called glacial cargo, with them on their way to Europe. Imagine a glacier moving across the land, like a giant mass of pudding. What it found along the way was either flattened or carried along. The glaciers had a thickness of several hundred meters. The Muskau Glacier, for example, was up to 500 m thick! With its power, it could easily move tons of sand, rock and rubble, and even those enormous boulders with a diameter of one to two meters. During the melting process, the large blocks of stone remained at the site of their deposit - and that's how it's possible that we can find, for example, Swedish granite in Mecklenburg-West Pomerania and Brandenburg! Some rocks have traveled well over 1,000 km! Some weigh up to 300 tons. They are more frequent in the north. Today, it is still the case that glaciers (such as in the Alps) leave boulders behind as they retreat.

The exact origin of these boulders cannot always be determined. It's helpful to know that the mineral composition of some stones is so specific, that it only occurs in certain places, for example Stockholm granite and Småland granite from Sweden, or Åland-Rapakivi granite from Finland.

Many boulders are protected due to their geological-historical significance. That means they're not allowed to be moved from their location – which would be difficult anyway - or have their outer appearance altered. Now you've got a certain respect for these titans, who've made such a long and adventurous journey – right?

Do you know any in your region?

Findlingspark Nochten

GeoSites
dunes – traces of the ice age

The Muskauer Heide („Muskau Heath"), south of Weißwasser, is considered to be the largest inland dune region in Germany. However, these sometimes massive windblown sand accumulations aren't recognizable at first glance. They are often covered with forest and look like small hilly landscapes. Dunes that don't occur on the coast, which are instead located in the countryside, are called „inland dunes" - and in our region they aren't rare at all!

The dunes are particularly recognizable from the air. They look like a chain of hills and have a distinct shape that resembles a crescent. At the highest point they sometimes rise 25 meters above the ground. These dunes developed about 10,000 years ago, towards the end of the last ice age. At that time, the ice no longer extended down into our region, but it was still cold enough here that no plants could survive. Additionally, the wind was much stronger than today, so that it could easily carry small grains of sand over long distances. At natural obstacles, or where the winds died down, this sand cargo was then deposited and the dunes were formed. If you look at them more closely, they look like huge sickles. In fact, because of their shape, you can recognize where the winds came from, way back then. These „sickles" open towards the west, and that indicates that the winds were blowing from that direction.

Dune sand is recognized by the fact that the grains are all relatively small, about the same size, and very round.

Open sandy areas, by the way, are an important habitat for many rare animal and plant species. Many wild bees and beetle species build their nests in the sand. Bit by bit, however, nature continues to take these areas back, so the dunes are slowly being grown over. A so-called sandy grassland usually develops first. One of the first plants that's able to „take root" in the sand is grey hair-grass. It is perfectly adapted to hot and dry locations, due to its silver color and curled blades, and it even has its own sun protection because its blades turn red in excessive sunlight (similar to the way our human skin gets brown). A heath landscape will eventually develop out of the sandy grassland, followed later by pine forest.

discovery tour 9 From Schwerer Berg („Heavy Hill“) in Weißwasser to Nochten

Start and finish	Tower Am Schweren Berg („at the heavy hill“), Am Schweren Berg Straße 2 in Weißwasser/O.L.
Time	approx. 1 hour
Distance	approx. 13 km

Well?? Want to see how huge boulders can be, with your own eyes? Then check the air in your bicycle tires, pack something to eat and drink, and then, together with your family, head over to a park that‘s unique in Europe - Lausitzer Findlingspark („Lusatian Boulder Park“) in Nochten!

If you want your trip to have more variety, in summer you could ride the Waldeisenbahn Muskau train from Weißwasser directly to your starting point - the tower at Schwerer Berg („Heavey Hill“). You can take your bikes with you on the Waldeisenbahn train. Find out before you go about the train schedule, or special tour dates!

TIP!

Waldeisenbahn Muskau

At the „Waldeisenbahn Muskau“ (Muskau Forest Railway), at Teich street in Weißwasser/O.L., you‘ll not only have the chance to ride the train, but also to experience something very special! There‘s a railway museum here. In the museum you can see about 20 historical locomotives and numerous wagons. And you can also learn more about Muskau Arch. That‘s because the founding of the „Waldeisenbahn Muskau“ was closely connected to the Arch. In 1895, the owner of the „Standesherrschaft“ estate of Muskau, Hermann Graf (Count) von Arnim, connected his many operations with a narrow-gauge freight train. That way, the lignite, clay, paper, wood, briquettes and other goods could be transported more quickly. At that time, the small train was a real industrial railway! Today, only tourists are transported. On trips to Kromlau or Bad Muskau, you‘ll have the opportunity, in comfort, to observe the charming landscape with its mystic-colored lakes, tree-lined „Gieser“ ditches or enchanting parklands. If you‘re interested, then ride on one of these puffing steam engines or a diesel locomotive. Or be very athletic and drive a hand trolley, and move a wagon with the power of your own arms! It‘s even possible to ride in the train driver‘s cabin! The „Räuberbahnhof“ (bandit‘s station) playground awaits young visitors at Teichstraße station.

Every year, the season starts at Easter and ends at the beginning of October. You can find out when the steam or diesel engines are in operation on the website www.waldeisenbahn.de!

Waldeisenbahn Muskau GmbH
Central departure at Teichstraße Station in Weißwasser
Telephone: 03576 207472
wem.gmbh@waldeisenbahn.de

Before you set off on your bikes, take a quick trip up the tower. We hope you‘re not afraid of heights, so that you can admire the view over Nochten from Schwerer Berg hill, and the huge (former) open-cast mining area!

But now let‘s go! We‘ll start at Schwerer Berg and head towards Findlingspark in Nochten. The Hermannsdorfer Radweg cycling path goes from Schwerer Berg hill to Lausitzer Findlingspark Nochten. The entire route is covered in asphalt and all of the service roads you‘ll pass by are well signposted. But be aware - you‘re not allowed to go on those roads! Before you start, you can check out the route on the information panel. There‘s a boulder with a „map“ made of bronze that shows you interesting points of the tour.

You‘ll be riding along the eastern border to the Tagebau (open-cast mine) „Nochten“, along the already recultivated landscape. Lignite has been excavated in Open-Cast Mine Nochten since 1960. About 17 million tons are produced every year. The Nochten open-cast mine belongs to the Lausitzer Braunkohlerevier („Lusatian Lignite Mining Area“), which is located in Brandenburg and Saxony and is Germany‘s second largest lignite mining region. After the first 1.5 kilometers, you can read something about the Nordic drift. Along the

way, there will be more information panels for you to learn things about nature and technology. The rest areas invite you to have a picnic, where you can share your impressions of the huge mining landscape with your traveling companions, during the short break.


viewing tower on the Hill near Weißwasser

After about 9.5 kilometers you'll come to a crossroads. Turn left onto the Pechhüttenweg trail and you'll come into a forest, where you'll go straight for about 3 km. Now you'll find the first sign for „Findlingspark", on the right side of the path. You're almost there!

TIP!

Erratic Boulder Park Nochten

The Lausitzer Findlingspark Nochten park area, with its approximately 7,000 boulders, is one-of-a-kind in Europe. All of these stone giants are witnesses of the ice age and tell the story of how they once traveled to Lusatia from Scandinavia about 12,000 years ago, and how they were shaped by ice. If you want to know more, you can look around in the visitor and information center. Illustrations depict Lusatia, around Weißwasser, during the ice ages.

„Outside" there are around 20 hectares of landscaped gardens, where you can not only admire the impressive stone monuments, but also the picturesquely designed garden world. But the biodiversity of the plant world is not only there to be explored in the summer time. Findlingspark Nochten is designed in such a way that the flora already displays its beautiful diversity beginning in March.
Things are blooming as of February/March. First there's winter heather, followed by moss phlox in May, thyme in June, then broom heather lights up the boulder park in late autumn, and November completes the cycle again with winter heather. Additionally, there's a playground, where younger guests can go on their own discovery expedition, with fun and games. Waterways and ponds, as well as „Little Scandinavia", invite you for a stroll and a picnic.

As you can see, Findlingspark is not only for geo-explorers, but also for garden lovers and people thirsty for knowledge. That's why the park is a great destination for the whole family! After your stop here, you'll certainly manage the trip back to the tower at Schwerer Berg hill, refreshed and full of colorful impressions – right?

Erratic Boulder Park
Parkstraße 7, 02943 Boxberg OT Nochten
tel. +49 35774 556352
www.findlingspark-nochten.de
opening hours: 15. March - 15. November
daily 10.00 - 18.00

For kindergardens, school classes, after school clubs and other leisure -time facilities, the head office of the UNESCO-Geopark has developed so-called SAND PROJECTS.

The younger ones have lots of fun on a DreamSandTtrip around the world and learn in a playful way origin, diversity and significance of sand. For the older ones there are different offers based on a modular principle, which will deepen and expand knowledge on the various topics in combination with experiments, for example:

Geologically considered: Sand - origin, deposit, features
Geodiversity: Sand? – A global view
Sand as habitat - surprise on the doorstep
Raw material sand - why we can not do without him

You need more information? info@muskauer-faltenbogen.de or +49 35600 368714

Along the way...

You've probably noticed what a massive impact open-cast mining has on nature, and how it vastly and uniquely changes the landscape. You can already see, however, that nature has taken root again on the recultivated areas, roads have been built and even nature reserves have been created.

Do you know what recultivation is? It's the legally required restoration of close-to-nature habitats for plants and other creatures. It usually takes decades. During the intensive preparation of the reconstructed terrain, it's even possible to create agricultural and forestry areas, by depositing nearly two-meter-thick layers of soil onto the leveled surface. That's actually not so bad, right?

What do you think about that? Talk to your parents about it - about what you need electricity for, how you could reduce your energy consumption, and what alternatives there are. Remember the miners and their families, too. What do you find exciting about recultivation – how would you do it? Where do you see problems? Discuss the advantages and disadvantages of mining in Lusatia with your parents – and design your own „blossoming" post-mining landscape! Color and glue a picture about how you imagine Lusatia might look, after mining. If you want, you can send us your results – as a copy or in original form. We like to reward creative ideas!

Send your creations to:UNESCO Global Geopark Muskauer Faltenbogen / Łuk Mużakowa
Geschäftsstelle
Muskauer Straße 14
03159 Döbern


erratic boulder park Nochten

Did you like the book? Did you discover and learn a lot? And take a lot of photos? Then let us participate in your experiences! Your task is to take a few photos demonstrating your trips. Send the pictures you took in our UNESCO-Geopark to the following email address: info@muskauer-faltenbogen.de. For the best pictures, you'll receive a Geopark Explorer's gadget!

If you want to know more about our region or want to do other cycling or hiking tours, we are at your disposal! Our office and GeoAdventure–Center is located at Muskauer Straße 14, D-03159 Döbern. More information can also be found at www.muskauer-faltenbogen.de or on our Facebook page!

Tel. +49 35600 368713

opening hours: mo – fri 9.00 - 15.00

info@muskauer-faltenbogen.de

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