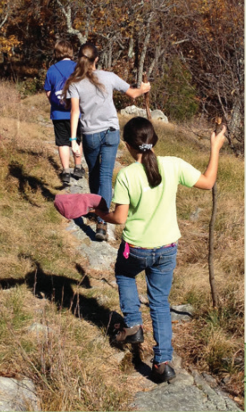
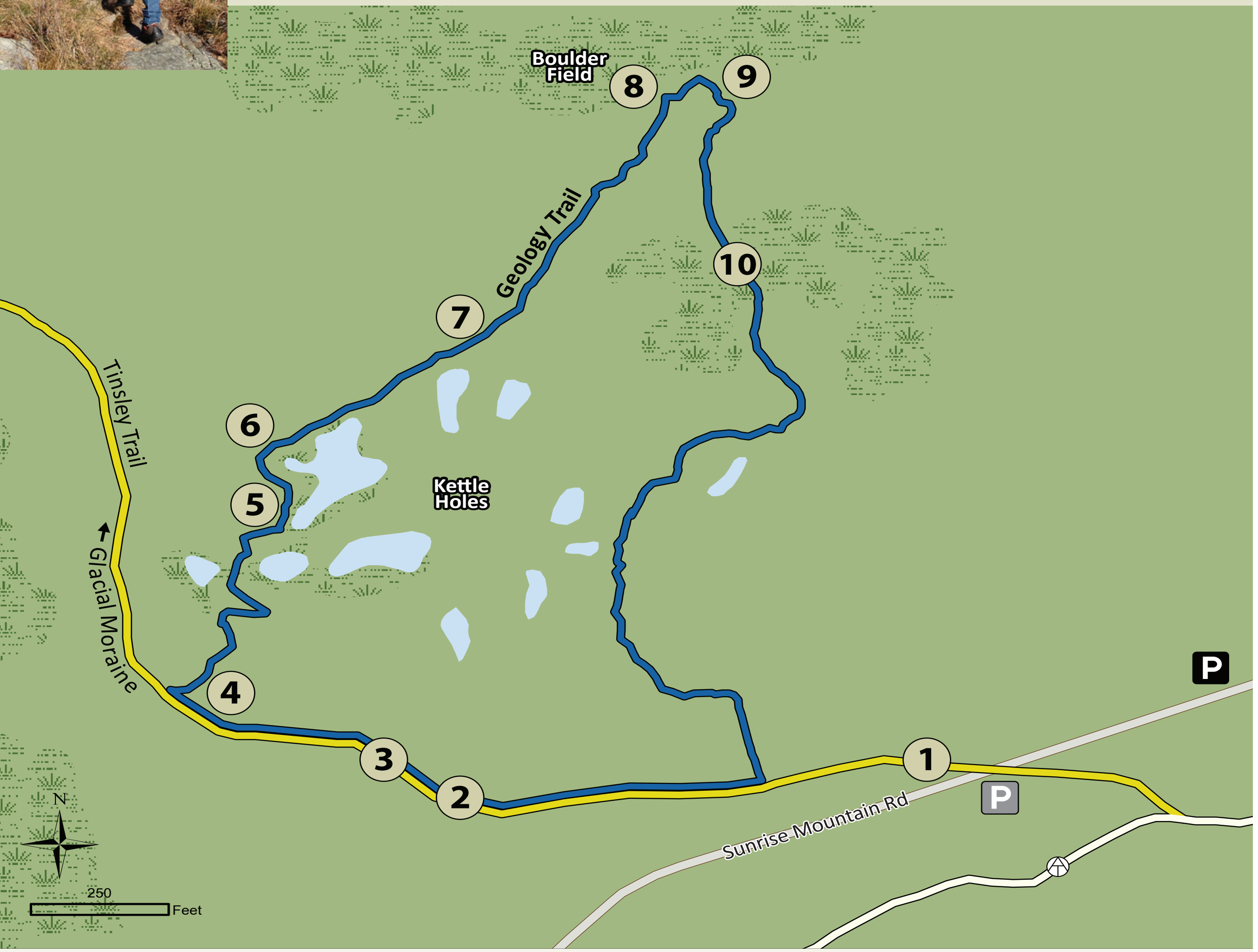


STEP BACK IN TIME …

If you could travel back in time 600 million years to this very spot, you would be swimming in a warm, tropical shallow sea. 450 million years ago, you would see mountains recently heaved up out of that sea when the continents collided. If 80 million years ago, you would see those same mountains eroded to low hills, soon to be uplifted again 20 million years later.

Then came the glaciers…



DIRECTIONS - Start where Tinsley Trail crosses Sunrise Mountain Road. **Geology Trail** is blazed with blue triangles. It shares the path with Tinsley Trail (yellow circles). Stop at the Kiosk 1 then walk downhill on Tinsley Trail/Geology Trail looking for the brown numbered posts. At post 4 Geology Trail leaves Tinsley Trail. Continue to follow blue triangles and brown numbered posts.

1 INTRODUCTION

(At the kiosk on Tinsley Trail at Sunrise Mountain Rd.)

Over the past million years, the land you're standing on has been covered, scraped and shaped by three different glaciers. The most recent, the Wisconsinan Glacier, entered New Jersey about 27,000 years ago. At its peak, about 20,000 years ago, the ice here measured up to a half a mile high. That's nearly thick enough to cover the Empire State Building twice over!

Most of the landforms and features you see in Stokes State Forest today were shaped by that half-mile high sheet of ice. A walk on the one-mile-long **Kittatinny Glacial Geology Trail** will introduce you to some of those features.

Take Tinsley Trail downhill to post 2

2 TALUS SLOPE

The rocky face of the hill facing you is the remains of a talus slope. Alternate freezing and thawing of a cliff face causes rocks and boulders to loosen, break off, and fall to the base of the cliff forming a **talus slope**. Notice that the rocks in this slope are angular and jagged, and not smoothed by glacial action.

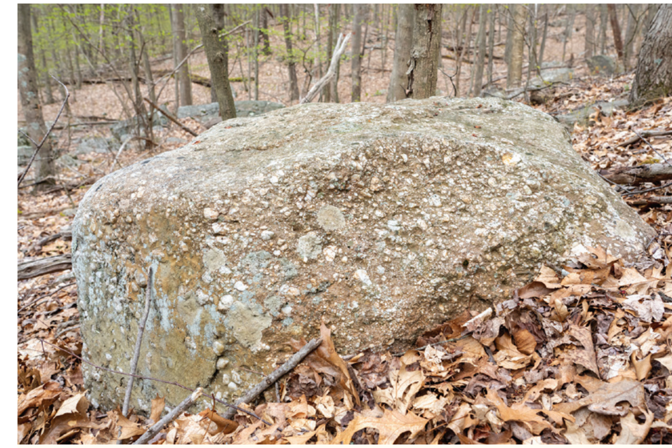
Continue down Tinsley Trail to post 3

3 PUDDINGSTONE

High above this trail is the Kittatinny Ridge – part of the Appalachian Mountain Range. The ridge is made of a very hard, resistant rock called the **Shawangunk Conglomerate.** As the glaciers scraped and eroded the softer rock around it, the Shawangunk Conglomerate stood firm – mostly. The glacier did manage to knock some large chunks of rock off the ridge; one of these is in front of you.

The **Shawangunk Conglomerate** – also known as **puddingstone** for its resemblance to traditional British, fruit-filled puddings – is excellent building material, popular in the 1800s for building houses, churches, bridge abutments, foundations and fireplaces.

Look closely at the boulder to your left. You can see the smaller rounded quartz pebbles bound together by solidified sand.



Shawangunk conglomerate or **puddingstone**

Continue down Tinsley Trail to post 4
Turn right to leave Tinsley Trail and continue on Geology Trail.

4 WHICH ROCK IS IT?

As you step off Tinsley Trail, turn right and look at the rocks around you. Some look like the pebble-filled puddingstone you saw at 4. Some have a more uniform, sandy consistency and slightly sparkle in the sun. If the latter, you could be looking at **sandstone** or, perhaps **quartzite** – another common rock type in this area.

Quartzite is a metamorphic rock formed when sand and finer rocks are partially melted under great heat and pressure.

Continue to follow blue triangles and numbered posts.

KITTATINNY GLACIAL GEOLOGY TRAIL

5 KETTLE HOLES

The circular hollows and temporary ponds around you are called kettles, or **kettle holes.**

As the glacier retreated, huge chunks of ice fell to the ground and were partially or wholly smothered by sediments from the melting glacier. The sediment insulated the ice for a while, but when it eventually melted, the sediment settled around the edges of the glacial water creating a round pool – or **kettle hole**.

6 GLACIAL ERRATICS

Some of these rocks are not like the others…

The cage here contains **nepheline syenite**, a rock of volcanic origin. The nearest natural outcrop of this type of rock is more than four miles east of here. *So, how did it get here?*

As a glacier moves, it scrapes the surrounding landscape and removes chunks of rock. When the ice begins to melt, the rocks fall to the ground. This is why rocks carried and dropped by glaciers - called **glacial erratics** - are different from the local bedrock.

Glaciers can transport boulders the size of large trucks hundreds of miles before dumping them!

Note: There's a massive chunk of puddingstone on the edge of the kettle hole to your right between post 6 and post 7.

7 VERNAL POOLS

Some **kettle holes** contain water year-round, some only in the spring, and some have fully silted in. Those that hold water in spring, known as **vernal pools,** are essential breeding grounds for amphibians. In spring, look for egg masses of salamanders and frogs.

8 BOULDER FIELD

The sheer size of the boulders you see in this **boulder field** are evidence of the massive forces associated with glaciers. After they were buried with other debris in this **glacial moraine**, they were forced upward to the surface through intensive freezing and thawing to their current resting places. All the moving, tumbling and grinding removed the sharper edges and rounded some of these boulders.

9 BARE AND BARREN NO MORE

How does an environment of bare boulders change into a lush forest? It takes time, weathering and erosion.

Take a look at all the plants growing on the rocks! Most of them are **lichens.** Lichens are a fungus and an algae 'living together.' They absorb water from the air which freezes and thaws with the seasons. This, along with weak acids that lichens release, slowly wears away the surface of the rocks causing cracks to form.

As cracks form in the rocks, water gets in. Freezing and thawing open up the cracks further, allowing plant seeds and decaying plant matter to collect there. As the plants grow, their roots work themselves into the smallest crevices searching for water and nutrients, splitting the rock even more.

Eventually, soil is formed as many generations of plant life and elements work away at the rocks. Look for plants and young trees growing out of crevices and cracks in rocks. *(Is this where paper beats rock?)*

10 OF BOULDERS AND BERRIES

As you head back to Tinsley Trail, look for the different types of rocks underfoot. Are they the pale-colored puddingstone or quartzite, or can you find a glacial erratic – a rock that came from further away? You might be lucky enough to see large seams of white quartz.

Close to 10, you enter a large patch of huckleberries and blueberries. *(Be aware that bears love berries!)* As you walk along the trail, you'll see many different types of moss. *Which one would YOU call pin cushion moss, common hair moss or fern moss?*

When you reach Tinsley Trail again, turn left to get back to the kiosk, or turn right to walk along a glacial moraine ridge.

Thank you for taking the time to learn about the glacial history of Stokes State Forest.

For more glacial features in Stokes State Forest:

GLACIAL MORAINE

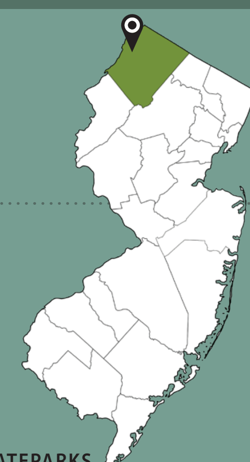
Exit Geology Trail onto Tinsley Trail, turn right and walk 600 feet past 4. You'll find yourself walking along a prominent ridge. This ridge is a **glacial moraine**: a pile of unconsolidated rocks and debris left by the glacier. The glacier likely paused here on its last retreat.

GLACIAL STRIATIONS

Drive to the Sunrise Mountain parking lot and walk to the summit; you'll walk over some smoothed and polished bedrock. Look closer and you'll see long, thin, parallel gouges in the bedrock. As the half-mile-high sheet of ice scoured over the land, stones and rocks trapped beneath the ice gouged deep grooves, called **glacial striations**, in the bedrock.

Please stay on the trail, take only pictures, be aware of changing trail conditions and report any trail issues to the park.

STOKES STATE FOREST
1 Coursen Road
Branchville, NJ 07826
Phone 973-948-3820
Fax 973-948-3359



State of New Jersey
Department of
Environmental Protection
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KITTATINNY GLACIAL GEOLOGY TRAIL

INTERPRETIVE TRAIL GUIDE