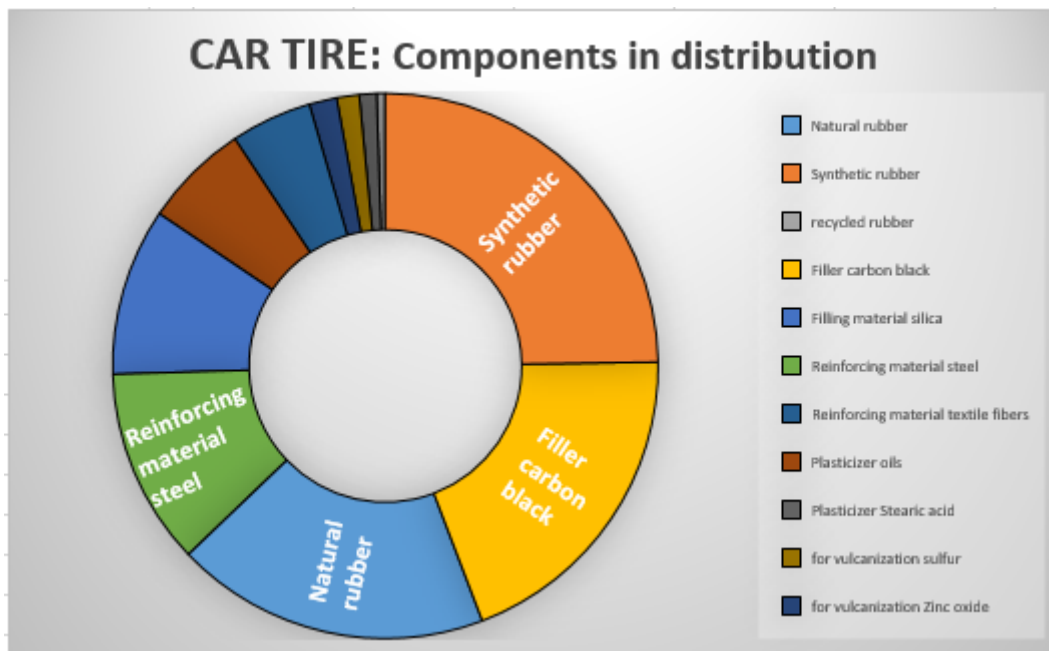


## SECTION 1 FACT-CHECK CAR TIRES

Individual transport is important, and the number of vehicles is constantly increasing worldwide. Car tires are the link between the vehicle and the road. They have to withstand many mechanical loads and temperature fluctuations. Tires also have a significant influence on the driving characteristics and performance of a vehicle.

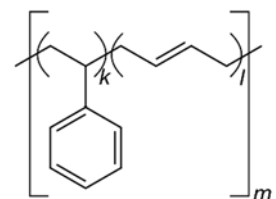
### FACT-CHECK CAR TIRES

The manufacture of a car tire is still considered the "top class" in plastics technology today. Tires are complex composite materials. On average, a modern passenger car tire contains up to 25 components and 12 different rubber compounds.



The proportion of natural rubber in tire rubber is around 20%. It is used in the outer cover layer. Its exceptionally high elasticity ensures good adhesion to the road surface. However, the natural rubber is soft and abrasion is high. A tire with a mileage of 10,000 km /year loses an average of 1 mm. This abrasion ends up as microplastic on the road and represents a large part of the fine dust pollution.

As far as possible, the natural rubber in tires is replaced by fossil-based polymers. So-called synthetic rubber consists of styrene-butadiene units, for example, and is known as "BUNA". BUNA is more abrasion-resistant and significantly extends the mileage of the tires.



### TASKS:

1. Research the manufacturing process of a tire.
2. Outline the main steps in the process.
3. Explain the term vulcanization and sketch a chemical reaction equation.
4. Why are tires black? What is the role of carbon black/soot?
5. Bridgestone, Goodyear, Michelin, Pirelli, Continental are the "Big 5" of regular tire production. Lego Group dominates in the toy division. Research production figures, market shares and profits.

## SECTION 2 FACT-CHECK NATURAL RUBBER



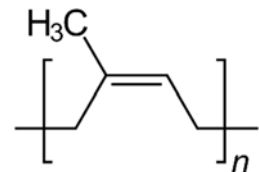
The tree has great economic importance because its milky sap, known as natural rubber (latex), is the most important natural source of this renewable raw material for rubber production. It is grown in what is known as the rubber belt, which is located in areas near the equator. Thailand, Indonesia, Vietnam, India and Ivory Coast produce over 75% of the world's 14.7 million tons of natural rubber in 2020.



Natural rubber is obtained from the rubber tree (*Hevea brasiliensis*). The trees, which are cultivated in large plantations, have their barks injured and a milky sap comes out. This liquid (latex) is collected, thickened by means of acid and washed. What remains is an elastic rubber-like substance known as natural rubber, which is compressed into bales and sold on the market.

Rubber trees require a temperature of 20 to 28 degrees and an annual rainfall of 1,800 to 2,000 mm. At the age of about 25 years, the tree stops producing latex, so it has to be felled in the plantation economy and replaced by new plants. The resulting wood, so-called "rubberwood", about 50 million m<sup>3</sup> per year, is used for furniture making and is extremely hard and resistant to moisture fluctuations.

Responsible for the elastic consistency of natural rubber is its chemical structure consisting exclusively of cis-1,4-polyisoprene units. This cis-linkage leads to long and straight chains, which can be arranged in a honeycomb-like and densely stacked manner.



A trans-linkage of the polyisoprene units, on the other hand, leads to entangled polymer chains with lower elasticity, as is the case, for example, in gutta-percha, cycle and other plant juices.

### TASKS:

6. Research the growing conditions in the countries of thailand and brazil.
7. Compare the yields, land and water consumption, and pesticide/fungicide use.

Use the DATA SET and the listed literature sources to get started:

FAOstat (2020): Crops. URL: <https://www.fao.org/faostat/en/#data/QCL>

Pesticides. URL: <https://www.fao.org/faostat/en/#data/EP> (last view: 10.4.2022).

<https://en.wikipedia.org/wiki/Tire>

[https://en.wikipedia.org/wiki/Natural\\_rubber](https://en.wikipedia.org/wiki/Natural_rubber)

SECTION 3 DATA SET LCA „Natural Rubber & Car Tires“ - Part 1 Production and Country Comparison

Naturkautschuk Produktionszahlen / Natural Rubber Production Numbers					All Land Data 2019		
Land / Country	Produktion 2020	Area Harvested	Yield	COUNTRY AREA total	Ackerland Arable Land	Dauerkulturen Permanent Crops	under permanent meadows & pastures
Land / Country	in Tsd. T	ha	hg/ha	km <sup>2</sup>	1000 ha	1000 ha	1000 ha
Thailand	4703.2	3292671	14284	513115	16810	5400	800
Indonesien / Indonesia	3366.4	3668735	9176	1904569	26300	25000	11000
Vietnam / Viet Nam	1226.1	728764	16824	331690	6787	4931	642
Indien / India	962.8	457370	21051	3287263	155478	13300	10338
Elfenbeinküste / Cote Ivory	936.1	578923	16169	322463	3500	4500	13200
China	687.6	745000	9230	9596961	119473	16201	392834
Malaysia	514.7	1106861	4650	330290	826	7460	285
Guatemala	436.4	110400	39530	109021	862	1183	1811
Philippinen / Philippines	422.4	230723	18308	343000	5590	5585	1500
Brasilien / Brazil	225.6	163254	13820	8515770	55762	7756	173361
<b>Production Gesamt / Total</b>	<b>14775.8</b>						
zum Vergleich BRD / for comparison FRG				357588	11664	198	4730

TASKS:

Discuss based on the facts and data collected in SECTION 1 + 2:

Hektogram pro Hektar  
 hg/ha = 1 hg = 100 g = 0,1 kg  
 ha = 10.000 m<sup>2</sup>  
 1 km<sup>2</sup> = 100 ha  
 1 Fußballfeld hat eine Fläche von 7140 m<sup>2</sup>.  
 1 t = 1000 kg

8. Compare plantation areas with production figures and yields achieved.
9. Make meaningful graphs via Excel or Numbers. Use the dATA SET.
10. Which producing country is working very efficiently, which is not?
11. What is the reason? Collect reasons (climate, soil conditions, availability of water, pests).
12. Prepare a presentation of the group results.

**Group discussion / expert panel / group puzzle**

The final presentation of the results (via keynote, PowerPoint, padlet or as a poster) and discussion (as a group puzzle / panel discussion / expert round) succeeds in communicating the results from the group work to the entire learning group.

The pollutants and influencing parameters are to be used as an argumentation aid in a panel of experts to provide the pros & cons for the extraction of natural rubber in the selected cultivation countries Brazil and Thailand.