L2) The Natural Sciences: From Plant Studies to World Bio - Geography. By Dr Robert Rose

Steiner intended Plant Studies to introduce the pupils to the living realm. It has at least the following levels:

1) Study of plants in their environmental context: Sun – Earth; light, warmth, air, water, etc (**Spatial Holism**).

2) Study of plant morphology (root, stem, leaf, flower, fruit (seeds); in the context of the whole plant "over time" and in relationship to the elements (**Time Holism**).

3) Plants in the **Regions** of the **Whole Earth (Biogeography)** and in metaphor with the human **senses.**

4) The Plant World in metaphor with **Human Soul Qualities**. Plant classification according to Human **Soul** Characteristics of **Thinking**, **Feeling** and **Willing**.

5) Plant Classification System in metaphor to the **stages of childhood consciousness**.

Metaphor in Plant Education

Metaphor plays a distinctive role in Steiner's views on plant education. Even in our contemporary usage of our words this can be the case. Take the word "dandelion", it has perhaps been forgotten in the English, but the word has a French origin and it means "lion's tooth". It is the same in German "Löwenzahn". It is unlikely that someone thinks that a dandelion is literally like lion's teeth, but that there is a similarity in form between that of the plant leaf and that of the set of lion's teeth.

Moreover, it may sometimes be thought that a metaphor implies something that is not a real connection, but one purely of fantasy. In the above example, it seems fairly evident; however, there is a dimension to the metaphor that has a connection with reality. It may be possible to understand Steiner's metaphors in the respect. But the question is: to what extent is Steiner's higher level metaphors partially imaginary and partly factual? In what way, if any, are Steiner's metaphors more appropriate to child development than the mechanical – computer centred ones often found in modern science and modern science education?

For Steiner, the main question was always: how to maintain or create the human connection? Moreover, what does this mean? Some may wish to challenge the particular examples that Steiner gives, but the question is a more generic one: how can education help the children learn at best: is it through mechanistic – computer based learning, or through metaphors centred on human – world reality?

Plant Studies in the 10th Year (Class 4)

Botany as such does not begin in Steiner Schools before class 4, that is when children are in their 10th year. Steiner explained that this is due to the fact that the children undergo a significant change in their development at this age:

"Until the end of the ninth year, everything children learn about plants, animals, and stones, about the sun, moon, and stars, or about clouds, mountains, and rivers should be clothed in pictures, because children will feel at one with the world. In those young days, a child and the world are one whole. With the arrival of **the great change** a new situation arises. Children now begin to experience themselves as self-contained. They learn to distinguish themselves from the environment, which offers the **possibility** - indeed, the **necessity** - of introducing them to the world in new terms. Now teaching should emphasize the fundamental difference between the plant world and that of the animals, because children need to be introduced to each of these two natural kingdoms in its own way." Steiner, R (1921/2): Soul Economy, Anthroposophic Press, p. 162/3. (My bold)

As we have seen before, in the first sub-phase in the lower school, all subjects can be taught, but from the point of view of "living pictures". What this means in this context is that during the first sub-phase (classes 1 to 3), is that plants can be introduced but through the teaching method of imaginative anthropomorphisms as we introduced in module 3.

In the second sub-phase, which may begin part way through class 3, but mostly class 4, the children develop a different consciousness from before. Just after the turn of the 10th year, a stronger "subject – object" awareness develops in the children. This enables them to make a stronger differentiation between plants and animals and this in turn needs to be reflected in the teaching. According to Steiner, it is at this time that, for the children, all the World feels to be "alive" as distinct from being "sentient" as in the previous sub-phase. Due to this, a differentiation occurs in the child consciousness in which the plant and animal realms begin to be differentiable in their essential nature. This has its consequences in the teaching method as well as the curriculum; the former being orientated around the method of "living pictures" and the latter in a different approach to the plant and animal curricula. For Steiner, this means that the teaching not only **reflects** the development of the child, but also enables it to **emerge** in a healthy way.

Plant Studies to follow Animal Studies

In terms of when to place the plant studies, this was to be sometime after a main lesson period on the Human – Animal curriculum:

But let me first say that the correct procedure is to study the animal world ***before coming to terms with the natural conditions* of the plants**. In the efforts necessary to characterize the form of your botany lessons—finding whatever examples you can from one plant or another—you will become clear why the animal period must come first. Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 115. (My bold)

As we will see in module 8, this impacts on how the design of a whole year curriculum is built up.

Plants: a Holistic Approach

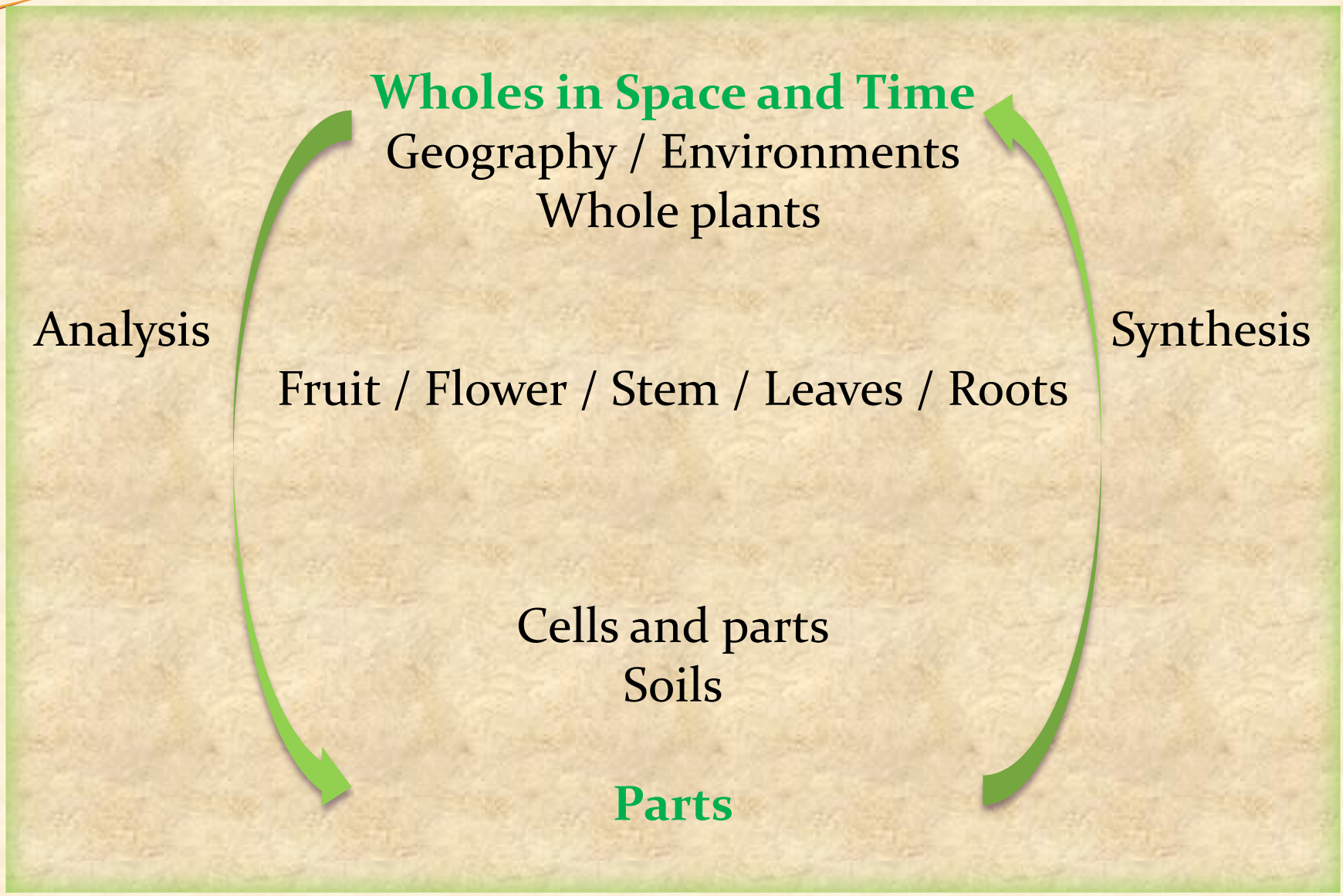
It is without doubt that Steiner's approach to plant education is holistic, and in a number of different ways. For him, individual parts of plants were not wholes without the entirety of the plant; a tree is not a whole without the colony of plants that live on it; and many plants are not wholes without the environment around them:

"When children have turned nine or ten you must introduce certain elementary facts of the outside world [late class 3 into class 4], the facts of the plant and animal kingdoms… A plant by itself is not a reality… **The rose is only a reality together with the *whole* rosebush**… For what is actually a tree? **A tree is a colony of many plants**. And it does not matter whether you are considering **a hill that has less life in itself but that has many plants** growing on it, or a tree trunk where the living earth itself has as it were withdrawn into the tree. Under no circumstances can you understand any plant properly if you examine it by itself." Steiner, R (1924): The Kingdom of Childhood, Anthroposophic Press pp 36-38. (My emphasis)

Steiner's holism extended also to include how the subject was to be taught in context of other subjects; the main point to present to the students the whole context of things to which plants belong:

"Therefore you must not teach geography and geology by themselves, and then botany separately. That is absurd. Geography must be taught together with a description of the country and observation of the plants, for the earth is an organism and the plants are like the hair of this organism. Children must be able to see that the earth and the plants belong together, and that each portion of soil bears those plants that belong to it." Steiner, R (1924): The Kingdom of Childhood, Anthroposophic Press, p. 39.

Linking this with the idea first presented in module 5, L1c, symbolically, we can represent this in the following way:


Wholes in Space and Time
Geography / Environments
Whole plants
Analysis
Synthesis
Fruit / Flower / Stem / Leaves / Roots
Cells and parts
Soils
Parts

Individual Plants as Wholes in Space & Environment

Steiner recommended that whole plants be considered in the context of their natural environment.

"Much of what you have said is good, but it would also be good in the course of your description to acquaint your students with the different **parts** of a **single plant**, because you will continually have to speak about the parts of the plant—leaf, blossom, and so on. It would therefore be good for the pupil to get to know certain parts of a plant, always following the principle that you have rightly chosen—that is, **the study of the plant in relation to Sun and Earth**. That will bring some life to your study of the plants; from there you should **build the bridge to human beings**... Earth, and so on—and always remember to speak of them in **relation to the universe**. Then when you give the proper form to your lesson you will find that the children meet what you present with a certain understanding". Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 117/8. (My Bold).

The aim is to show the intimate connection that the whole plant, including different parts, has with the distinct elements, such as the soils, water, air, warmth and Sun light. In doing so, the studies maintain the connection between the individual plant and its natural context as is presented to the child consciousness.

As can be seen from the above, part of the context of the plant is the **soil**. Later he writes:

"Here we have a plant (see drawing) but this alone is not the plant, for the **soil** beneath it also belongs to the plant, spread out on all sides and maybe a very long way. There are some plants that send out little roots a very long way. And when you realize that the small clod of earth containing the plant belongs to a much greater area of soil around it, then you will see how necessary it is to manure the earth in order to promote healthy plant growth… In order to understand how the earth is really a part of plant life you must find out what kind of soil each plant belongs to; the art of manuring can only be arrived at by considering earth and plant world as a unity, and by looking upon the earth as an organism and the plant as something that grows with this organism. Thus children feel from the very start that they are standing on a living earth. This is of great significance for their whole life." Steiner, R (1924): The Kingdom of Childhood, Anthroposophic Press, pp 37-40. (My bold)

Steiner elaborates on his holistic approach to Plant studies:

"Plant and earth belong together… We let them experience how a plant is more earth-like in its root; a root adapts itself to the varying nature of the soil… Students should gradually develop a feeling for how roots, for example, are different in dry or wet soil, or how they grow when close to towering rocks or near the sea. First of all, children must learn to see the plant as part the earth's soul, and see all sprouting vegetation as arising from the soil. Then we have to develop a feeling in children for the contrast between the **earth-like root** and the **blossom and fruit, which are closely related to the sun**. When talking about blossoms and fruit, we should lead children from the earth to the sun sphere. Students should get a feeling for how the blossom unfolds in the warmth and light of the sun's rays, and how, in blossom and fruit, the plant is emancipated from the fetters of the earth. Earth, plant growth, and the sun's influence all have to be seen as being part of a **complete whole**." Steiner, R (1921/2): Soul Economy, Anthroposophic Press, p. 163/4. (My bold).

Steiner contextual approach to plant studies extends also then to the other elements, particularly in the context of time, which we will consider next.

Individual Plants as Wholes Over Time

This way of considering plants is extended to its growth process in time:

"There is much in what you say, but no one has tried to give the children an understanding of the plant itself in its various forms. What would it be like if, for example, you perhaps ask, "Haven't you ever been for a walk during the summer and seen flowers growing in the fields, and parts of them fly away when you blow on them? They have little 'fans' that fly away. And you have probably seen these same flowers a little earlier, when summer was not quite so near; then you saw only the yellow leaf shapes at the top of the stem; and even earlier, in the spring, there were only green leaves with sharp jagged edges. But remember, what we see at these three different times is all exactly the same plant! Except that, to begin with, it is mainly a green leaf; later on it is mainly blossom; and still later it is primarily fruit. Those are only the fruits that fly around. And **the whole is a dandelion**! First it has leaves—green ones; then it presents its blossoms, and after that, it gets its fruit." Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 119. (My bold)

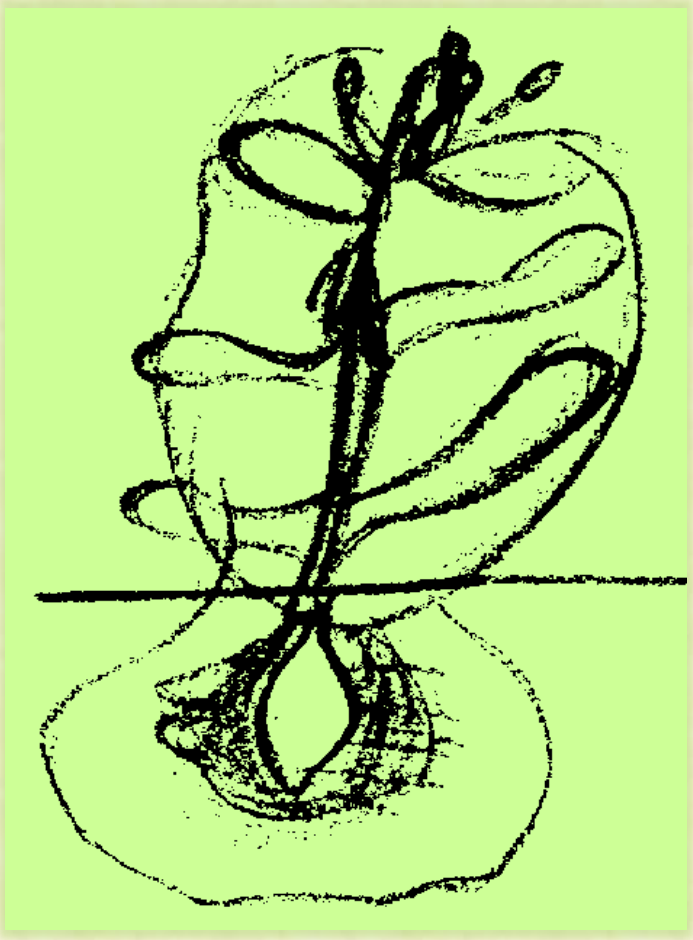
The individual parts of the plant can also be introduced in this way, but seen as they emerge over time. The description Steiner suggests is one in which the children's consciousness is drawn to their memories of the natural sequences of plant growth, in this case the dandelion. This sequence could then be extrapolated to other kinds of plants, showing their similarities and differences.

As a part of this temporal process, Steiner proposes that the surrounding spatial context should be included:

"This is how you should introduce the organs of the plant, at the same time relating these organs to the conditions of **air** and **heat**. You can now go further, and try to elaborate the thoughts that were touched on when we began today, **showing the plants in relation to the outer elements.** In this way you can also connect morphology, the aspect of the plant's form, with the external world. Try this." Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 120. (My bold)

Here we have a plant (see drawing) but this alone is not the plant, for the soil beneath it also belongs to the plant, spread out on all sides and maybe a very long way. There are some plants that send out little roots a very long way. And when you realize that the small clod of earth containing the plant belongs to a much greater area of soil around it, then you will see how necessary it is to manure the earth in order to promote healthy plant growth. Something else is living besides the actual plant; this part here (below the line in drawing) lives with it and belongs to the plant; the earth lives with the plant. Steiner, R (1924): The Kingdom of Childhood, Anthroposophic Press, p. 37/8

In this way, the different parts of the plants are interpreted in the context of time and the environment:



Blossom / Seeds - Sun

Leaves - Air

Roots / Water
Earth / Soil

Warmth

The Plant World over the Whole Earth and the Human Senses – a Human Centred Biogeography

Steiner intended that Plant Studies included the way plants grow around the World, not just individual plants in the locale of a school or a home. Today such a study would be called "Biogeography":

"Try now to translate the thought I indicated to you into language suited for children. Exert your fantasy so that by next time you can give us a vivid description of the **plant world all over the Earth**, showing it as something that shoots forth into herb and flower, like the soul of the Earth, the visible soul, the soul made manifest. And show how the **different regions of Earth** - the warm zone, the temperate zone, and the cold zone — **each has its prevailing vegetation**, just as in a human being each of the various spheres of the senses within the soul make a contribution. Try to make it clear to yourself how one whole sphere of vegetation can be **compared** with the world of sound that a person receives into the soul, another with the world of light, yet another with the world of smell, and so on." Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 124/5. (My bold).

In this way, Steiner takes his holistic approach to another level, namely the World but at the same time joins it up with the human sense experience, a metaphor for making the learning process more inward.

The Plant World as the Soul of the Earth made Visible

In the previous quote, there is a reference to the realm of plants being the "soul of the earth". So what did he intend with this? For Steiner, plant education, like the other kinds of education, is about first establishing the **human** connection. In this context, this means educating the children into the relationship between the world of plants and the human inner life:

"All children, who in their youth learn to know plants according to scientific principles, should *first learn about them as we have described*—that is, by comparing them with **soul qualities**. Later they can study the plant system more scientifically. It makes a difference whether we try first to describe the plants and then later study them scientifically, or vice versa. You can do much harm by teaching scientific botany first, instead of first presenting ideas that relate to the feeling life, as I have tried to show you. In the latter case the children can tackle the study of scientific botanical systems with a truly **human** understanding. **The plant realm is the soul world of the Earth made visible**". Steiner, R (1919): Discussions with Teachers, Anthroposophic Press, p. 127/8. (My bold).

To do this, Steiner gave teachers the task of relating the three human soul forces, thinking, feeling and willing, to the different species of plants; some of which may be related to one soul force more than the other:

"Now here is your task for tomorrow. Please make out a table; on the left place a list of the human soul characteristics, from thoughts down through all the emotions of the soul—feelings of pleasure and displeasure, actively violent emotions, anger, grief, and so on, right down to the will; certain specific plant forms can be compared with the human soul realm. On the right you can then fill in the corresponding plant species, so that in the table you have the thought plants above, the will plants below, and all the others in between." Steiner, R (1919): Discussions with teachers, Anthroposophic Press, p. 133/4.

In proposing this, Steiner was attempting to form an education in which the inner life of the human being is the primary mode through which learning can occur. Rather than just comparing one perception with another, or even using metaphors of a mechanical nature, Steiner intended the realisation of deep inner learning to occur through teaching through inner soul correspondences to the various plant forms and species.

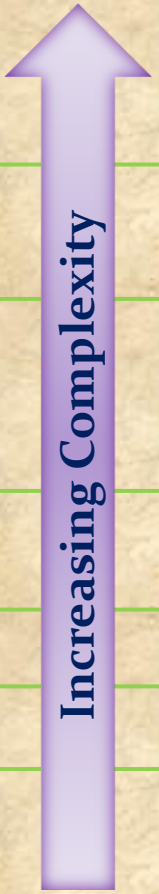
Plant Classification in Metaphor with Stages of Consciousness

Moreover, Steiner's starting point for this approach was the classification of plants in accordance with which parts were most developed in terms of structure. This then he leads on to the connection with a soul quality:

"You must first distinguish what are properly seen as the different parts of the plant—that is, root, stem (which may develop into a trunk), leaves, blossoms, and fruits. All the plants in the world can be divided into groups or families. In one family the root is more developed; the rest of the plant is stunted. In another the leaves are more developed, and in others the blossoms; indeed, these last are almost entirely blossom. Such things must be considered in relation to each other. **Thus we can *classify* plants by seeing which system of organs *predominates*, root, trunk, leaves, and so on, since this is one way that plants vary. Now, when you recognize that everything with the nature of a blossom belongs to a certain *soul quality*, you must also assign other organic parts of the plant to other soul qualities.** Thus, whether you associate single parts of the plant with qualities of soul or think of the whole plant kingdom together in this sense, it is the same thing. The whole plant kingdom is really a single plant". Steiner, R (1919): Discussions with teachers, Anthroposophic Press, p. 138. (My emphasis)

In the original text, these soul qualities were represented in the following way: 1) Pleasures of infancy (babies); 2) Pleasures of early childhood (the awakening life of feeling, both sorrows and joys): 3) Experiences at the awakening of consciousness of self: 4) Experiences of fifth and sixth year, up to school age: 5) First school experiences, seventh, eighth, ninth, tenth and eleventh year: 6) Experiences of the eleven-year-old: 7) School experiences from twelfth to fifteenth year. To our modern consciousness, such designations may seem curious to say the least. However, one way of understanding these is that they may be seen as metaphors of consciousness to aid child understanding in the learning process. It is one possibility for the teacher to mediate a certain set of ideas in an age relevant way, rather than only through classification of plant forms alone. In terms of modern botany, Steiner does go on, however, to utilise the concept of **organisational complexity** in the ordering of the plant world. We can see an edited version of this represented in the next image (bear in mind the protista are included in this):

A System of Plant Studies according to Complexity	
The 7 Major Types of Plant	
Net-veined plants, Dicotyledons; Plants with green calyx and coloured petals.	
Simple dicotyledons	
Parallel-veined plants, Monocotyledons; Plants with simple perianth.	
Gymnosperms, Conifers	
Ferns	
Mushrooms, Mosses	
Algae, Fungi	



Towards a Holistic Plant Curriculum

In the design of the curriculum from classes 4 to 8, it might be advantageous create a holistic order to the process. For example, the description of the parts of the whole plant can be used to determine the nature of the 7 major types of plants. Following this, the 7 major types of plants described above can act as a starting condition for a **biogeography** consideration. This is because the **global biomes** are in turn described by these. This can lead to a spatial arrangement around the World in line with the 7 major plant types. As a consequence, the holistic, i.e. the becoming global, curriculum acquires a particular order as depicted in the following table and the image after:

Class 4/5	Class 6/7	Class 7/8

Increasing Wholeness

Individual Plants as Wholes in Space and Time:

•Parts of the whole plants.
• The plant environment and the elements.
• The Sun and the weather in relationship to plants.

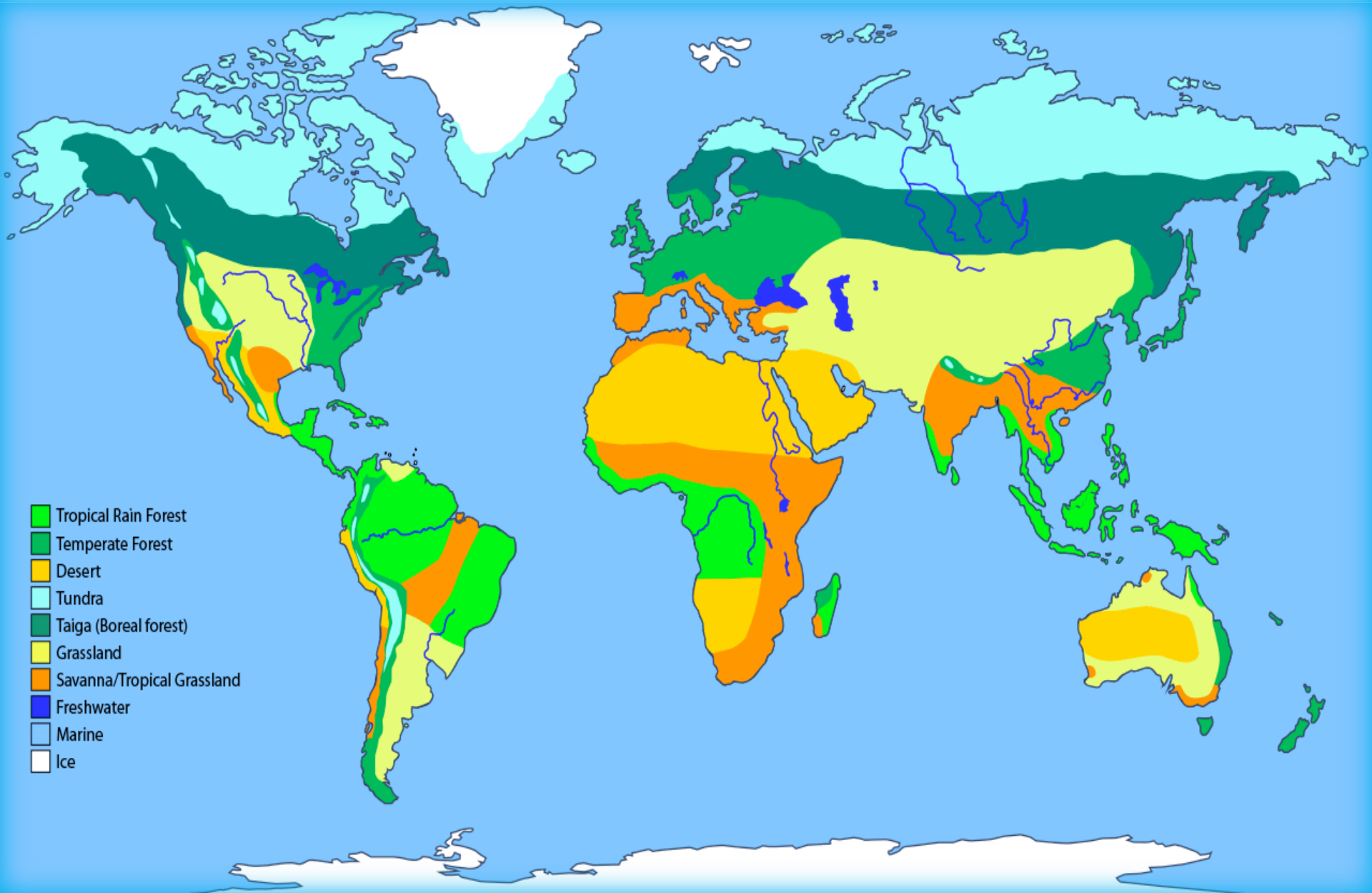
The Plant World as a whole: the 7 major types of plants:

1) Algae, Fungi
2) Mushrooms, Mosses
3) Ferns
4) Conifers
5) Parallel-veined plants, Monocotyledons; [including some deciduous trees]
6) Simple dicotyledons [including some other deciduous trees]
7) Net-veined plants (some deciduous trees), Dicotyledons; Plants with green calyx and coloured petals.

The Global Whole: the major World Biomes (see also next image):

•The Sun's Light and Warmth and the Earth in space leading to:
• Arctic, Tundra
•Taiga
•Coniferous forest
•Deciduous forest (Temperate zone)
•Grasslands and Savannah
•Tropical Rain forests
•Deserts.

The Global Whole and the World's Biomes



From out of this exploration of the World's biomes, it may then be possible to proceed to a consideration of the dependencies of the different forms of plant life first on the mineral / soil realm (see module 5, L 4), then on each other, such as in a basic introduction to the trophic levels in nature, elementary ecology and agriculture. This may then lead on to how the different species of animals thrive in these World biomes and how, historically, humans have depended on these, giving rise to a variety of cultures and social forms around the World (see module 5). In this way, the children may be given a basic introduction to the existential interdependencies of different beings around the World.

Geography Revisited

In light of this, you might like to revisit some of the ideas we considered in module 5 in order to make a step towards the social aspect of geography presented there in L4. The relevant slides are included here again:

Towards the Global Whole of the Living Realm

The teacher's task is then to expand this into each part of the teaching as well as outward to the economic realm:

"Again linking mineralogy with geography, we must not omit a discussion of how all the things of **economic value we find in nature** are used. Referring to what we have said about the stony structure of the mountains, we discuss all the substances, such as coal, that we have a use for, in industry and elsewhere. We depict these things in a simple way, but the **starting point is our discussion of the mountains**. Nor should we neglect to describe a sawmill when we are dealing with the forest. **We start with the forest**, move on to a discussion of wood, and come finally to the sawmill." Steiner, R (1919): Practical Advice to Teachers, Anthroposophic Press, p. 153.

One can see in this a number of different "wholes to parts" teaching processes: Mountains to Minerals; Forests to Wood; each of these is then lead over into the economic realm. As we have seen, this can then grow into the cultural perspective and then the beginnings of the rights sphere. Together with our previous discussions this leads to an extended and holistic picture of the geography curriculum in the lower school:

Type of Geography	Elements of Geography	Increasing Wholeness
Human:	Cultural	**Wholes**
	Political	
	Economic	
Life:	Agriculture Crops, Plants and animals	
Physical:	Sun Weather Rivers Oceans Soils Mountains, Rocks / Minerals	**Parts**

Summary of the Geography Curriculum of the Lower School with Interpretation

Sub-phase 1: 7th – 10th yrs	Sub-phase 2: 10th -12th yrs	Sub-phase 3: 12th -14 yrs
Pedagogy / Methodology:		
Imaginative Geographic Stories:	**Characterisations:**	**Understanding:**
1) **Imaginative Stories** as introducing geographical relationships. 2) Creating a story of a geographical situation, event or being.	**Geographic Narratives / Descriptions** of local places, processes and events and their extension to nation:	**Systematic Geography** of national & global places, processes and events:
Curriculum Content:		
Imaginative Geography	**Local and National Geography**	**World Geography**

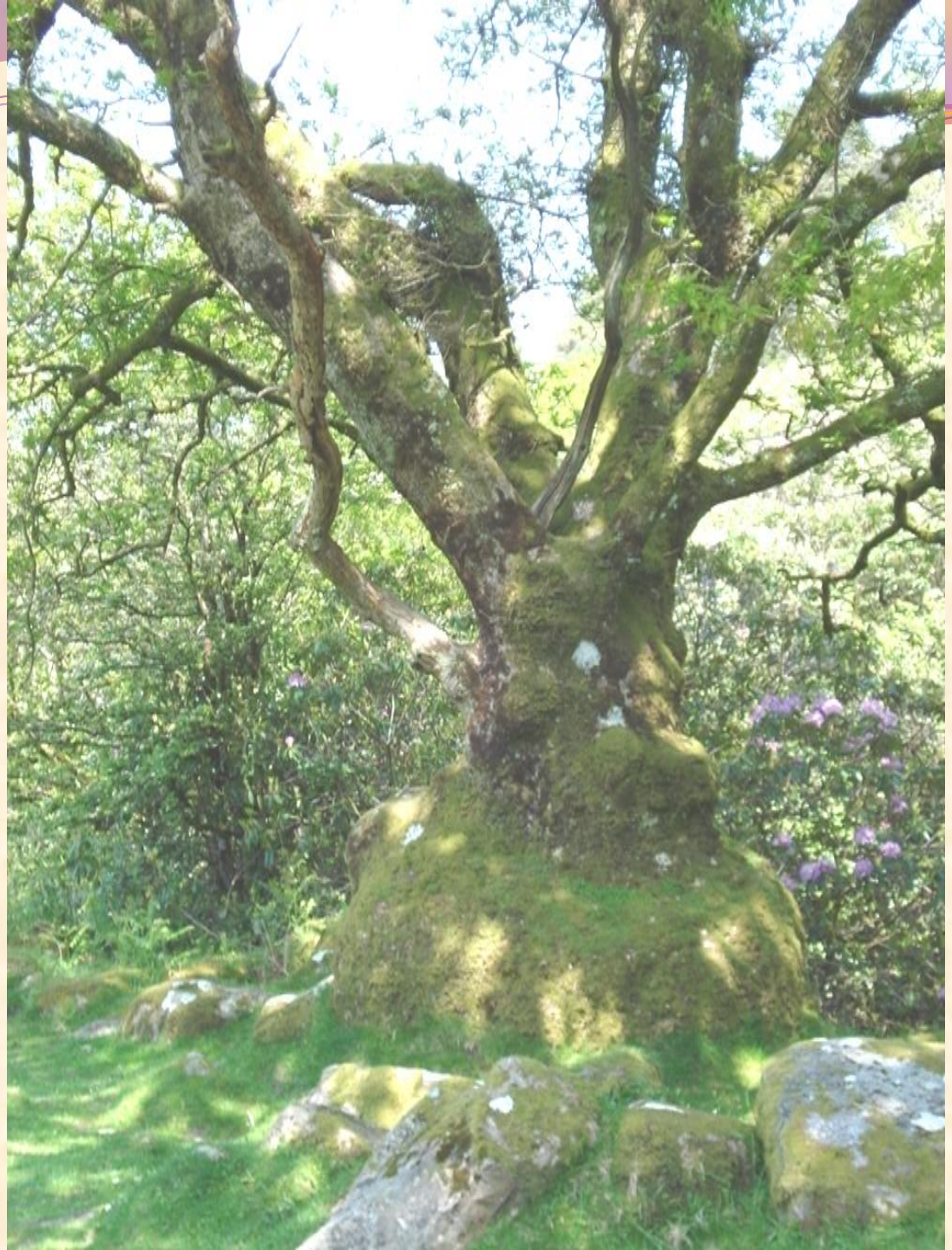
Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8
Imaginative Geographic stories of the kingdoms of nature.	Imaginative Geographic stories of the kingdoms of nature.	As per class 2 and as per class 3.	Local Geography, Geography and the foundations of the economy	Wider Local Geography, Geography and the broader foundations of the economy	As per class 5 and as per class 7.	From National Geography to the Beginnings of Global Geography Geographic Foundations of the economy, culture and the beginnings of rights questions.	From National Geography to the Beginnings of Global Geography Geographic Foundations of the economy, culture and the beginnings of rights questions.

Focussing on the Content of the Curriculum:

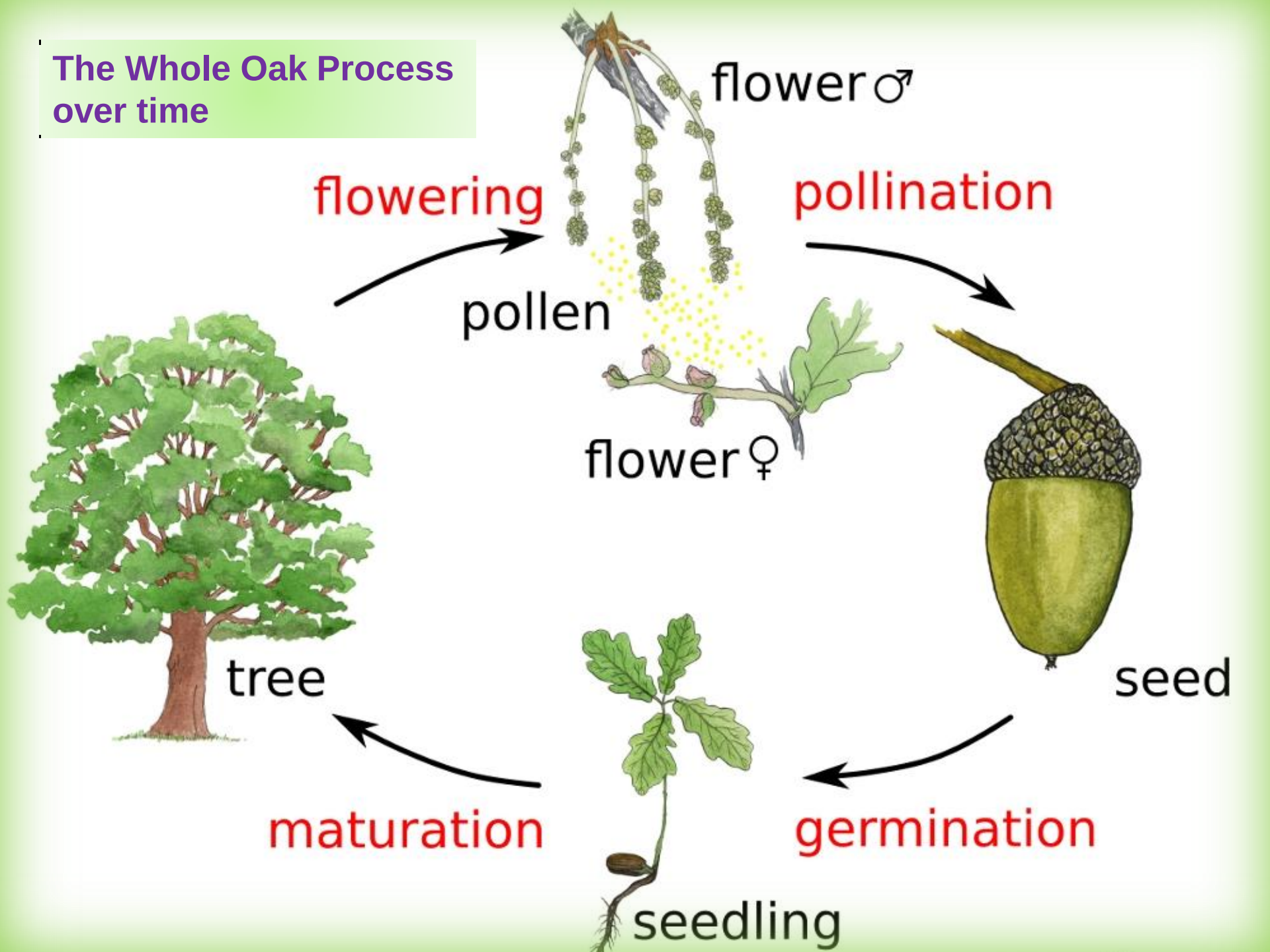
Summary of the Lower School Geography Curriculum in "Discussions with Teachers" with Interpretation							
Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**	**Class 6**	**Class 7**	**Class 8**
Awakening to the surroundings. Familiar animals, plants, and soil formations, or to local mountains, creeks, or meadows.	Description of surroundings continuing from grade 1.	Meadows and woods and so on to business relationships, composing business letters. Making mortar from earth materials and the building of houses. Manuring, tilling and the growing of crops. Animals and Plants in the landscape.	Local Geography and local agriculture. Connection to local industry.	Wider local Geography. Climatic conditions. Astronomical Conditions (for example, "Earth to Sun" relationship in different locations).	Expanding to different parts of the Earth including the climatic and astronomical conditions.	Expanding to different parts of the Earth including the climatic and astronomical conditions.	Expanding on Earth to astronomical conditions. Cultural and Spiritual (e.g. Religious) aspects of Geography. Connecting to the economic dimension to Geography.

Case Study: the Oak in Geographical Context:

The next set of slides are taken partly from Shipley Bridge, a part of the Avon Valley, near South Brent, Devon. They show a series of images of an oak tree in a granite landscape. To the right hand side of the first image is the river Avon. There is a great deal of moisture in the narrow little valley leading to the growth of lichens, mosses and ferns throughout. The slides then lead on to more generic pictures of the oak over a typical life span. The intention is to give a sense for one type of holistic process of an individual species of tree. This includes the whole tree in a landscape as well as the observation process from the whole tree in a landscape to its parts.



The Whole Oak Process over time



Exercises

You might like to try a couple of exercises:

1) Make some observations of a real oak tree near to where you live and identify the different stages as per the previous slides.

2) Make some drawings (colour preferably) of these stages and put them in their real time sequence.

3) Create some imaginary in-between stages as a drawing but also as inner pictures of the mind and see if you can create an inner growth process to parallel the real outer one.

4) Consider how you would present this to class 4 as per the three stage process as discussed in module 5, lecture 1.