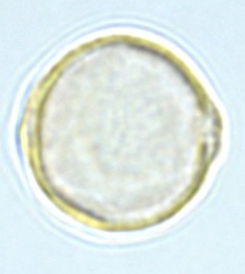
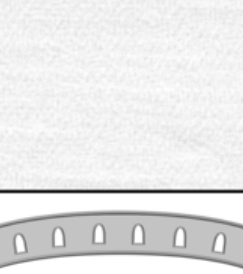
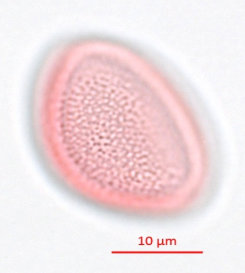
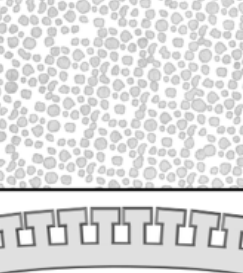

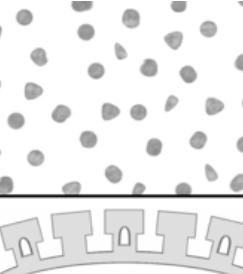

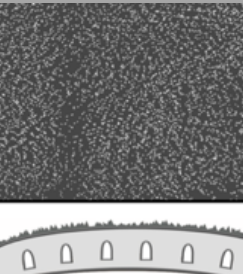

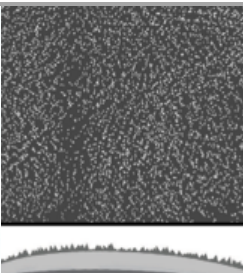
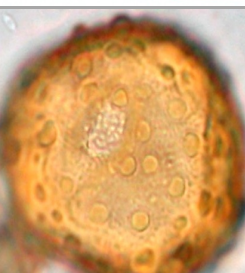
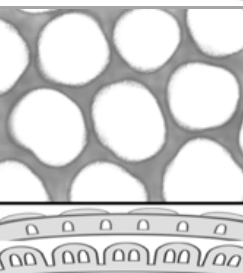

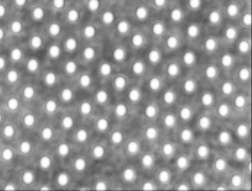


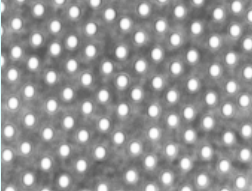
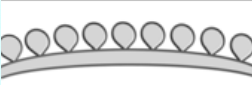
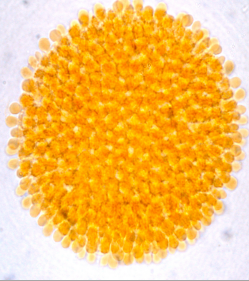
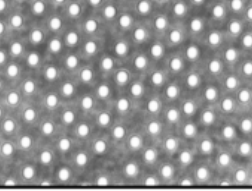

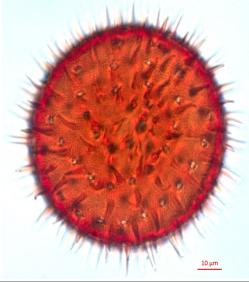
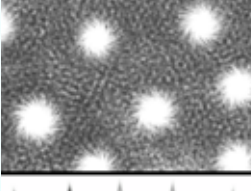


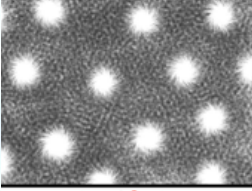

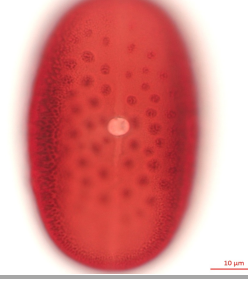
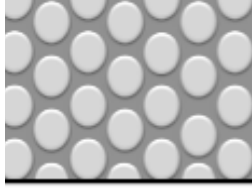


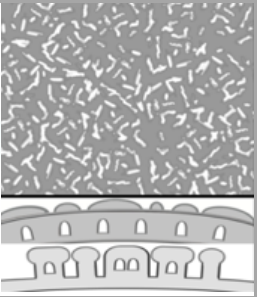
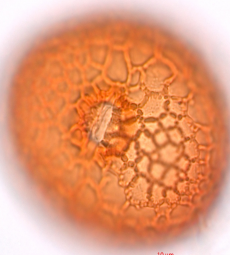
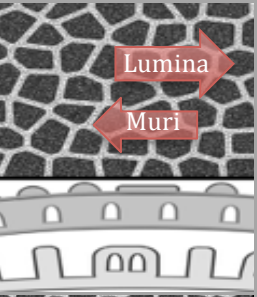

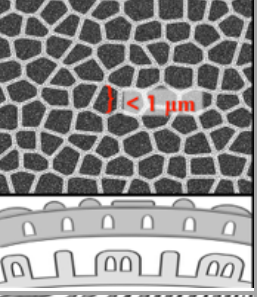

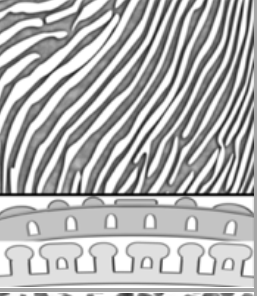

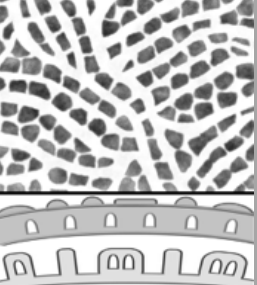


Pollen Grain Surface Pattern Terminology


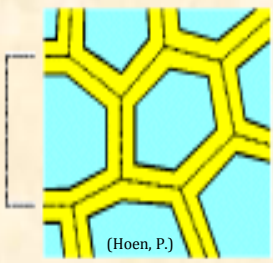
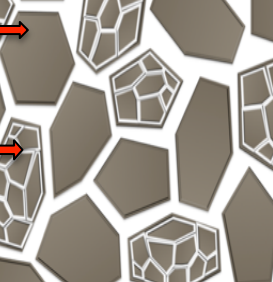
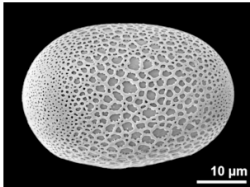
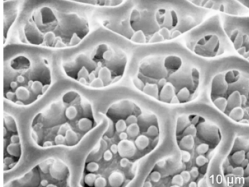
(NOTE: The top panel of the cartoon images below reflects the first plane of focus for the pollen grain. The lighter areas are indicative of protruding structures, such as echini or bacula; the darker areas are indicative of depressions or holes.)

<p>Psilate</p>	<p>Completely smooth surface Exine: Tectate</p> <p style="text-align: right;">Example: Moraceae – <i>Helianthostylis sprucei</i></p>		
<p>Perforate</p>	<p>Surface having small holes or depressions less than 1µm in diameter Exine: Tectate</p> <p style="text-align: right;">Example: Myristicaceae – <i>Virola calophylla</i></p>		
<p>Foveolate</p>	<p>Surface having lumina (holes or depressions) 1µm or greater in diameter; typically the distance between two adjacent lumina is larger than their diameter Exine: Tectate</p> <p style="text-align: right;">Example: Arecaceae – <i>Ammandra decasperma</i></p>		
<p>Scabrate</p>	<p>Any sculptural element less than 1µm in diameter (shape may vary); pattern may appear more irregular (compared to granulate) Exine: Tectate</p> <p style="text-align: right;">Example: Boraginaceae – <i>Hydrophyllum canadense</i></p>		
<p>Granulate</p>	<p>Any sculptural element less than 1µm in diameter (shape may vary) Exine: Intectate</p> <p style="text-align: right;">Example: Anacardiaceae – <i>Rhus</i> sp.</p>		
<p>Verrucate</p>	<p>“Wart-like” sculpturing elements more than 1µm tall, typically broader than they are high; never constricted at the base Exine: Tectate, Semitectate; Intectate</p> <p style="text-align: right;">Example: Fabaceae (C) – <i>Brownneopsis ucayalina</i></p>		

<p>Baculate</p>	<p>Rod-shaped sculpturing elements (bacula), longer than wide and greater than 1 μm high Exine: Intectate</p> <p>Example: Rubiaceae – <i>Galianthe grandifolia</i></p>		 
<p>Gemmate</p>	<p>Sculpturing elements (gemma) higher than 1 μm; approximately the same width as height; constricted at their base; “balloon-like” Exine: Intectate</p> <p>Example: Malvaceae – <i>Septotheca tessimannii</i></p>		 
<p>Clavate/Pilate</p>	<p>Club-shaped sculpturing elements (clavae), or rods with knob heads, appearing “lollipop-like” (pila); height greater than 1 μm; diameter of clavae or pila is smaller than its height; thicker at apex than at base. Exine: Intectate</p> <p>Example: Euphorbiaceae – <i>Pausandra morisiana</i></p>		 
<p>Echinate</p>	<p>Pointed sculpturing elements (echini) 1 μm or greater in height Exine: Tectate</p> <p>Example: Malvaceae – <i>Sidalcea neomexicana</i></p>		 
<p>Microechinate</p>	<p>Pointed sculpturing elements (echini) less than 1 μm in height Exine: Tectate</p> <p>Example: Lamiaceae – <i>Aegiphila integrifolia</i></p>		 
<p>Areola</p>	<p>Small, and mostly convex, exine islands separated by grooves; a form of “negative reticulum” Exine: Tectate</p> <p>Example: Acanthaceae – <i>Justicia carnea</i></p>		 



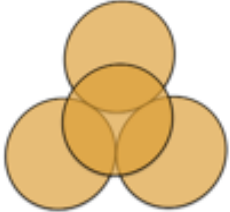
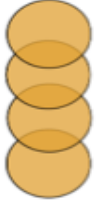
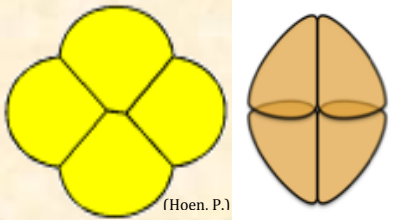
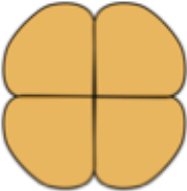
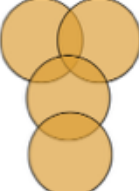
<p>Rugulate</p>	<p>Elongated sculpturing elements greater than 1µm long; pattern irregularly arranged; may resemble an intermediate between reticulate and striate, but this is not necessarily the case</p> <p>Exine: Tectate, Semitectate</p> <p>Example: Violaceae – <i>Rinorea racemosa</i></p>		
<p>Reticulate</p>	<p>Sculpturing elements as ridges arranged in a network which has gaps (lumina) 1µm or greater in diameter; Muri (breadth of ridges) equal to or narrower than the width of the lumina; also described as “network-like pattern” formed by muri</p> <p>Exine: Tectate; Semitectate</p> <p>Example: Malvaceae – <i>Ochroma lagopus</i></p>		
<p>Microreticulate</p>	<p>Appears as reticulate, however, the lumina <u>less than</u> 1µm in diameter</p> <p>Exine: Tectate; Semitectate</p> <p>Example: Acanthaceae – <i>Justicia adhotoda</i></p>		
<p>Striate</p>	<p>Sculpturing elements elongated with the length at least 2 times the width; running more or less parallel; Ridges = muri; gaps between = grooves; surface may look like a fingerprint</p> <p>Exine: Tectate, Semitectate</p> <p>Example: Rosaceae – <i>Prunus reflexa</i></p>		
<p>Striate-reticulate</p>	<p>A pattern in which parallel rows of muri are linked to form reticulum within the grooves; the connections between the muri may lie on a single level or different levels. Exine: Tectate; Semitectate</p> <p>Example: Anacardiaceae – <i>Cyrtocarpa edulis</i></p>		



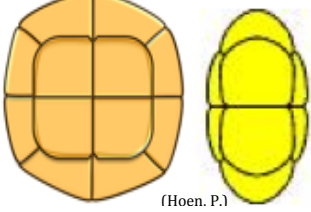
Reticulate Pollen Terminology




<p>Reticulum Cristatum</p> <p>Croton pattern</p>	<p>Special type of reticulum; Muri has prominent sculpturing elements; add this description to the “Note” section in the database</p> <p>Special type of reticulum cristatum with regularly arranged elements on muri; typically comprised of five to six raised sculpturing elements around a circular area; add this description to the “Note” section in the database</p> <p style="text-align: right;">Example: Buxaceae – <i>Pachysandra procumbens</i></p>	
<p>Brochus</p>	<p>One lumen of a reticulum and half of the width of the surrounding muri</p> <p>Plural: brochi</p>	 <p style="text-align: right;">(Hoen, P.)</p>
<p>Bi-reticulate</p>	<p>Large meshed reticulate (suprareticulum) filled with smaller meshed reticulate (microreticulum); can be categorized under heterobrochate</p>	
<p>Heterobrochate</p>	<p>Reticulated pollen surface with brochi of varying sizes; the size variation may be random or gradual</p>	 <p style="text-align: center;">(Hesse, et al.)</p> <p style="font-size: small;"><i>Dyckia rariflora</i> (Bromeliaceae) 2. polar proximal view Picture credit: Halbritter H.</p>
<p>Homobrochate</p>	<p>Reticulated pollen wall with brochi of uniform size</p>	 <p style="text-align: center;">(Hesse, et al.)</p> <p style="font-size: small;"><i>Dipteracanthus devosianus</i> (Acanthaceae) 4. exine surface Picture credit: Halbritter H.</p>

Pollen Grain Dispersal Form








(NOTE: A dispersal unit for pollen is considered as mature or fully developed pollen grains.)




<p>Monad</p>	<p>Dispersal unit consisting of a single pollen grain</p>	
<p>Dyad</p>	<p>Dispersal unit consisting of two pollen grains</p>	
<p>Tetrad</p>	<p>Dispersal unit of four pollen grains</p>	
<p>Linear Tetrad</p>	<p>Uniplanar tetrad where four units are arranged in a row</p>	
<p>Rhomboidal Tetrad</p>	<p>Uniplanar tetrad with the proximal sides of two individual units in direct contact, and the remaining two units are separated</p>	 <p style="text-align: right; font-size: small;">(Hoen. P.)</p>
<p>Tetragonal Tetrad</p>	<p>Uniplanar tetrad where all four units are in contact at the center for the tetrad forming a cross</p>	
<p>T-Shaped Tetrad</p>	<p>Uniplanar tetrad with two of the units perpendicular to the other two forming a "T" shape</p>	







Tetrahedral Tetrad	Multiplanar tetrad with each unit in contact with the other three units	
Decussate Tetrad	A tetrad of pollen grains arranged in two pairs lying across one another, the pairs (dyads) more or less at right angles to each other	
Polyad	Dispersal unit consisting of <u>more</u> than four pollen grains	 <p style="text-align: right; font-size: small;">(Hoen. P.)</p>





Pollen Grain Exine Types		
Tectate	Pollen grain with a continuous tectum; also known as 'eutectate'	
Semitectate	Discontinuous tectum that covers less than 50% of the pollen grain's surface	
Intectate	Pollen grain lacking a tectum; also known as 'atectate'	

Pollen Grain Terminology - Polar Shape


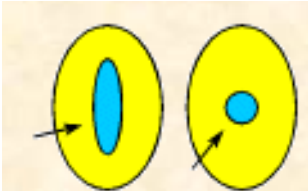
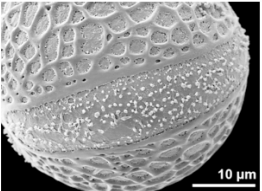
Circular	The length of the vertical axis and horizontal axis are approximately equal; ratio of 1:1	
Elliptic	The length of the vertical axis and horizontal axis are unequal, one having a greater length than the other	
Triangular Convex	A triangular shaped grain with protruding walls connecting two apexes	
Triangular Concave	A triangular shaped grain with walls sloping inward connecting two apexes	
Triangular Straight	A triangular shaped grain with a relatively straight wall connecting two apexes	
Quadrangular	A single unit pollen grain having four angles (degrees may vary) and four sides	
Quinquangular	A single unit pollen grain having five angles (degrees may vary) and five sides	

Lobate	A single unit pollen grain having distinctive lobes created by the inward folding of the apertures of the grain			
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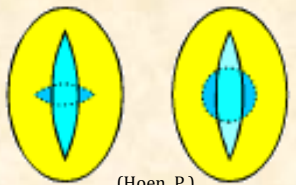


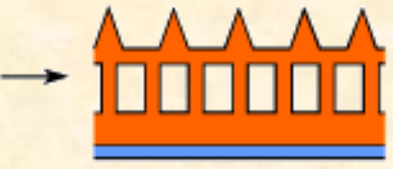
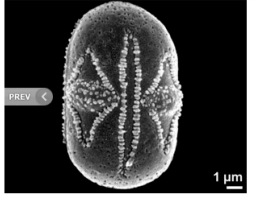


Pollen Grain Terminology - Equatorial Shape		
Oblate	A grain with a polar axis that is shorter than the equatorial diameter in a ratio of approximately 0.5 - 0.75 : 1; (Polar length is 50% to 75% of equatorial length)	
Suboblate	A grain with a polar axis that is shorter than the equatorial diameter in a ratio of approximately 0.75 - 0.95 : 1; (Polar length is 75% to 95% of equatorial length)	
Circular	A grain with a polar axis and equatorial axis that are approximately equal in a ratio of 1 : 1 (Polar and equatorial is relatively equivalent in length)	
Subprolate	A grain with a polar axis that is greater than the equatorial diameter in a ratio of approximately 1 : 0.75 - 0.95 (Equatorial length is 75% to 95% of polar length)	
Prolate	A grain with a polar axis that is greater than the equatorial diameter in a ratio of approximately 1 : 0.5 - 0.75 (Equatorial is 50% to 75% of Polar)	
Perprolate	A grain with a polar axis that is <u>greater</u> than the equatorial diameter in a ratio of approximately 2 : 1 (Equatorial is 50% or less of Polar)	


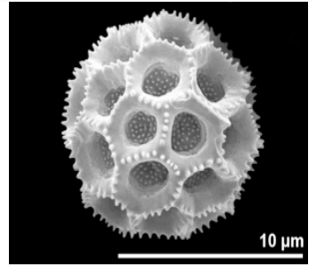
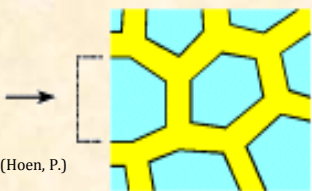

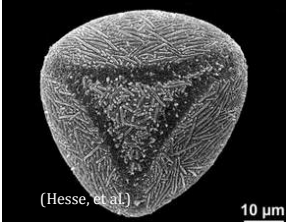
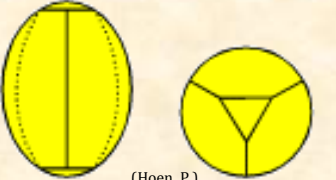


Rectangular Tall	An angular grain with four corner and four sides; polar axis is greater than the equatorial axis	
Rectangular Broad	An angular grain with four corner and four sides; polar axis is less than the equatorial axis	
Rhombic Tall	Oblique-equilaterally shaped grain with four angles and four sides; the polar axis is greater than the equatorial axis	
Rhombic Broad	Oblique-equilaterally shaped grain with four angles and four sides; the equatorial axis is greater than the polar axis	



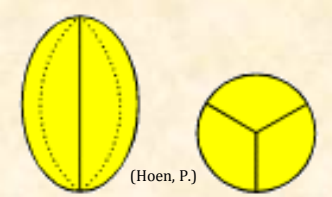

Common Pollen Morphology Terminology

Annulus	An area of the exine surrounding a pore that is noticeably differentiated from the remainder of the exine, either in ornamentation or thickness; “ring”	 (Hoen, P.)
Aperture	Region of the pollen wall that is morphologically and/or morphologically different from the rest of the wall; typically thinner than the surrounding wall. Apertures = site of germination. The pollen tube emerges through the aperture, that particular aperture becomes a “germinal” aperture.	 (Hoen, P.)
Aperture Membrane Ornamentation	The exine layer covering the aperture with noticeably distinct ornamentation; typically a different pattern on the aperture than on the surface of the grain	 (Hesse, et al.)

Dicentra spectabilis (Papaveraceae)
9. aperture
Picture credit: Halbritter H.

Colporus	Compound aperture composed of a colpus and pore; plural: colpori	 <p>(Hoen, P.)</p>
Colpus	Elongated aperture positioned along the equatorial region of the pollen grain or regularly distributed over the grain; plural: colpi	 <p>(Hoen, P.)</p>
Columella	Rod-like structure element often used to support the tectum. Can also be free-standing, as found in semi-tectate grains; plural: columellae;	 <p>(Hoen, P.)</p>
Exine	Outer layer of the pollen wall	 <p>(Hoen, P.)</p>
Heteroaperturate	Pollen grain with two different types of apertures; only one type of aperture is functional, serving as the site of germination; the term typically applies to pollen grains with alternating colpi and Colpori; the term heterocolpate could be used to describe a grain that has two different types of colpi (see definition below)	 <p>(Hesse, et al.) <i>Myosotis ramosissima</i> (Boraginaceae) 4, equatorial view Picture credit: Halbritter H.</p>
Heterocolpate	Pollen grains that possess two or more types of colpi, one of which differs in length and/or presence or absence of endoapertures (pori), exine thinning, invaginations or other structures	 <p>(Hoen, P.)</p>
Heteropolar	Grain in which the distal and proximal faces of the exine are different, either in shape, ornamentation or apertural system; the red line in the image divides the proximal and distal faces of the grain, divided at the level of the pore	 <p>(Hoen, P.)</p>

Isopolar	Grain in which the proximal and distal faces of the exine are alike	 <p>(Hoen, P.)</p>
Lacuna Lophae a/k/a "Fenestrate"	Depressed area surrounded by ridges (lophae) in lophate pollen grains; plural: lacunae Window-like pattern of ridges (=lophae) formed by an outer exine surrounding window-like spaces or depressions	 <p>(Hesse, et al.)</p> <p><i>Pfaffia gnaphaloides</i> (Amaranthaceae) 1. hydrated pollen grain Picture credit: Halbritter H.</p>
Lumen	General term for space enclosed by muri (depicted in light blue); plural: lumina	 <p>(Hoen, P.)</p>
Nexine	The inner, non-sculptured part of the exine, which lies below the sexine	 <p>(Hoen, P.)</p>
Parasyncolpate Parasyncolporate	Grain with apertures that are split and attach to the adjacent aperture creating a triangular shape at the pole	 <p>(Hesse, et al.)</p>  <p>(Hoen, P.)</p>
Pore	The endoaperture(s) situated at the equator or disbursed evenly over the pollen grain	 <p>(Hoen, P.)</p>
Pseudocolpus	Colpus in heteroaperturate pollen grains, assumed to be a non-functional aperture	 <p>(Hesse, et al.)</p>

Sexine	The sculptured outer layer of the exine	 <p>(Hoen, P.)</p>
Syncolpate Syncolporate	Grain with apertures that have been fused together at one or both poles	 <p>(Hesse, et al.) 10 µm</p>  <p>(Hoen, P.)</p>
Tectum	Outer layer of the exine; can be tectate, semitectate, or intectate	 <p>(Hoen, P.)</p>

Work Cited:

Photographs and Definitions From-

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(All SEM images from source 2; all illustrated images from Danielle Huffner of the Applied Center of Biogeography at the Florida Institute of Technology, unless otherwise cited as (Hoen, P.); Definitions used from all above mentioned sources.)