EQAT Phytoplankton

External Quality Assessment Trials Phytoplankton

Final report proficiency test phytoplankton 2023

December 2023

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&

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LANDESTALSPERREN VERWALTUNG SACHSEN

State Reservoir Administration of Saxony (LTV)

DAkkS Deutsche Akkreditierungsstelle

Content

1. Organisation

1.1. Organiser details

EQAT Phytoplankton (External Quality Assessment Trials) is an activity of the State Reservoir Administration of Saxony (LTV). The LTV is a state-owned enterprise, for which the Saxon State Ministry for Energy, Climate Protection, Environment and Agriculture is responsible. The LTV operates, administers and monitors the state's 87 reservoirs and water storage facilities. The LTV offers phytoplankton quality assessment trials every two years. This 2023 proficiency test was the **ninth** since the start of the activity in 2002. The LTV's proficiency testing laboratory is accredited for sampling from standing and flowing waters and for phytoplankton analyses in accordance with DIN EN ISO/IEC 17025:2017. It is also accredited as a proficiency testing provider in accordance with DIN EN ISO/IEC 17043:2010 since June 2013.

The following personnel has been involved in the proficiency test phytoplankton 2023 (Table 1):

Table 1. Distribution of tasks.

Task	Name	Organisation	Task
Coordinator	Dr. Elly Spijkerman	LTV	Planning, execution, communication, report
Dept. coordinator	Dr. Tilo Hegewald	LTV	Statistics
Expert committee	Dr. Gabriele Packroff	ATT	Consultant
	Dr. Arndt Mehling	ATT	Consultant
	Wolf-Henning Kusber	BGBM, FU Berlin	Taxonomy

Address of EQAT:

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Spijkerman	
Date:21.12.2023	Date:21.12.2023

1.2. Declaration of confidentiality

Independence and impartiality are fundamental prerequisites for working as a proficiency testing laboratory; only with these prerequisites can trust in the proficiency testing programmes be guaranteed. Maintaining competence and integrity are particularly important for maintaining reputation. Essential contents of the declaration of independence are therefore:

- The proficiency testing programmes are carried out to the best of our knowledge and belief on the basis of the state of the art in science and technology and in an absolutely neutral and confidential manner in accordance with the principle of equal treatment of all participants. All data are stored on a separate part of the LTV server that is only accessible by the EQAT team. All data analyses are executed without direct knowledge about the participants ID. Printed material present in the laboratory does not contain any clues towards the participant's identification.

- Any influence by third parties is excluded. The EQAT team members function independent from the LTV during the time cause of the test, so that the service and data analysis is not subject to any influence from outside or from the superior body.

- The proficiency testing laboratory and its employees are free from any commercial, financial and other influences that could affect their professional and technical judgement. The remuneration of the personnel employed does not depend on the number of tests or their results.

- It is guaranteed that the EQAT team does not engage in activities that could jeopardise confidence in the independence of the assessment and the integrity of its activities.

- In any exceptional (unlikely) event that would jeopardise the independence or impartiality of the EQAT laboratory the participants will be informed beforehand in writing.

1.3. Participants and data

We had 63 registrations for this test, of which 61 participants handed in their results on time. The 63 participants originated from 12 countries in Europe. Twenty-seven registrations originated from Germany. All gathered results from this trial that was used in the statistical analyses are provided in appendix 3, 4 and 5.

1.4. Design of the trial

This proficiency test checks the analytical performance of the participants in counting phytoplankton according to DIN EN 15204:2006 using inverted microscopy (Guidance standard using Utermöhl technique), calculation of the biovolume (possibly according to DIN EN 16695:2015) and the taxonomic determination of limnetic algae (Fig. 1).

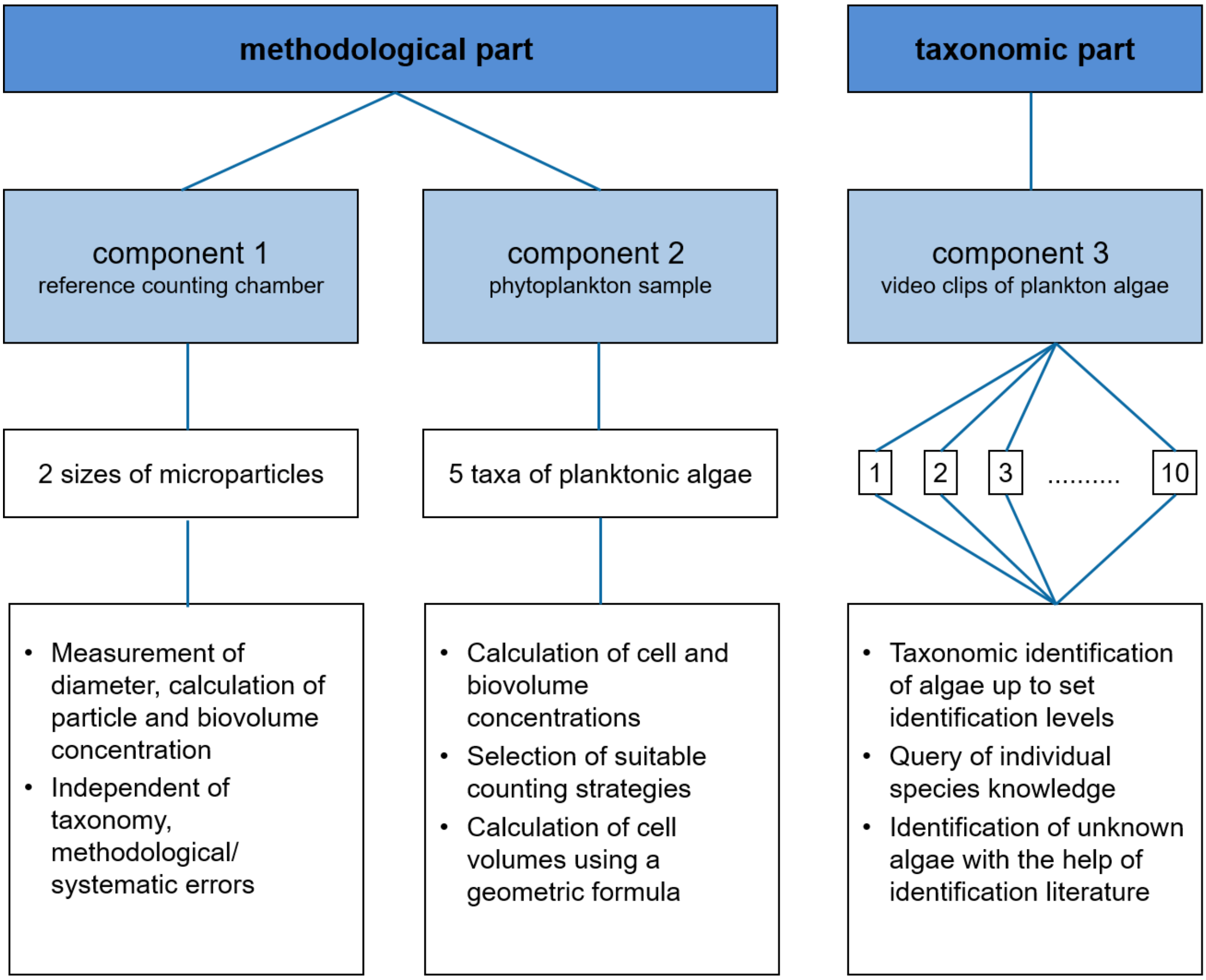


Figure 1: Visualisation of the proficiency test 2023.

1.5. Procedures for the Proficiency test Phytoplankton

The proficiency test phytoplankton was announced in December 2022, and registration on our newly developed web portal was possible from December 22nd 2022 until February 10th 2023. The natural phytoplankton sample was sent on March 27th and the reference counting chamber on June 5th. The analysis phase ran from April 4th until July 31st 2023. On August 28th, we released the preliminary results on the web site and sent a notification about this release to all the participants. Between October 27th and November 3rd 2023 the certificates and result sheets were sent to every participant. The final report was completed in December 2023 and is available on our web-site: www.planktonforum.eu.

2. Production, handling of samples and statistical tests

2.1. Metrological traceability

Microscopic size/length measurements of the LTV are metrologically traceable to the reference standard (certified object micrometer) from Olympus with the serial number AX0001 OB-M (certificate number 11514, Zeis, Oct. 2022).

2.2. Evaluation criteria

The evaluation of the EQAT phytoplankton test (components 1 and 2) follows the specifications of DIN 38402-45:2014. In order to determine the assigned target values and the comparative standard deviations, the results of all participants were used. As a method of robust statistics - these methods offer the advantage of the advantage of being able to dispense with outlier elimination - the estimation method according to HAMPEL and the Q method (calculation of the repeatability and comparative standard deviation) were used. The HAMPEL estimator is defined as the assigned target value. The comparative standard deviation calculated using the Q method is defined as the target standard deviation for the corresponding criterion. The combination of both methods guarantees an efficient and robust determination of conventionally correct values.

The quality assessment of the EQAT scheme participants is based on the deviations of their laboratory mean value from the robust target value. In order to determine the tolerance limits, we have calculated the z_u-scores. The z-score is a standardised measure of the deviation of a laboratory result from the robust mean, taking into account the comparative standard deviation. The z-scores are calculated according to the following formula:

$$z = \frac{y - \hat{\mu}}{s_{target}},$$

where y is the laboratory mean value, û the assigned target value (HAMPEL estimator) and s_{target} the target standard deviation. The z_u-score is calculated from the z-score, taking into account an asymmetric tolerance interval (Uhlig 1998). The z-scores are modified to z_u-scores using an iteratively determined factor in order to take the symmetry of the tolerance interval into account. The z_u-scores were used as exclusion limits that lead to the evaluation of the participant results: z_u-scores between -2 and +2 were rated as successful (rated as “taken part successfully”). Within this range, there is a 95% probability that the laboratory result is correct. Values that deviate further are categorised as unsuccessful and are only shown with the rating "taken part". The following handling is also considered unsuccessful:

- Non-determined EQAT components
- Results from subcontracting to an external laboratory

The robust mean and standard deviations, tolerance limits and z_u-scores by Q-method and HAMPEL estimator were calculated in the A45-excel sheet of © AQS Baden-Württemberg Stuttgart.

The scores for the taxonomy component (No. 3) followed the qualitative analysis in Schilling et al. (2006), which we extended with a qualification when only the genus level was required (Table 2). The participants were successful in this component when an 80% score was realised (i.e. 8 out of 10 points score).

Table 2. Qualitative scores used for the taxonomy component (3).

Points	Qualification
1	Species or genus correct
0.83	Species required, genus correct. Species not specified („sp.“)
0.67	Species required, genus correct. Species wrong
0.5	Genus required, but wrong. Next taxonomic level correct
0.33	Species required, species and genus wrong. Next taxonomic level correct
0	Next taxonomic level wrong (or not provided)

Figures were produced in R (R Core Team, 2017) using the packages tidyr (V 1.2.0) and ggplot2 /tidyverse (2016). Results are typically shown in boxplots where the mean value is shown as a small, orange box. The whiskers range up to the minimum and maximum of the data extremes. Values off-scale are included in the analyses but excluded from the figure and the mean is mentioned in the figure legend.

2.3. The reference counting chamber

The numbers, size and distribution of the particles on bottom coverslip of the reference counting chamber were set by the EQAT laboratory. The production was carried out by TSO Thalheim Spezialoptik GmbH, Pulsnitz on the basis of subcontracting. The reference counting chamber consists of a counting chamber embedded in a base plate. The counting chamber consists of a bottom coverslip mounted to the base plate by a threaded metal ring (Fig. 2). The bottom coverslip has a defined number of differently sized, micro particles engraved as set by us. The numbers and sizes of particles on the reference counting chamber are true target values and the chamber can support future internal quality assessment in the participants' laboratory.

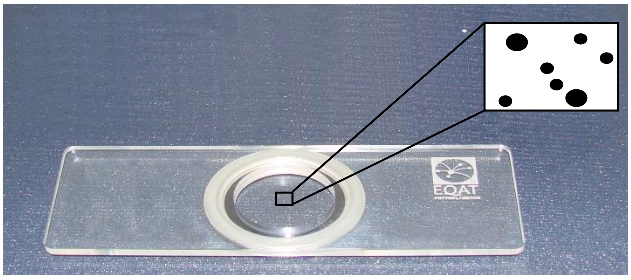


Figure 2: Reference counting chamber for the enumeration and the calculation of volume concentration of the micro particles, which are engraved on the bottom coverslip.

The EQAT team set the number, size and distribution of two different size-classes of micro particles (Table 3).

Table 3. Diameter and particle concentration (assuming 10 mL sedimentation volume) set to be engraved in the bottom coverslip of the reference counting chamber.

	Particles large	Particles medium
Diameter (µm)	30	20
Number (Particles /L)	7,500	300,000
Volume concentration (mm^3 /L)	0.106	1.257

The distribution of the particles on the bottom coverslip was specified for every particle size using a Poisson distribution. After this, every distribution was checked for overlapping particles. Ten randomly selected reference counting chambers were subjected to a quality check by the EQAT laboratory (Table 4).

Table 4. Diameter and particle concentration (assuming 10 mL sedimentation volume) measured in the reference counting chamber by the EQAT laboratory on May 31st 2023. Mean of 10 different chambers for number and volume concentration ± SD, 3 chambers with 20 measurements of diameter.

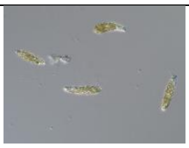
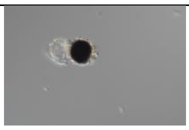
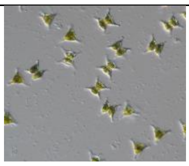
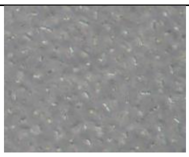
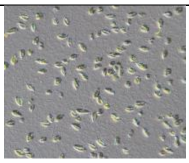
	Particles large	**Particles medium**
Diameter (µm)	28.8 ± 0.2	18.1 ± 0.1
Number (Particles /L)	7,510 ± 94	309,000 ± 15,454
Volume concentration (mm³ /L)	0.094 ± 0.002	0.964 ± 0.052

Our measurements were mostly close to the set values, but most importantly, variation between reference counting chambers was very low. The reference counting chambers were therefore shipped on 5 June 2023.

2.4. Phytoplankton sample

The aim was to provide an almost "natural phytoplankton sample", which we made of mixing five different mono-algal cultures (Table 5). Approximate target concentrations were set before homogeneously mixing the culture and subsequently fixing with a basic Lugol's solution according to DIN EN 15204:2006. Several control counts were made for every single algal culture before mixing them together in a large vessel in the desired density. From this large vessel, the 100 mL sample bottles were filled with 85 mL Lugol-fixed sample by using five shifted fills with well-mixed suspension. After filling all necessary sample bottles, ten bottles were randomly selected for homogeneity inspection and three bottles were selected for stability.

Table 5. Taxonomic composition of the phytoplankton sample, with a photo and the origin of the culture.

No.	**Photo**	**Name**	**Strain No.**	**Origin**
1		*Euglena gracilis*	CCAC 2359 B	CCAC University of Cologne
2		*Peridinium cinctum*	CCAC 0102 B	CCAC University of Cologne
3		*Staurastrum chaetoceras*	CCAC 1371 B	CCAC University of Cologne
4		*Pseudanabaena sp.*	CCAC1777B	CCAC University of Cologne
5		*Mallomonas akrokomos*	SAG84.88	SAG Culture Collection of Algae at Göttingen University

2.4.1.Homogeneity test

To ascertain that the variability between phytoplankton samples was smaller than that within, the cell number of *Staurastrum chaetoceras* (Species No. 3) was checked in 10 randomly selected sample bottles (Fig. 3). On March 1st and 2nd 2023, all 10 homogeneity flasks were counted in 2-fold. This means that for every single bottle, 2 times 10 mL was sedimented and from every chamber 2 transects at a 200-fold magnification were counted. The mean value found from these 20 counts was 129, whereas the minimum was 109 and the maximum 171 (Fig. 3).

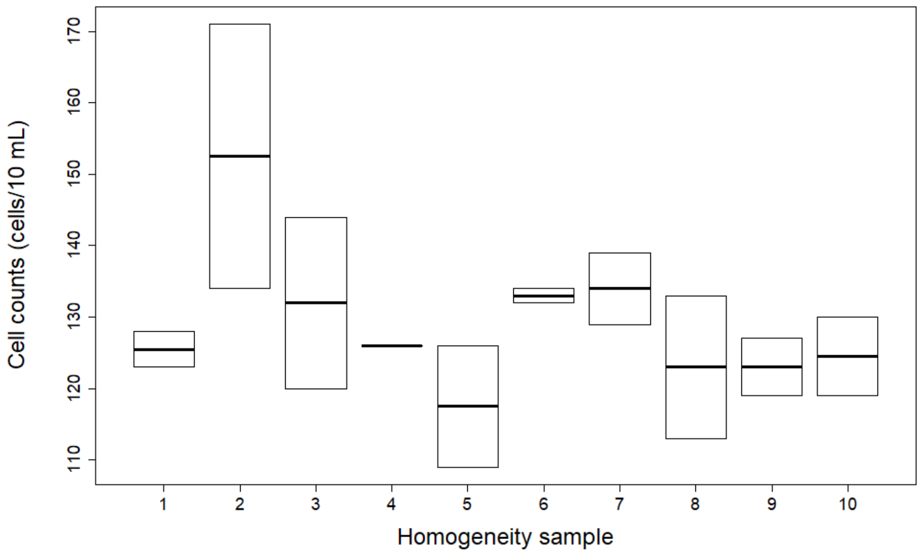


Figure 3: Cell counts of *Staurastrum chaetoceras* for the homogeneity test. Counts from 10 randomly selected sample bottles (n=2). Please note that the y-axis does not start at zero.

The homogeneity was checked using the data analysis spreadsheet of © AQS Baden-Württemberg Stuttgart, which complies with the DIN ISO 13528:2015 standard. The homogeneity was valid with an expected standard deviation for the proficiency assessment of 19.4. The within sample standard deviation was 12.1 and the between sample deviation 4.5, showing that expected variation within 1 bottle was larger than between bottles. We subsequently posted the natural sample to the participants on March 27th, 2023. Although we only tested 1 out of 5 species, there are no reasons why the homogeneous distribution of *Staurastrum* would not be similarly valid for the other algae species.

2.4.2. Stability test

Three sample bottles were randomly selected after filling all sample bottles, and these were used to ascertain stability of the cell concentration and biovolume of the phytoplankton sample over the course of the test-period. The three sample bottles were analysed in 3-fold on 11.4., 9.6., and 24.7.2023, covering the whole analysis period. On every occasion, the same counting strategy was used, similarly as done by the participants. The stability of the cell concentration in the sample was confirmed by showing that the median cell concentration of every species on every date did not exceed the tolerance limits as set by the z_u-scores between -2 and +2 (Fig. 4).

From every stability sample, 20 cells per species were measured and these measurements were used to calculate a cell volume for every species using the appropriate geometric formula (following DIN EN 16695:2015). The stability of the calculated biovolume concentration in the samples was confirmed by showing that the median values did not exceed the tolerance limits as set by the z_u-scores between -2 and +2 (Fig. 5).

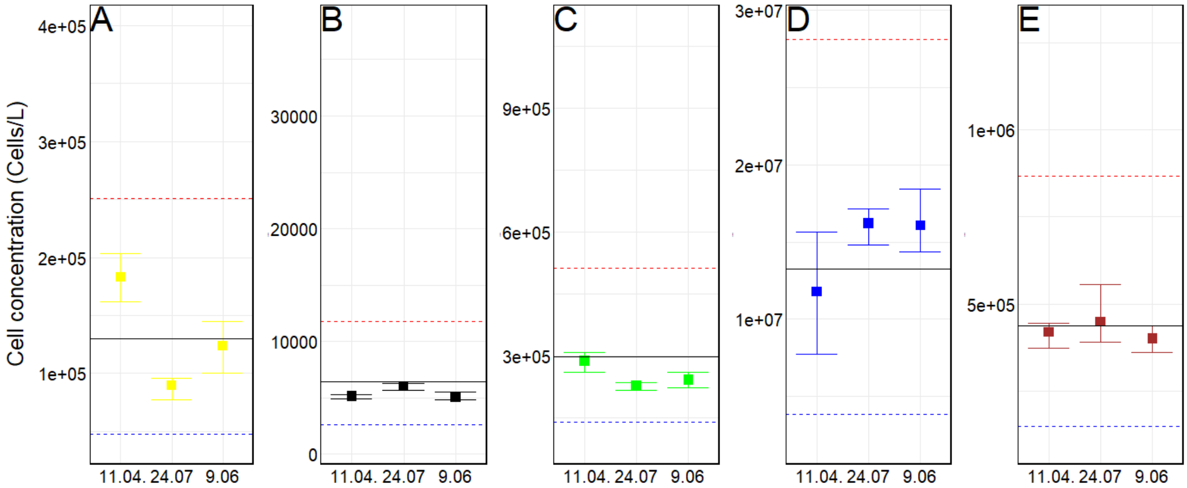


Figure 4: Cell concentrations of the five species in the phytoplankton stability samples. Data points are the mean values and the whiskers reach up to the minimum and maximum value. The robust mean, lower and upper tolerance limits are given as horizontal lines (black, blue and red, respectively). The date of counting is provided under the x-axis (all in 2023). Dates cover the whole analysis period (i.e. April 4th until July 31st 2023). A, species 1; B, species 2; C, species 3; D, species 4; E, species 5.

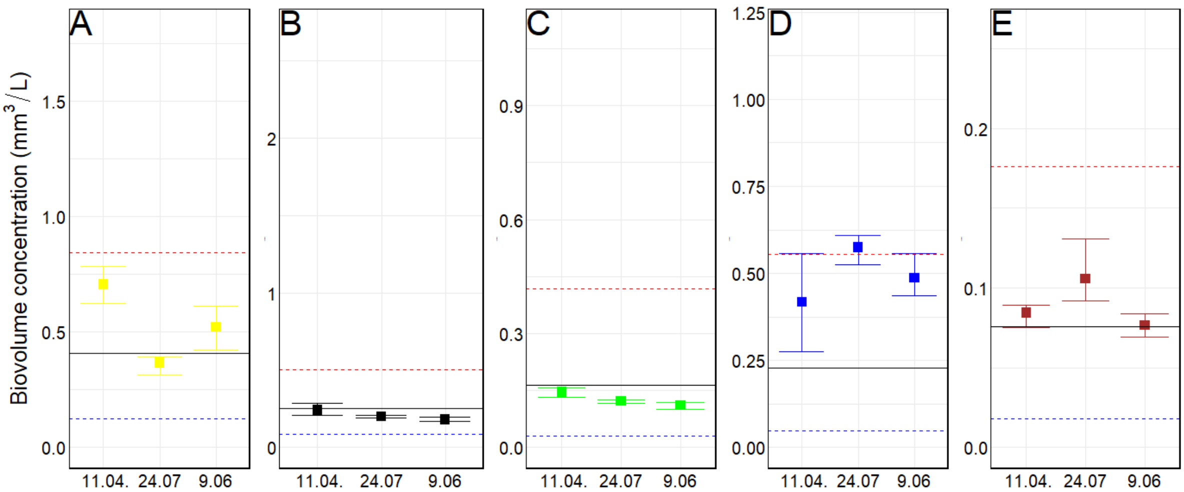


Figure 5: Biovolume concentration of the five species in the phytoplankton stability samples. Data points are the mean values and the whiskers reach up to the minimum and maximum value. The robust mean, lower and upper tolerance limits are given as horizontal lines (black, blue and red, respectively). The date of the measurement is provided unter the x-axis. Dates cover the whole analysis period (i.e. April 4th until July 31st 2023). A, species 1; B, species 2; C, species 3; D, species 4; E, species 5.

An additional stability test was performed by using a returned package that had been in the post and was falsely stored for 4-5 weeks (called “post sample”). The last participant received the package with the natural sample mid May, and therefore the returned “post sample” was stored in the fridge at that moment until analysis. The post sample had been sent to a non-existing address in Europe, returned at EQAT and was stored at room temperature until May 15th. This treatment was considered a “worst-case-scenario”. The “post sample” was analysed on June 6th 2023, shortly before the 2nd stability sample (analysed at 9.6.2023) to be able to compare both. The stability of the cell concentration in the post sample was confirmed by showing that the median values did not exceed the tolerance limits as set by the z_u-scores between -2 and +2 (Fig. 6).

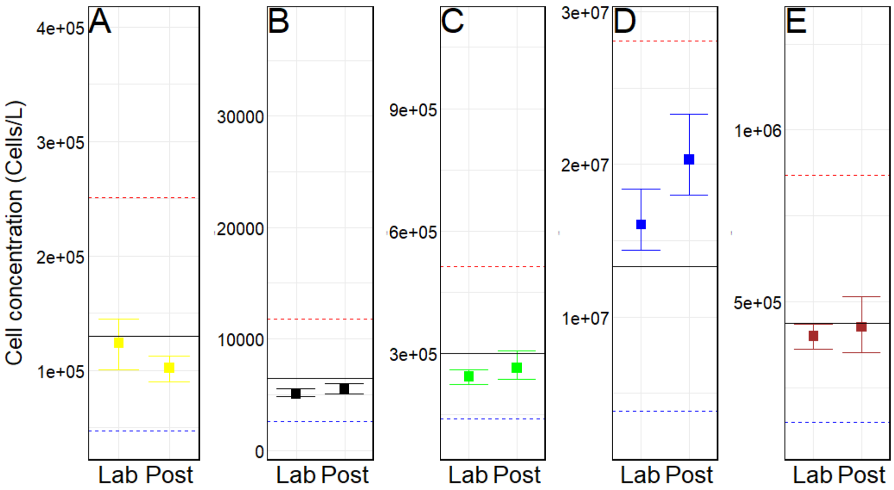


Figure 6: Cell concentrations of the five species in the phytoplankton stability samples. Data points are the mean values and the whiskers reach up to the minimum and maximum value. The robust mean, lower and upper tolerance limits are given as horizontal lines (black, blue and red, respectively). The "lab"label refers to the stability sample counted on 9.6.2023. The "post"-label refers to the returned postal package counted on 6.6.2023. A, species 1; B, species 2; C, species 3; D, species 4; E, species 5.

Similar to the procedure for the stability sample, 20 cells per species were also measured in the "post sample" and calculated into a biovolume concentration for every species (Fig. 7). The stability of the calculated biovolume concentration in the post sample was confirmed by showing that the median values did not exceed the tolerance limits as set by the z_u-scores between -2 and +2 (Fig. 7).

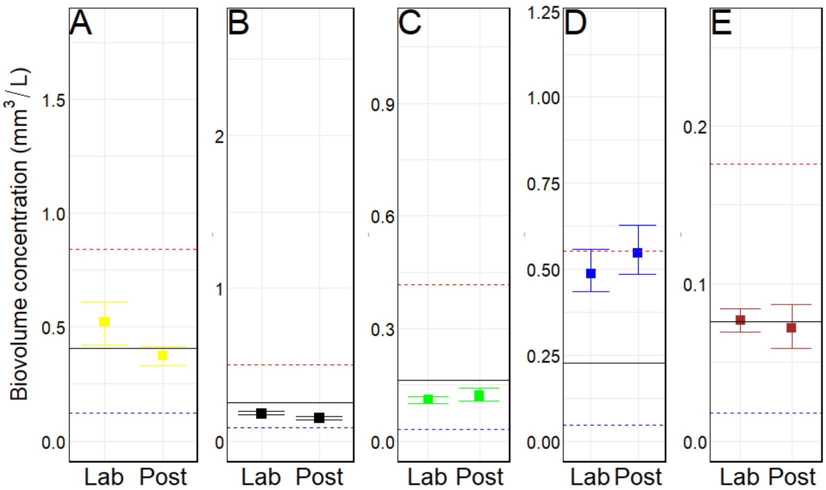


Figure 7: Biovolume concentration of the five species in the phytoplankton stability samples. Data points are the mean values and the whiskers reach up to the minimum and maximum value. The robust mean, lower and upper tolerance limits are given as horizontal lines (black, blue and red, respectively). The "lab"label refers to the stability sample counted on 9.6.2023. The "post"-label refers to the returned postal package counted on 6.6.2023. A, species 1; B, species 2; C, species 3; D, species 4; E, species 5.

2.5. Video clips

A great number of video clips from individual phytoplankton species were made by the EQAT laboratory. A selection of 35 videos were sent to Wolf-Henning Kusber (Freie Universität Berlin, Botanischer Garten Berlin und Botanisches Museum) for taxonomic evaluation (on a subcontract basis). Based on his evaluation report (received 22.11.2019) we made a selection of 10 taxa. Nine taxa were pre-assigned for determination on the species level and one taxa for determination at the genus level.

3. Results & Discussion

For counting a reliable number of particles, the norm asks us to count at least 40 units for every dominant organism, but up to 200 units is considered optimal to comply with a maximum of 20% measurement uncertainty. For every parameter we calculated the specific measurement uncertainty (U) as follows (in which Sl is the standard deviation of reproducibility (variation between participants), Sr the repeatability standard deviation (variation within one participant) and m is the number of replicates:

$$U = 1.96 * \sqrt{\left(Sl^2 + \left(\frac{Sr^2}{m}\right)\right)}$$

3.1. Component 1: Reference counting chamber

The reference counting chamber contained spherical micro-particles in 2 different size classes. The participants had to calculate the particle concentration, measure the diameter of 20 particles and calculate the particle volume concentration per litre. To calculate a concentration a sedimentation volume of 10 mL had to be assumed. For every parameter description, we will first focus on the large particles, then the medium particles. In every figure we show the mean results as small, orange box plots for every laboratory, the robust mean value (bold black line), the lower and upper tolerance limits set at $z_u=|2|$ (blue and red dashed lines). Whiskers reach to the minimum and maximum values. Median laboratory results that were out of scale are mentioned in the legend.

3.1.1. Particle concentration

For the proper counting of the large particles, the whole chamber had to be counted, which was applied by most of the participants (Table 5). Most of the participants reported the pre-assigned value (7,500) as the robust mean was 7,361 Particles/L, although there were some exceptions (Fig. 8). Participants 9, 23, 27, 52 and 78 counted the large particles in transects or fields, which can explain their deviating result. Participants 3, 9, 23, 27, 28, 37, 52 and 78 did not count enough particles to arrive at a reliable estimate of the desired particle concentration. Participant 3 provided the results for the large and medium particles in particles per mL instead of per L. Corrected for this mistake the results of participant 3 lie well within the tolerance limits of both size classes. The applied strategies are summarized in Table 6.

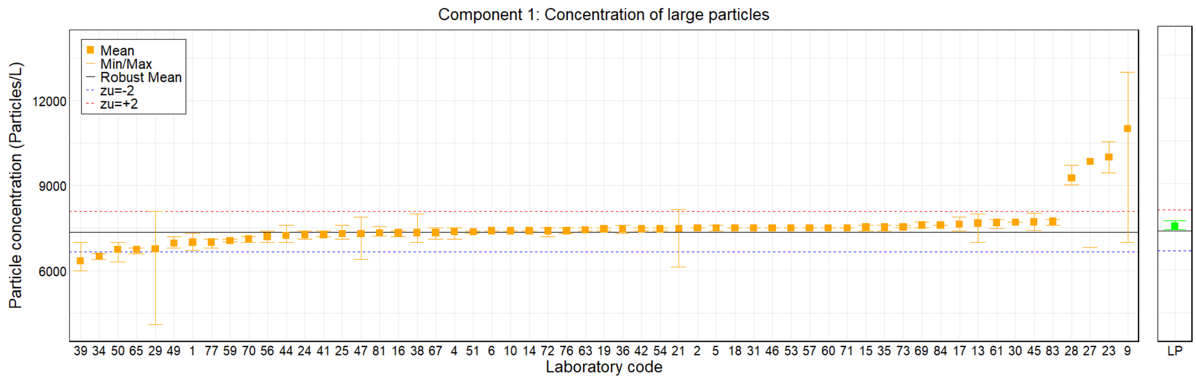


Figure 8: Large particle concentration in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 3 (7 particles/L); 78 (962 particles/L); 37 (2,300 particles/L) and 52 (34,616 particles/L). The robust mean, lower and upper tolerance limits were 7361, 6672, and 8084 Particles/L, respectively. The standard deviation of reproducibility was 5.81% and the repeatability standard deviation 0.85%. The specific measurement uncertainty (U) was 11.4%.

Table 6. Summary of counting strategies used for the large particles.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	
chamber	0.5	2	40	40	140	400	23	70	80	51
transect	2	3.2	6	100	240	400	1	7	22	5
fields	1	48.6	100	200	300	600	1	20	76	5

For the proper counting of the medium particles, 2 transects at a 100- or 200-fold magnification were sufficient for counting, which was applied by most of the participants (Table 7). With this method between 72 and 144 particles should theoretically be captured. Most of the participants reported the pre-assigned value ($30.0\ 10^4$) as the robust mean was $30.28\ 10^4$ Particles/L, although there were some exceptions (Fig. 9). Participant 52 counted not enough fields at their chosen counting strategy to arrive at a correct particle concentration. Participants 3, 52 and 78 applied the same counting strategy for both particle sizes, which does not apply to the DIN EN 15204. Not adapting the counting strategy according to the number and distribution of the particles increases the chances of a wrong result. Participants 3, 37 and 52 did not count enough particles to arrive at a reliable estimate of the desired particle concentration.

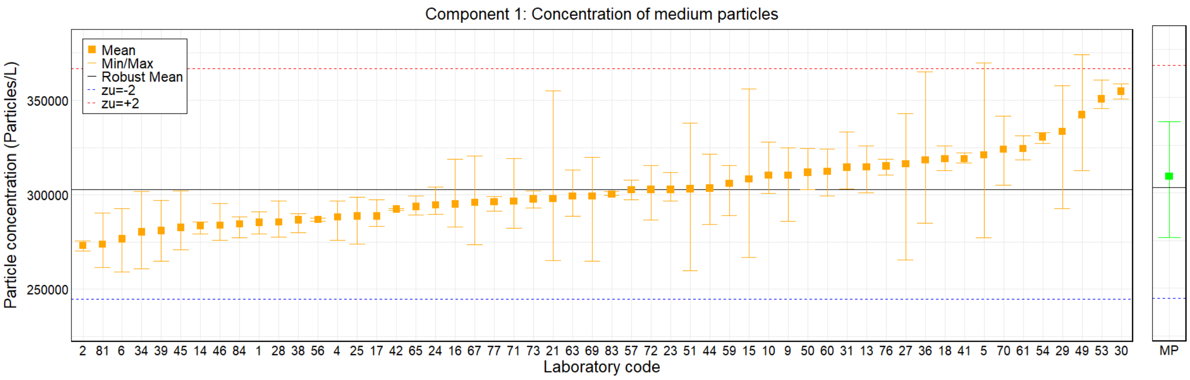


Figure 9: Medium particle concentration in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 3 (256 particles/L), 35 (6,633 particles/L), 37 (28,567 particles/L), 19 (30,800 particles/L), 78 (32,423 particles/L), 52 (510,594 particles/L) and 47 (593,254 particles/L). The robust mean, lower and upper tolerance limits were 302,777, 244,874, and 366,775 Particles/L, respectively. The standard deviation of reproducibility was 10.01% and the repeatability standard deviation 3.84%. The specific measurement uncertainty (U) was 20.1%.

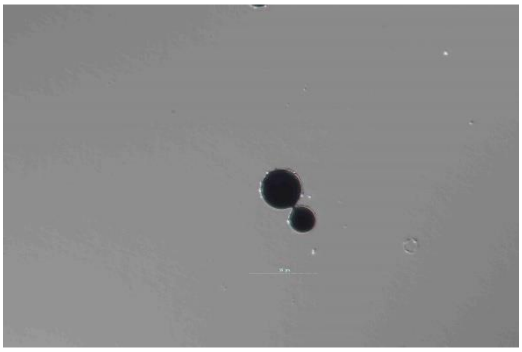
Table 7. Summary of counting strategies used for the medium particles.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	
chamber	0.25	25	50	200	200	200	250	482	728	2
transect	1	2.9	20	100	253	600	34	207	592	40
fields	10	89.1	315	50	246	600	18	252	561	19

In conclusion: Deviations from the robust mean were predominantly caused by choosing an improper counting strategy or by counting too few particles within the selected counting strategy to arrive at a correct particle concentration. Do not forget to adapt your counting strategy according to the number and distribution of the particles, otherwise the probability of an incorrect result will increase.

3.1.2. Diameter

Although we intensively checked ten reference counting chambers before sending the packages to the participants, and although we checked for overlapping particles in our calculations, we could still find particles that were connected (see photo below). These minor exceptions were no problem to count and determine the diameter of the two particle sizes properly.



Only one participants measured a too small diameter (No. 14) and two participant a too big diameter (Nos 10 and 65) for the large particles (Fig. 10). The pre-assigned value (30 µm) was very close to the robust mean of 29 µm.

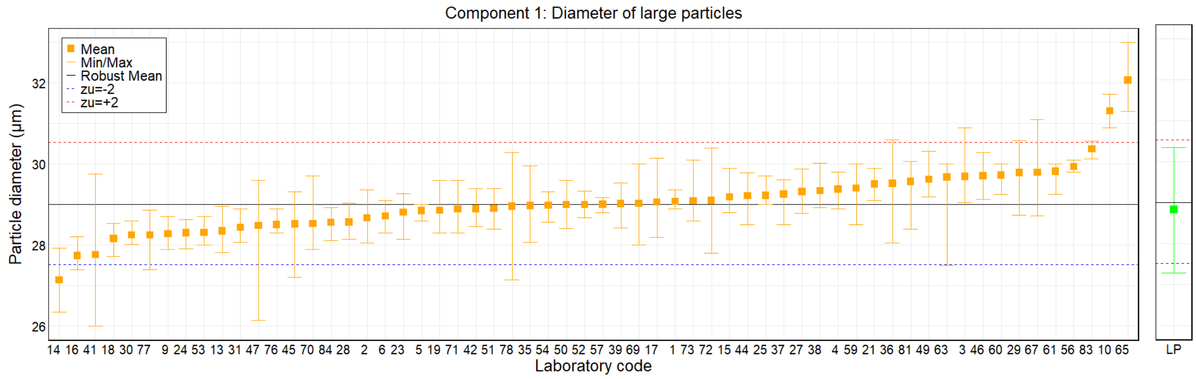


Figure 10: Diameter of the large particles in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. The robust mean, lower and upper tolerance limits were 29, 27.52, and 30.53 µm, respectively. The standard deviation of reproducibility was 2.59% and the repeatability standard deviation 0.98%. The specific measurement uncertainty (U) was 5.1%.

For the medium particles participant no. 14 again measured a too small diameter and participants 65 and 83 a diameter that was too large (Fig. 11). The pre-assigned value (20) was close to the robust mean of 18.82 µm.

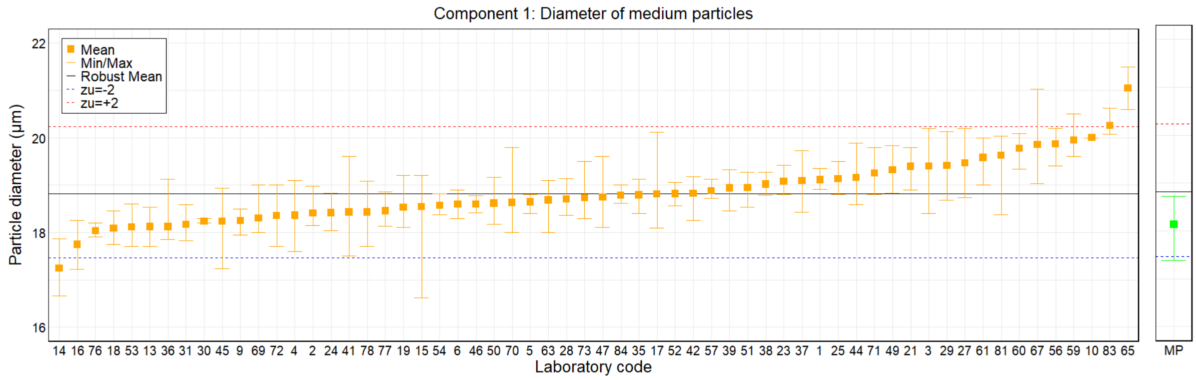


Figure 11: Diameter of the medium particles in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. The robust mean, lower and upper tolerance limits were 18.82, 17.46, and 20.23 µm, respectively. The standard deviation of reproducibility was 3.68% and the repeatability standard deviation 1.33%. The specific measurement uncertainty (U) was 7.2%.

We made a quick comparison when the mean instead of the median diameter was used to calculate the particle volume. The DIN EN 16695:2015 recommends using the median value, whereas we asked to provide the mean value (in component 2). For large particles the median diameter deviated -1.7 (participant 81) up to +2.7% (participant 41) from the mean value, which translated into deviations for the spheric volume between -5.1 and +8.0%. For medium particles the median diameter deviated -2.6 (participant 41) up to +1.5% (participant 36) from the mean value, which translated into deviations for the spheric volume between -7.9 and +4.4%. Although the deviations are not too big because we demanded 20 measurements, the calculation with the median will be more appropriate for daily routine.

In conclusion: Participants 14 and 65 should check their microscope calibration or measuring method as their values consistently deviated from the mean diameter of both large and medium particles.

3.1.3. Volume concentration

The pre-assigned value for volume concentration (0.106 mm^3/L) of large particles was close to the robust mean of 0.096 mm^3/L (Fig. 12). The participants calculated the volume concentration in mm^3 per litre from their particle concentration and particle volume measurement. Participant 37 calculated an 10-fold too low value and participants 54 and 81 had an 1000-fold higher entry. Participants 9, 23, 27, 31, 52 and 78 had too high volume concentrations. For participant 31 this was caused by an error in completing the results sheets, which also happened with the volume concentration of the medium particles. Possibly, the too high volume concentration in the results from participants 23, 27 and 52 origins from the overestimation in particle concentration. Similarly, the underestimation of the volume concentration of participant 37 could originate from the too low particle concentration for large particles.

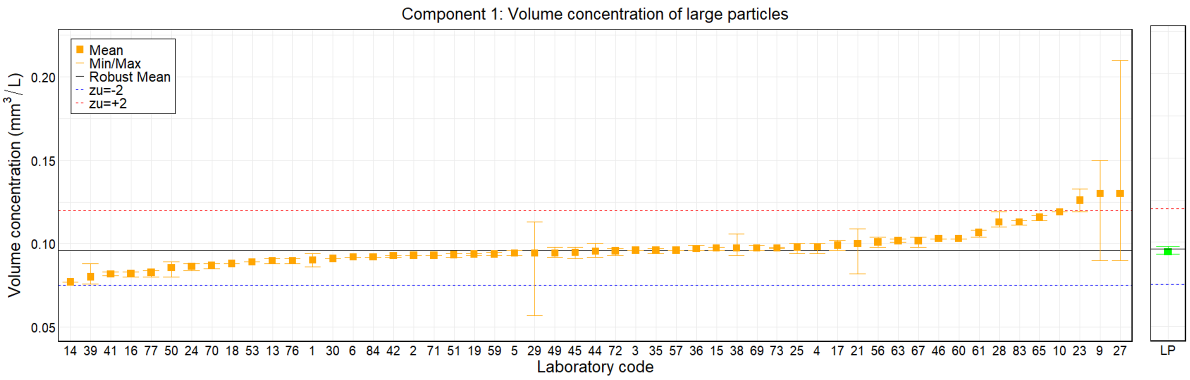


Figure 12: Volume concentration of large particles in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 37 (0.013 mm^3/L), 52 (0.442 mm^3/L), 31 (0.476 mm^3/L), 78 (5.56 mm^3/L), 54 (95.1 mm^3/L) and 81 (99.1 mm^3/L). The robust mean, lower and upper tolerance limits were 0.096, 0.075, and 0.12 mm^3/L, respectively. The standard deviation of reproducibility was 11.75% and the repeatability standard deviation 2.586%. The specific measurement uncertainty (U) was 23.2%.

For the medium particles (Fig. 13), the robust mean was 1.059 mm^3/L, whereas the pre-assigned value for volume concentration 1.257 mm^3/L was. Two participants calculated a lower value (Nos 14 and 31) and participants 54 and 81 again had an 1000-fold higher entry. In addition, participants 52, 65 and 78 overestimated the volume concentration. Possibly, the too high volume concentration in the results from participants 52 and 78 origin from the overestimation in particle concentration, whereas for participant 65 it could result from the higher particle diameter.

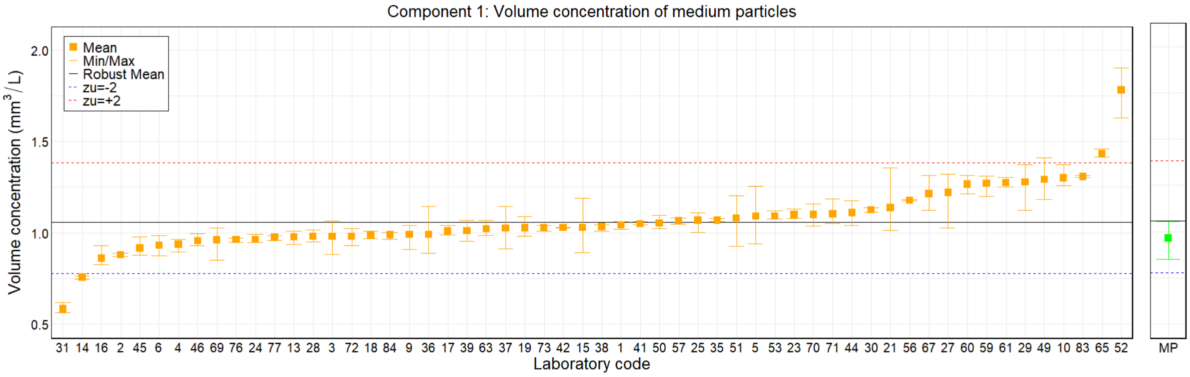


Figure 13: Volume concentration of medium particles in the reference counting chamber. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 78 (47.84 mm^3/L), 81 (1,084 mm^3/L) and 54 (1,108 mm^3/L). The robust mean, lower and upper tolerance limits were 1.059, 0.778, and 1.383 mm^3/L, respectively. The standard deviation of reproducibility was 14.14% and the repeatability standard deviation 4.99%. The specific measurement uncertainty (U) was 28.3%.

In conclusion: Some deviations in the volume concentrations could have originated from a deviation in either the particle concentration or the particle diameter. Some deviations with a factor of 1000 could result from calculation mistakes.

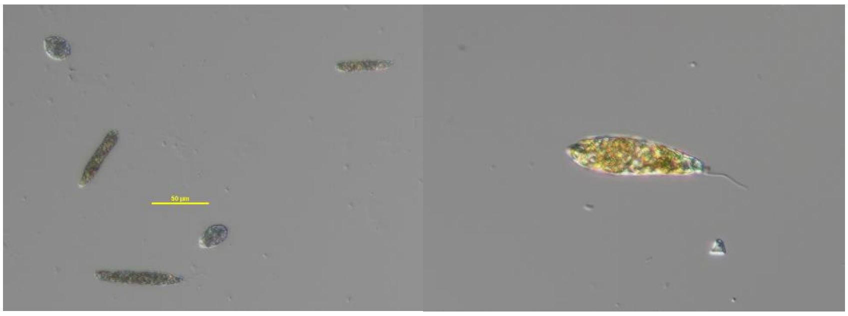
The majority of participants performed very well in component 1. Only 14 participants of 61 failed some parts of this component (23%, by an >80% overall score). In total 6 points could be scored. The major problems for not passing this component have been discussed above (choice of counting strategy, number of particles counted, calculation mistakes, and wrong entry of the data). Participants with deviating results (z_u<-2 or z_u>+2) should critically examine the their relevant phytoplankton analysis routines and change them if necessary.

3.2. Component 2: Phytoplankton sample

In the mixed algal sample (Table 5), the cell concentration and the biovolume concentration from five phytoplankton species is evaluated. The participants also reported the number of cell counts, geometric shape, cell volume and counting strategy for every species in the sample. We advised to sediment 10 mL sample volume. In every figure we show the results as small orange box plots for the mean of every laboratory, the robust mean value (bold black line), the lower and upper tolerance limits set at z_u=|2| (blue and red dashed lines). Whiskers reach to the minimum and maximum value. Mean laboratory results that were out of scale are mentioned in the legend. Results were analysed according to DIN 38402-45:2014 (see paragraph 2.2. for details).

3.2.1. Cell concentration

The species No. 1 was *Euglena* sp. and the robust mean was 1.30 10^5 cells/L (Fig. 14). Participant 37 reported a too low cell concentration for reaching the lower tolerance limit. Participants 1, 77 and 81 had z_u-scores higher than +2. Although the mean cell concentration provided by participant 1 was within the tolerance limits, the highest value was too high for a successful score. Participant 81 writes in the comment that the provided cell concentration includes the cysts. This can well explain the higher cell concentration for this species. The cysts should not have been included in the counting of this species. When including cysts in your counting protocol, they should be treated as a separate category within the phytoplankton. This is because quite often, the cell volume of the species and the cyst are largely different, and in the natural phytoplankton, we can often not determine the species of the cyst. Although many participants found it hard to set a border between flagellate and cyst, the specific measurement uncertainty in cell concentration of this species was well in the range between those of the other species. The photos here show the species in close-up (right) and three flagellate cells and two cysts (left).



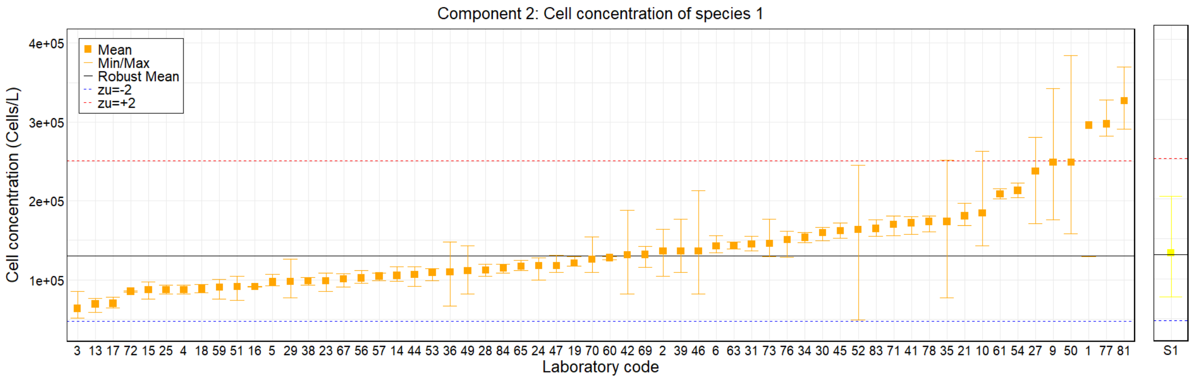


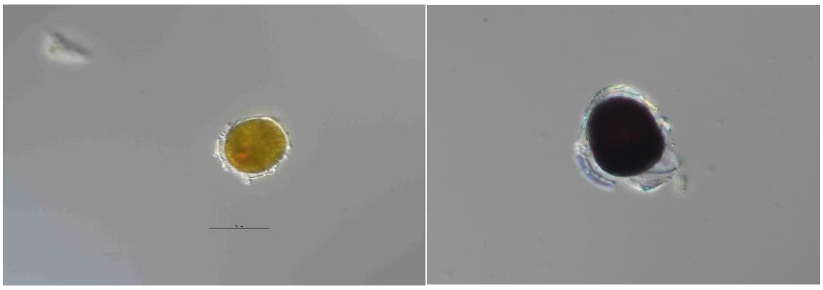
Figure 14: Cell concentration of species 1: *Euglena* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. The off-scale value is from laboratory 37 (6,267 cells/L). The robust mean, lower and upper tolerance limits were 130,173, 47,506 and 250,618 cells/L, respectively. The standard deviation of reproducibility was 36.9% and the repeatability standard deviation 11.52%. The specific measurement uncertainty (U) was 73.5%.

To check if these deviations were related to the choice for a certain counting strategy we summarized the counting strategies in Table 8. Most of the participants counted species 1 in transects, which is the preferred strategy. Some participants only counted 1 transect, which is too little. Although the number of counted particles can be sufficient, the distribution of the cells over the chamber cannot be random enough to ensure a proper estimate. For transects a minimum of 2 is correct. Participant 37 counted only 1 transect and in addition only 6, 7 and 12 cells. Both arguments can result in incorrect results. Two participants counted between 816 und 936 cells in the whole chamber. These high numbers at first sight when scanning through a chamber should trigger the participant to choose a different counting strategy. Participants 1 and 77 choose the same counting strategy for species 1, 3, 4 and 5 (31 fields at 600-fold magnification and 30 fields at 400-fold magnification, respectively). Participant 37 choose the same counting strategy for species 2, 4 and 5 (1 transects at 400-fold magnification). This inflexible arrangement for counting led to an incorrect estimate in cell concentration for all species (participant 37), for species 1 and 3 (participant 1) and only for species 1 by participant 77. The incorrect cell concentration was due to an insufficient number of cells counted in the method for the species in question.

Table 8. Summary of counting strategies used for species 1: *Euglena* sp.

counting area	**number of counting areas**			**used magnification**			**counted particles**			**number of labs**
	min	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	
chamber	0.3	24.2	100	100	275	600	4	380	936	8
transect	1	3.2	20	100	243	500	6	103	297	38
fields	20	68	193	100	267	600	2	42	117	15

The species No. 2 was *Peridinium* sp. and the robust mean was 6.4 10^3 cells/L (Fig. 15). Participants 37 and 41 reported a too low cell concentration for reaching the lower tolerance limit and participants 9, 23, 29, 34, 47, 49, 52 and 78 had too high cell concentrations. The photos below show a life cell (left) and a typical lugol-fixed cell where the scales were loosened (right).



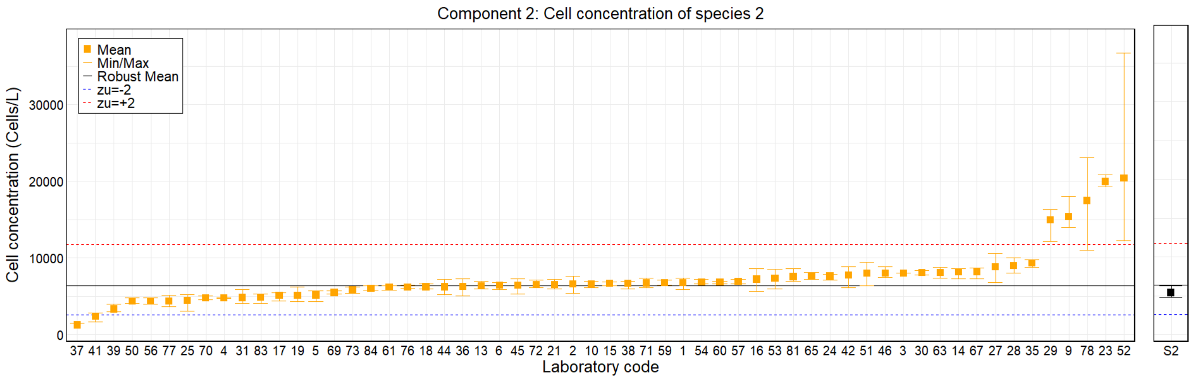


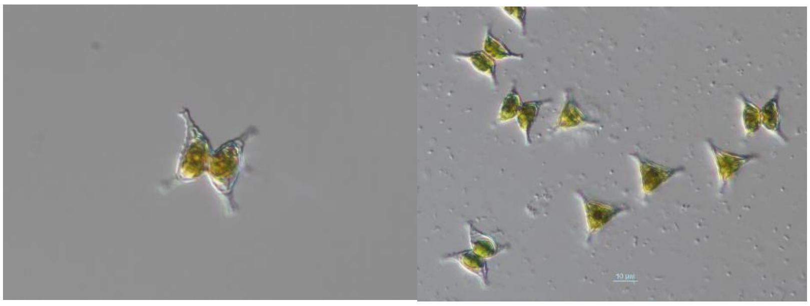
Figure 15: Cell concentration of species 2: *Peridinium* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 47 (70,084 cells/L), 49 (95,200 cells/L) and 34 (101,890 cells/L). The robust mean, lower and upper tolerance limits were 6,423, 2,624 and 11,768 cells/L, respectively. The standard deviation of reproducibility was 33.8% and the repeatability standard deviation 12.94%. The specific measurement uncertainty (U) was 67.8%.

To check if these deviations were related to the choice for a counting strategy we summarized the counting strategies in Table 9. Most of the participants counted species 2 in the whole chamber, which was the preferred strategy. For participants 9, 23, 29, 37, 49, 52 and 78 the incorrect cell concentration was due to an insufficient number of cells counted in the method for the species in question (ranging between 1 and 19 cells). Participant 49 choose the same counting strategy for all species (86.7 fields at 400-fold magnification). Participant 29 choose the same counting strategy also for species 1 and 5 (2 transects at 400-fold magnification). Participants 23 and 34 choose the same counting strategy also for species 1, 3 and 5 (100 fields at 200-fold magnification and 3 transects at 400-fold magnification, respectively). This inflexible arrangement for counting also led to an incorrect estimate in cell concentration for species 3 (participant 34) and for species 3, 4 and 5 (participant 49).

Table 9. Summary of counting strategies used for species 2: *Peridinium* sp.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	mean	max	min	mean	max	min	mean	max	
chamber	0.5	3.7	100	40	129	600	1	59	172	49
transect	1	3.3	6	100	289	400	1	30	87	7
fields	1	63.5	100	200	260	400	3	21	64	5

Species No. 3 was *Staurastrum* sp. and the robust mean was 3.0 10^5 cells/L (Fig. 16). Participant 37 reported a too low cell concentration for reaching the lower tolerance limit. Participants 1, 3, 29, 34, 49 and 50 reported too high values. The photos below shows a life cell (left) and some lugol-fixed cells with different views (right).



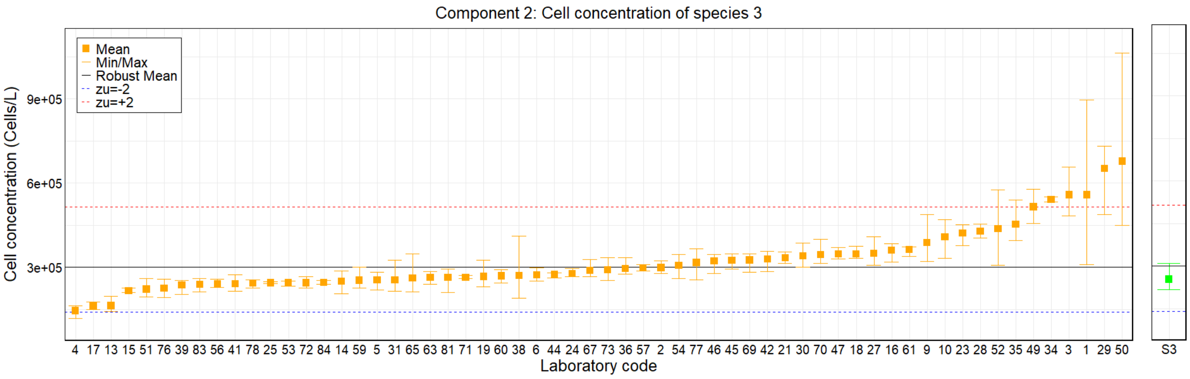


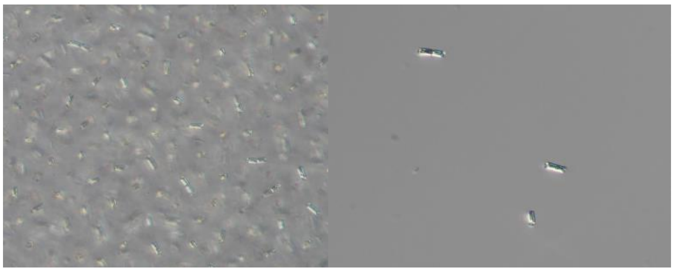
Figure 16: Cell concentration of species 3: *Staurastrum* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. The off-scale value is from laboratory 37 (56,400 cells/L). The robust mean, lower and upper tolerance limits were 299,398, 140,738 and 513,309 cells/L, respectively. The standard deviation of reproducibility was 29.79% and the repeatability standard deviation 12.52%. The specific measurement uncertainty (U) was 60.1%.

The applied counting strategies are summarised in Table 10. Most of the participants counted species 3 in transects, which was the preferred strategy. Participant 50 choose the same counting strategy also for species 1, 4 and 5 (59 fields at 600-fold magnification). Luckily, for this participant this inflexible arrangement for counting did not have any negative consequences for the cell enumeration of the other species. Participants 29 only counted 1 transect, where 2 is a minimum, that could explain the discrepancy. For participant 3 the deviating result could relate to the fact that the cell shape was described as a single tetrahedron. The unit for a single *Staurastrum* cell is however 2 semi-cells (i.e. a double tetrahedron), which would half the cell concentration.

Table 10. Summary of counting strategies used for species 3: *Staurastrum* sp.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	mean	max	min	mean	max	min	mean	max	
chamber	0.3	50.1	100	200	467	600	25	180	1017	3
transect	1	2.9	20	100	279	400	30	178	474	40
fields	1	59.4	193	40	333	600	11	104	413	18

The species No. 4 was *Pseudanabaena* sp. and the robust mean was 1.33 10^7 cells/L (Fig. 17). Participants 4, 36, 37, 49 and 84 reported a too low cell density for reaching the lower tolerance limit. The cell enumeration of species 4 had the highest specific measurement uncertainty. Photos below show the densely packed culture (left) and some single cells (right).



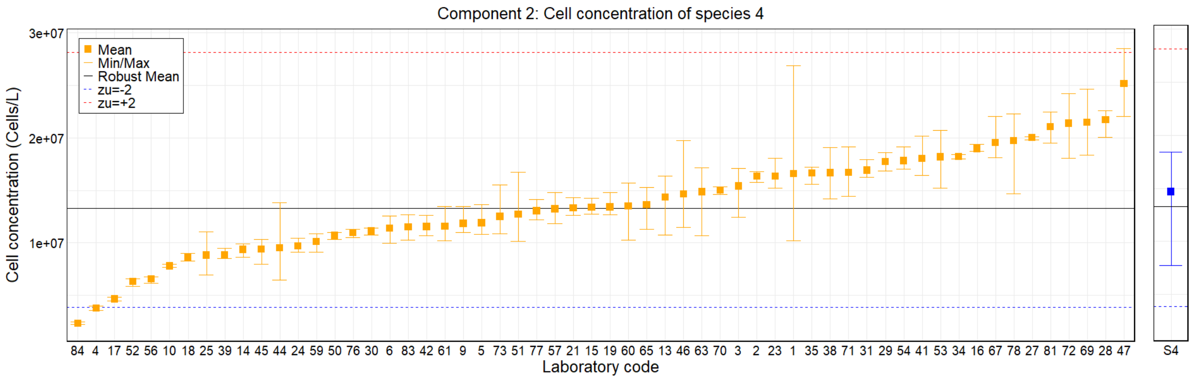


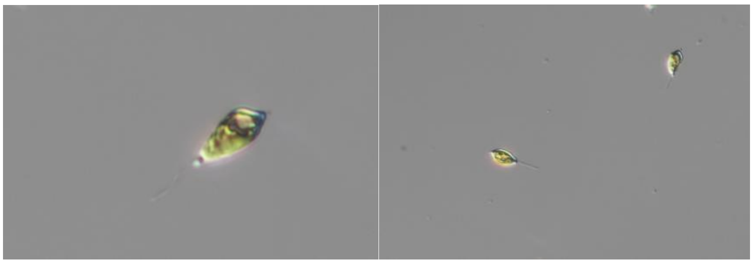
Figure 17: Cell concentration of species 4: *Pseudanabaena* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 49 (380,800 cells/L), 36 (668,157 cells/L) and 37 (754,733 cells/L). The robust mean, lower and upper tolerance limits were 13,281,225, 3,858,961 and 28,107,156 cells/L, respectively. The standard deviation of reproducibility was 43.26% and the repeatability standard deviation 9.39%. The specific measurement uncertainty (U) was 85.5%.

The used counting strategies are summarised in Table 11. Most of the participants counted species 4 in fields, which was the preferred strategy. Participant 36 counted only five fields, which can be problematic when cells are not equally distributed. Counting at least 20 fields is advisable. In addition, participant 36 used the automatic settings of its software in which *Pseudanabaena* is treated as a filament. Because the culture consisted of single cells and very short filaments, this probably resulted in the underestimation.

Table 11. Summary of counting strategies used for species 4: *Pseudanabaena* sp.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	mean	max	min	mean	max	min	mean	max	
chamber	10	30	50	600	600	600	212	240	268	2
transect	0.2	1.9	4	400	499	1000	191	1543	5016	20
fields	5	32.5	123	1	477	1000	49	2370	2370	39

The species No. 5 was *Mallomonas akrokomos* and the robust mean was 4.36 10^5 cells/L (Fig. 18). Participants 37 and 47 reported a too low cell concentration and participant 28, 49 and 81 a too high cell concentration exceeding the higher tolerance limit. The photos below show typical cells from the culture that have a deviating shape from the wild type cells normally found in the phytoplankton.



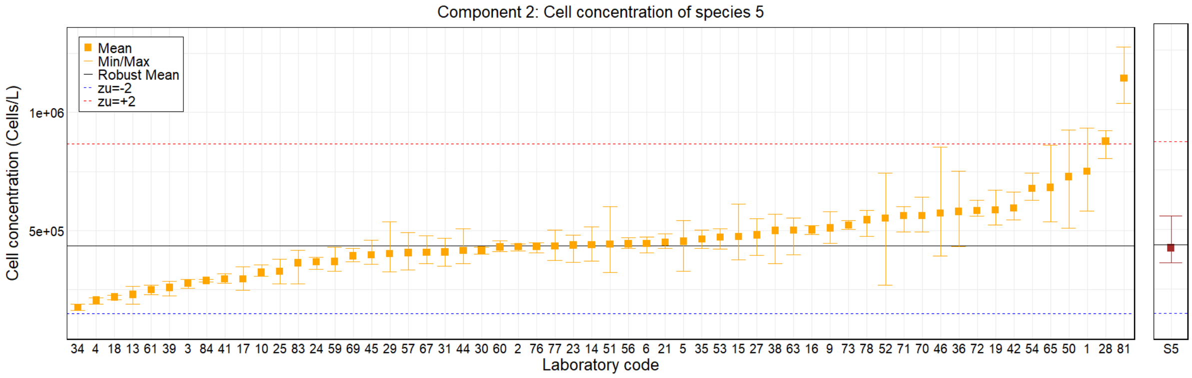


Figure 18: Cell concentration of species 5: *Mallomonas akrokomos*. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 37 (22,800 cells/L), 47 (46,086 cells/L) and 49 (10,066,267 cells/L). The robust mean, lower and upper tolerance limits were 436,548, 148,004 and 866,987 cells/L, respectively. The standard deviation of reproducibility was 38.92% and the repeatability standard deviation 13.68%. The specific measurement uncertainty (U) was 77.8%.

The counting strategies for species 5 are summarised in Table 12. Most of the participants counted species 5 in transects, which was the preferred strategy, but also fields could be chosen. Most deviations in the cell concentration were likely due to counting too little cells (Participants 28, 37, 47 and 81). On the other hand, participant 49 counted over 1000 cells, which large number can also result in deviations.

Table 12. Summary of counting strategies used for species 5: *Mallomonas akrokomos*.

counting area	number of counting areas			used magnification			counted particles			number of labs
	min	mean	max	min	mean	max	min	mean	max	
chamber	50	75	100	600	600	600	21	35	58	2
transect	1	3	20	200	394	1000	23	148	326	37
fields	20	58.4	123	200	462	630	5	140	1734	22

In conclusion: Most deviating results were caused by counting not enough cells. One cannot expect to estimate the correct cell concentration from counting less than 20 cells. To optimize the counting reliability, per taxa between 60 and 100 cells/object should be counted. The DIN EN 15204:2006 states that the total number of counted objects should be >400 (this is for total cell concentration). Another explanation for deviating results is the incorrect choice for a counting strategy. Of course, this is closely related to the number of counted cells/objects. Participants 1, 29, 34, 37, 49, 50 and 77 used the same counting strategy for many (if not all) species. One should however remember that a single counting strategy could never be correct for all species of phytoplankton. In addition, counting should always cover different parts of the chamber: For transects a minimum of 2, and for fields a minimum of 20.

The highest variation between the participants was found for species 4 (*Pseudanabaena* sp.), where the standard deviation of reproducibility was 43.3%. The highest variation within the three countings of one participants was found for species 5 (*Mallomonas akrokomos*), where the repeatability standard deviation 13.68%. The highest specific measurement uncertainty (U, 85.5%) was found for species 4 (*Pseudanabaena* sp.). Although it was expected that the variations and U were highest for species 1 (*Euglena* sp.) as a result of the presence of its cysts, this was not the case.

For interested participants, we offer an evaluation of the total cell concentration in Appendix 1.

3.2.2. Cell volume

Fifty-eight participants provided a cell volume for all species and those values were quite similar to that of the EQAT laboratory (Fig. 19). Next to the cell volume, all participants described a geometric shape used to calculate the cell volume, which will be included in our evaluation below.

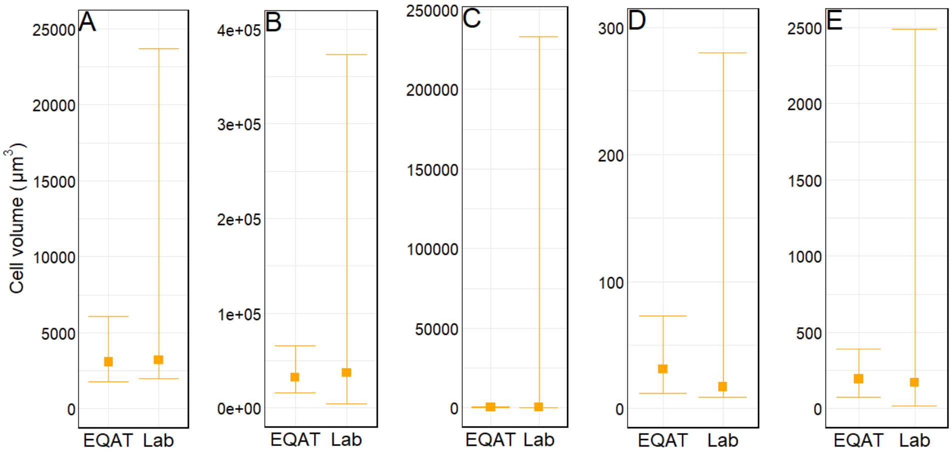


Figure 19: Cell volumes (in µm^3/cell) of the species present in the natural phytoplankton sample (component 2. $N_{participants}$=58). Summary data from the participants ("Lab") are shown directly next to those from the EQAT laboratory ("EQAT"). A, species 1; B, species 2; C, species 3; D, species 4; E, species 5.

For species 1: *Euglena* sp. the cell volume reported by the participants ranged between 1,982 and 23,700 µm^3. The median value was 3,193 µm^3. The median value of the EQAT laboratory was 3,086 µm^3 (Fig. 19).

Cell volumes strongly deviating from the median were measured by participant 52 (7,366 µm^3, based on the measurement of a single cell, and using a cylinder shape), participant 14 (11,117 µm^3) and participant 36 (23,700 µm^3). Both latter participants used an ellipsoid shape (Table 13). A minimum of 20 measurements is preferred for cell measurement. Only twenty participants used the preferred formula of a flattened ellipsoid, and only 8 used the preferred factor 0.8 for flattening. The flattened ellipsoid with a factor of 0.8 (DIN EN 16695:2015) was used by the EQAT laboratory. Most participants used an ellipsoid, which also resulted in an acceptable cell volume, although it will result in an overestimate.

Table 13. Used geometric shape used to calculate cell volume of species 1: *Euglena* sp. The bold formula is the preferred following DIN EN 16695:2015.

Formula	Number of participants	Mean cell volume (µm^3)
Flattened ellipsoid (d2=0.8*d1)	**8**	**2,845**
Flattened ellipsoid (with factor 0.82)	1	4,073
Flattened ellipsoid (with factor 0.85)	1	2,517
Flattened ellipsoid (with factor 0.65)	1	2,464
Flattened ellipsoid (with factor 0.3)	1	3,369
Flattened ellipsoid (unknown factor)	8	5,228
Ellipsoid /Spheroid	26	3,778
Spindle	8	2,925
Cylinder	1	7,366
Cone	1	2,672
Cone with hemisphere	2	4,748

For species 2: *Peridinum* sp. the cell volume reported by the participants ranged between 4,091 and 373,000 µm^3. The median value was 37,124 µm^3. The median value of the EQAT laboratory was 32,166 µm^3 (Fig. 19).

Cell volumes strongly deviating from the median were measured by participant 49 (4,091 µm^3, using the formula of a flattened ellipsoid with factor 0.8), participant 52 (72,062 µm^3 based on the measurement of a single cell and using the formula of a sphere) and participant 36 (373,000 µm^3, using a flattened ellipsoid with unknown factor). Only 8 participants used the formula of a cone with hemisphere as suggested by the DIN EN 16695:2015 for *Peridium* sp. Most participants used the formula of a flattened ellipsoid with a factor 0.82, although some participants used other or unknown factors (Table 14). For the species *Peridinium cinctum* (which was the species in culture) a sphere is suggested, which appears to overestimate the cell volume. The formula of an ellipsoid /spheroid that is suggested for some other *Peridium* species (following DIN EN 16695:2015) was used by 6 participants and the EQAT laboratory, and also resulted in a proper estimation. Although the geometric shapes listed in the DIN should be the preferred shape to calculate the cell volume, alternative shapes can be used wen found appropriate.

Table 14. Used geometric shape used to calculate cell volume of species 2: *Peridinium* sp. The bold formula is the preferred following DIN EN 16695:2015.

Formula	Number of participants	Mean cell volume (µm^3)
Cone with hemisphere	**8**	**35,421**
Sphere	7	48,664
Ellipsoid / Spheroid	6	38,359
Flattened ellipsoid (with factor 0.82)	19	34,742
Flattened ellipsoid (with factor 0.85)	3	33,142
Flattened ellipsoid (with factor 0.8)	4	34,236
Flattened ellipsoid (with factor 0.75)	1	27,491
Flattened ellipsoid (with factor 0.9)	1	40,500
Flattened ellipsoid (unknown factor)	8	76,521
Double cone	1	28,983

For species 3: *Staurastrum* sp. the cell volume reported by the participants ranged most widely between 45 and 233,043 µm^3. The median value was 526 µm^3. The median value of the EQAT laboratory was 475 µm^3 (Fig. 19).

Cell volumes strongly deviating from the median were measured by participants 3 and 37 (45 and 147 µm^3, both using the formula of a single tetrahedron), participant 65 (1,715 µm^3 using the formula of a flattened ellipsoid with unknown factor), participant 53 (2,315 µm^3, using the formula of 2 truncated cones), participants 9 and 36 (2,198 and 13,000 µm^3, using the formula of a cuboid), participant 52 (4,359 µm^3 based on the measurement of 2 cells and using the formula of a double pyramid) and participant 14 (233,043 µm^3, using a double tetrahedron). Most participants (24) used the formula of a double tetrahedron as suggested by DIN EN 16695:2015 for *Staurastrum* sp. (Table 15). This formula was also used by the LTV. Eight participants used a special formula for *Staurastrum* sp., which also resulted in a proper estimation.

Table 15. Used geometric shape used to calculate cell volume of species 3: *Staurastrum* sp. The bold formula is the preferred following DIN EN 16695:2015.

Formula	Number of participants	Mean cell volume (µm^3)
Double tetrahedron	**24**	**489**
Double tetrahedron (with factor 0.8)	1	353
(Double) tetrahedron (with factor 0.33+SQRT(6)(*a))	7	613
Tetrahedron	6	358
Tetrahedron (with factor 0.33)	1	497
Staurastrum shape (undefined)	8	746
Double truncated cone	1	2315
Truncated cone	1	1295
Double tetrahedron/cone + 6 cylinder	4	813
Double pyramid	2	2403
Cuboid	2	7599
Flattened ellipsoid (unkonwn factor)	1	1715

For species 4: *Pseudanabaena* sp. the cell volume reported by the participants ranged between 8.9 and 280 µm^3. The median value was 17.1 µm^3. The median value of the EQAT laboratory was 31.1 µm^3 (Fig. 19).

Cell volumes strongly deviating from the median were measured by participant 49 (162 µm^3, using the formula of a flattened ellipsoid with factor 0.8) and participant 36 (280 µm^3 based on the measurement with a cylinder shape). Most participants (49) used the formula of a cylinder as suggested by DIN EN 16695:2015 and the LTV also used this shape (Table 16). Participant 36 used the automatic settings of its software in which *Pseudanabaena* is treated as a filament. Because the culture shape of *Pseudanabaena* consisted of single cells and very short filaments, this resulted in a deviation.

Table 16. Used geometric shape used to calculate cell volume of species 4: *Pseudanabaena* sp. The bold formula is the preferred following DIN EN 16695:2015.

Formula	Number of participants	Mean cell volume (µm^3)
Cylinder	**49**	**23.7**
Elliptic cylinder (with factor 0.785)	1	14.3
Elliptic cylinder (with factor 0.36)	1	11.5
Elliptic cylinder (unkonwn factor)	3	21.8
Cylinder with 2 semi-spheres	1	20.8
Ellipsoid /Spheroid	2	11.3
Flattened ellipsoid (with factor 0.8)	1	161.7

For species 5: *Mallomonas akrokomos* the cell volume reported by the participants ranged between 15.6 and 2,488 µm^3. The median value was 171 µm^3. The median value of the EQAT laboratory was 194 µm^3 (Fig. 19).

Cell volumes strongly deviating from the median were measured by participant 49 (15.6 µm^3, using the formula of a cylinder), participant 36 (1300 µm^3, using the formula of an ellipsoid /spheroid) and participant 52 (2488 µm^3 based on the measurement of only two cells and using a cone shape). Most participants (28) used the formula of a spindle as suggested by DIN EN 16695:2015 for *Mallomonas akrokomos* and the EQAT laboratory also used this shape (Table 17). For other Mallomonas species in the DIN either an ellipsoid /spheroid (15 participants) or a flattened ellipsoid with a factor 0.8 (2 participants) are recommended. These shapes have also resulted in a correct estimate of the cell volume.

Table 17. Used geometric shape used to calculate cell volume of species 5: *Mallomonas akrokomos*. The bold formula is the preferred following DIN EN 16695:2015.

Formula	Number of participants	Mean cell volume (µm³)
Spindle	**28**	**165**
Flattened spindle (with factor 0.21)	1	116
Flattened ellipsoid (with factor 0.8)	2	216
Flattened ellipsoid (with factor 0.82)	1	148
Flattened ellipsoid (unkonwn factor)	4	269
Ellipsoid /Spheroid	15	204
Cone	2	1296
Cone with hemisphere	4	177
Cylinder	1	16

In conclusion: The majority of participants performed very well in this part of the proficiency test. Participants 36, 49 and 52 provided serious deviations in the cell volume of three or four taxa and should check their measurements and calculations. In addition, participant 52 measured only 1 or 2 cells for cell volume calculation, where at least 20 cells is required. For species 3 (*Staurastrum* sp.) some participants only measured the volume of one semi-cell, whereas one cell consists of two semi-cells. Although software is extremely useful and time-saving, it settings should always be checked.

3.2.3. Biovolume concentration of the phytoplankton

The participants calculated the biovolume concentration (in mm³/L) for every species from the reported cell concentration (in cells/L) and the cell volume (in µm³).

For species No. 1 the robust mean was 0.407 mm³/L (Fig. 20). Participants 14, 52, 54, 77, 78 and 81 reported a too high biovolume concentration exceeding the upper tolerance limit. Participant 78 filled in random numbers for all species, as they do not provide biovolume concentrations to their customers.

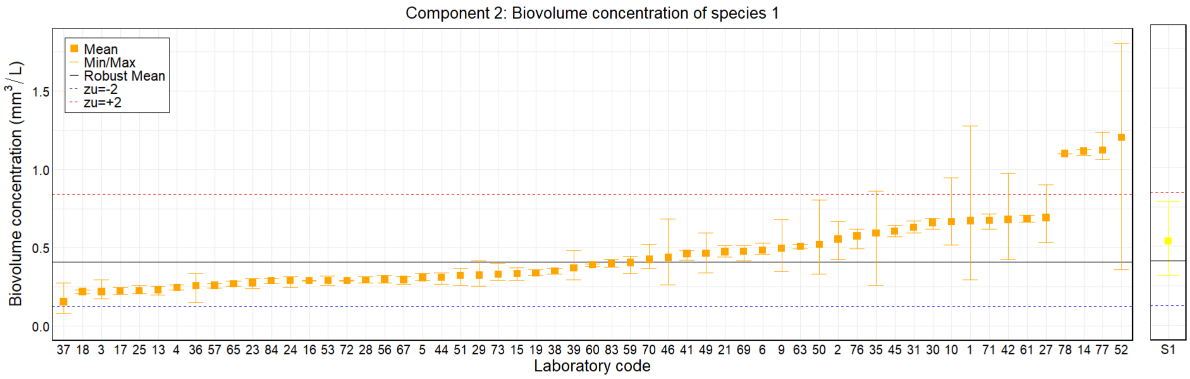


Figure 20: Biovolume concentration of species 1: *Euglena* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 54 (649 mm³/L), and 81 (1943 mm³/L). The robust mean, lower and upper tolerance limits were 0.407, 0.125, and 0.843 mm³/L, respectively. The standard deviation of reproducibility was 41.68% and the repeatability standard deviation 12.12%. The specific measurement uncertainty (U) was 82.8%.

The higher biovolume concentrations of participants 14 and 52 can be explained by their reported overestimation of the cell volume. Alternatively, participants 77 and 81 overestimated the cell concentration (Fig. 14), although this cannot explain the very high biovolume concentration given by participant 81. For participant 54 it is not clear why the biovolume concentration was overestimated, but this calculation mistake (?) was done for all species (see Figs. 21, 22, 23 and 24).

For species No. 2 the robust mean was 0.254 mm^3/L (Fig. 21). Participant 41 reported a too low biovolume concentration, whereas participants 23, 29, 37, 52, 54, 78 and 81 reported too high biovolume concentrations exceeding the higher tolerance limit.

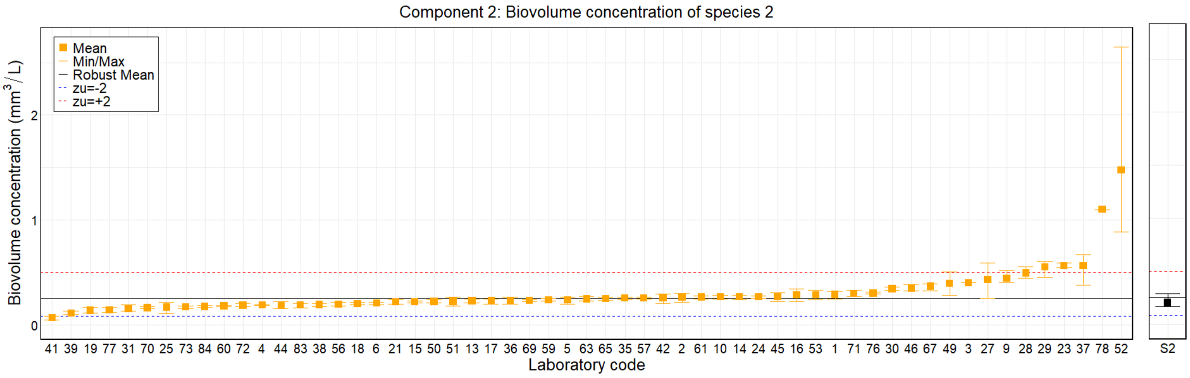


Figure 21: Biovolume concentration of species 2: *Peridinium* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 54 (273 mm^3/L), and 81 (362 mm^3/L). The robust mean, lower and upper tolerance limits were 0.254, 0.087, and 0.501 mm^3/L, respectively. The standard deviation of reproducibility was 36.56% and the repeatability standard deviation 11.18%. The specific measurement uncertainty (U) was 72.8%.

The lower biovolume concentration reported by participant 41 can be explained by their lower cell concentration (Fig. 15). The higher biovolume concentrations of participants 23, 29 and 52 likely resulted from overestimating the cell concentration (Fig. 15). For participants 37 and 81 it is not clear why the biovolume concentration was overestimated.

For species No. 3 the robust mean was 0.163 mm^3/L (Fig. 22). Participant 3 reported a too low biovolume concentration to reach the lower tolerance limit, whereas participants 1, 9, 14, 23, 28, 50, 52, 53, 54, 65, 78 and 81 provided a too high biovolume concentration exceeding the upper tolerance limit.

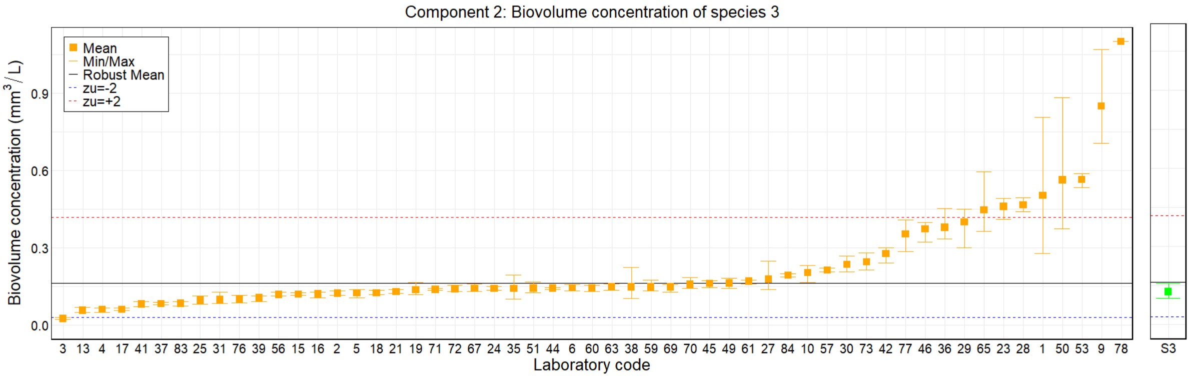


Figure 22: Biovolume concentration of species 3: *Staurastrum* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 52 (1.904 mm^3/L), 14 (58.1 mm^3/L), 54 (236 mm^3/L), and 81 (341 mm^3/L). The robust mean, lower and upper tolerance limits were 0.163, 0.031, and 0.417 mm^3/L, respectively. The standard deviation of reproducibility was 58.25% and the repeatability standard deviation 12.61%. The specific measurement uncertainty (U) was 115.1%.

The lower biovolume concentration reported by participant 3 can be explained by their 10-fold lower cell volume. The higher biovolume concentrations of participants 1 and 50 likely resulted from overestimating the cell concentration (Fig. 16). The overestimation of biovolume concentrations by participants 9, 14, 23, 28, 52, 53 and 65 could have resulted from too high cell volumes. For participant 81 it is again not clear why the biovolume concentration was overestimated.

For species No. 4 the robust mean was 0.227 mm^3/L (Fig. 23). Participant 36 reported a too low biovolume concentration to reach the lower tolerance limit. Participants 54, 72, 78 and 81 provided a too high biovolume concentration exceeding the upper tolerance limit.

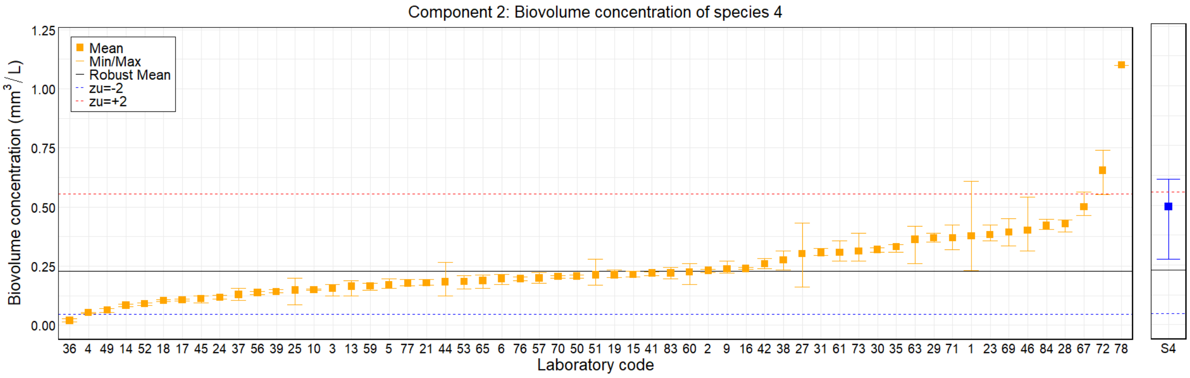


Figure 23: Biovolume concentration of species 4: *Pseudanabaena* sp. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 81 (285 mm^3/L), and 54 (336 mm^3/L). The robust mean, lower and upper tolerance limits were 0.227, 0.047, and 0.554 mm^3/L, respectively. The standard deviation of reproducibility was 54.42% and the repeatability standard deviation 10.04%. The specific measurement uncertainty (U) was 107.3%.

The lower biovolume concentration reported by participant 36 can be explained by their lower cell concentration (Fig. 17), although their reported higher cell volume for this species could have compensated to a correct biovolume concentration. The higher biovolume concentrations of participant 72 likely resulted from both a slightly higher cell concentration (Fig. 17) and cell volume. For participant 81 it is again not clear why the biovolume concentration was overestimated.

For species No. 5 the robust mean was 0.076 mm^3/L (Fig. 24). Participants 1, 28, 52, 53, 54, 65, 78 and 81 reported too high biovolume concentrations exceeding the upper tolerance limit.

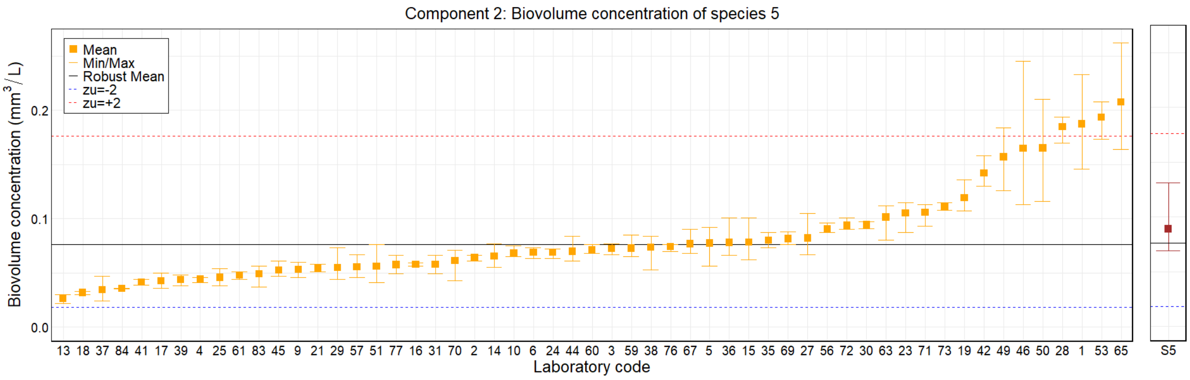


Figure 24: Biovolume concentration of species 5: *Mallomonas akrokomos*. The right panel is the result of the EQAT laboratory, whereas the left panel shows the results of the participants. Off-scale values are from laboratory 78 (1.1 mm^3/L), 52 (1.372 mm^3/L), 54 (135 mm^3/L), and 81 (400 mm^3/L). The robust mean, lower and upper tolerance limits were 0.076, 0.018, and 0.176 mm^3/L, respectively. The standard deviation of reproducibility was 49.72% and the repeatability standard deviation 12.71%. The specific measurement uncertainty (U) was 98.5%.

The higher biovolume concentrations of participants 1, 53 and 65 likely resulted from both a slightly higher cell concentration (Fig. 18) and cell volume. Alternatively, participants 28 and 81 overestimated the cell concentration (Fig. 18), although this cannot explain the very high biovolume concentration given by participant 81. For participant 52 the overestimated biovolume concentration likely resulted from the very high cell volume.

In conclusion: Some deviations in the biovolume concentration resulted from deviations in cell concentration (participants 1, 23, 28, 29, 36, 41, 50 and 77), some resulted from deviations in the cell volume (participants 9, 14, 52, 53 and 65). Participants 54 and 81 should check their calculations.

Standard deviations and uncertainties were slightly higher in the biovolume than in the cell concentration part. This results from a higher number of calculation steps in calculating the biovolume. The highest variation between the participants was found for species 3 (*Staurastrum* sp.), where the standard deviation of reproducibility was 58.3%. The highest variation within the three biovolume concentrations of one participants was again found for species 5 (*Mallomonas akrokomos*), where the repeatability standard deviation 12.7%. The highest specific measurement uncertainty (U, 115.1%) was found for species 3 (*Staurastrum* sp.). Although, also for biovolume concentration, it was expected that the variations and U were highest for species 1 (*Euglena* sp.), this was not the case.

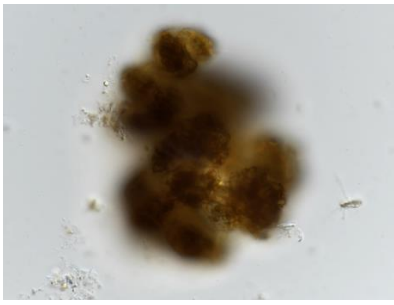
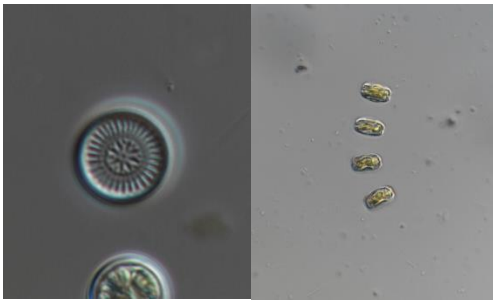
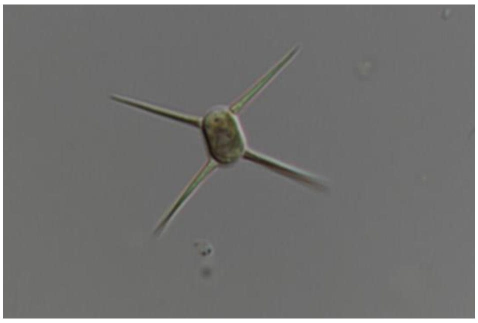
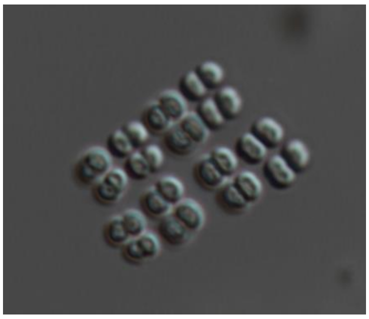
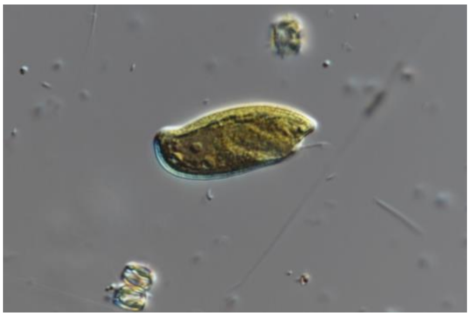
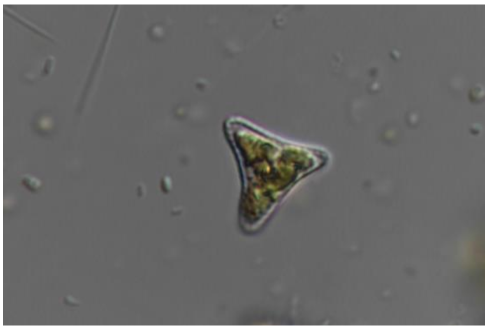
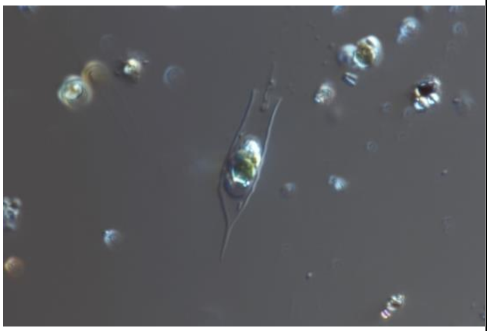
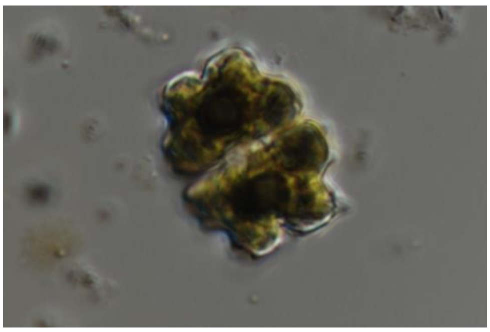
For interested participants we offer an evaluation of the total biovolume concentration in appendix 1.

The majority of participants performed very well in component 2. Only 7 participants of 61 failed the cell concentration of this component (11.5%) and 9 participants of 58 failed the biovolume concentration part (15.5%). For every part 5 points could be scored, and we set the success level on 80%. This means that one deviation from the z_u-score of |2| from the robust mean was tolerated to pass one part of this component. The major problems for not passing this component have been discussed above (choice of counting strategy, choice of geometric formula, calculation mistakes).

3.3. Component 3: Video clips / Taxonomy

This component requests the taxonomic identification of 10 limnetic algal taxa on the basis of video clips to the pre-assigned determination level. Sixty laboratories participated in this component. Most videos were recorded on Lugol-fixed material and full information (e.g. about size) was provided. In component 3 we asked for the following species or genus names (Table 18).

Table 18. List of the pre-assigned taxonomic determination levels, the preferred name and a screenshot of the video.

No.	**Determination level, name & preview**	**No.**	**Determination level, name & preview**
1	Species: *Botryococcus braunii* 	**6**	Species: *Discostella stelligera* 
2	Species: *Lagerheimia genevensis* 	**7**	Genus: *Merismopedia sp.* 
3	Species: *Bitrichia chodatii* 	**8**	Species: *Cryptomonas curvata* 
4	Species: *Stauridium tetras* 	**9**	Species: *Goniochloris mutica* 
5	Species: *Dinobryon crenulatum* 	**10**	Species: *Euastrum denticulatum* 

The overall success rate in component 3 demonstrated excellent phytoplankton identification skills by most participants (95%). Only 4 participants did not achieve the required 80% of the maximum score (10 points), as can been seen in Fig. 26.

3.3.1. Accepted synonyms and other species names

Additional to the preferred taxonomic names listed in Table 18, there were some synonym names and similar looking species that cannot be distinguished from the pre-assigned name, which we also considered to be correct.

Video 2. We accepted *Lagerheimia quadriseta* because it is given as a synonym of *Lagerheimia genevensis* in an identification book. However, the two species can be clearly separated because the video shows floating processes on small bases, which are not present in *Lagerheimia quadriseta*

Video 4. We accepted the objective synonym *Pediastrum tetras*. This is the outdated name.

Video 5. We also accepted *Dinobryon korsikovii*. The cell documented in the video is predominantly cylindrical and only very slightly spindle-shaped, which speaks in favour of *Dinobryon crenulatum*. However, if you decide for spindle-shaped in the identification key, you arrive at *Dinobryon korsikovii*. An extended description is given in section 3.3.2.

Video 6. We accepted the objective synonym *Cyclotella stelligera*. This is the outdated name. At the genus level, we accepted species names from the old genus *Cyclotella* that are not included in the new genus *Discostella*, such as *Cyclotella meneghiniana*, *Cyclotella striata* and *Cyclotella comensis*. This decision results from the use of identification literature where these species have not yet been renamed.

Video 8. We also accepted *Cryptomonas rostratiformis* and *Cryptomonas reflexa*. The size given in the identification literature for *Cryptomonas reflexa* (Huber-Pestalozzi 1968) fits the cell shown in the video better than that of *Cryptomonas curvata*. *Cryptomonas rostratiformis* and *Cryptomonas reflexa* are both given as a synonym of *Cryptomonas curvata* in the identification literature.

Video 9. We also accepted *Goniochloris pulchra*, because the two species cannot be unambiguously distinguished from each other under the light microscope.

Video 10. We also accepted the subjective=heterotypic synonym *Euastrum amoenum* F.Gay.

3.3.2. Description of the taxonomy's species

The species in video No. 1 could be identified as *Botryococcus braunii* Kütz using Komárek & Fott (1983: p. 378, plate 113: 4). Alternatively, the identification was also possible with John et al. (2011: p. 499, plate 113: fig. H). The flocculent, amorphous colony is clearly recognisable, and individual starch-containing cells in a gelatinous matrix can also be seen towards the end of the video. The cells are clearly Lugol's coloured.

The species in video No. 2 could be identified as *Lagerheimia genevensis* (Chodat) Chodat using Komárek & Fott (1983: p. 474, plate 141: 3). Alternatively, the identification was also possible with John et al. (2011: p. 488, plate 121, fig. A). The cell could be identified by the floating bristles, with one at each corner of the rectangular cell body.

The species in video No. 3 could be determined as *Bitrichia chodatii* (Reverdin) Chodat with John et al. (2011: p. 306, plate 80: fig. J) or with Starmach (1985: p. 406, fig. 852). The video shows a cell of the Chrysophyceae embedded in a lorica with processes required for floating. Identification is done by the orientation and number of floating processes.

The species in video No. 4 is described as *Stauridium tetras* (Ehrenberg) E. Hegewald in Buchheim et al. (2005). It could be determined as *Pediastrum tetras* (Ehrenberg) Ralfs with Komárek & Fott (1983: p. 303, plate 91: 5) or with John et al. (2011: p. 465, plate 119: fig. N). The plate-like arranged cells of the Chlorophyta /Pediastrum structure are clearly visible. The morphological features of the *Pediastum tetras* group (type and length of the cell wall extensions) are clearly visible.

The species in video No. 5 could be determined as *Dinobryon crenulatum* West & G.S.West with Starmach (1985: p. 228, fig. 462a) or with John et al. (2011: p. 291, plate 75: fig. L). The pointed spine of the lorica makes this species easily distinguishable from all other species with a wavy lorica (see Starmach 1985, Fig. 467). Two light olive-green chromatophores and heterokont flagellation are easily recognisable. The apical stigma on the chromatophore is unfortunately poorly recognisable. The lorica in the lower cylindrical part is wavy. The video shows a solitary species, if a colony-forming species was asked for identification, a colony would have been shown.

There may be problems with the identification of *Dinobryon crenulatum* in the identification book of Starmach (1985), because he did not use the original drawings of the first description, but later interpretations and he used the illustrations of the interpretations to create the identification keys. *Dinobryon crenulatum* has an unrealistically thin spine in the book, which is thinner than seen in the video. *Dinobryon korshikovii* has a sharpened posterior end that is significantly wider than seen in the video. Therefore, the key leads to *Dinobryon crenulatum*, although the drawing does not fit perfectly. According to the drawing, *Dinobryon korshikovii* should be excluded according to Starmach.

The following remarks on the taxonomy: In the original drawing in Korshikov (1926) he distinguishes between the nominate form (wavy) and a forma with a smooth lorica. Korshikov described the species only after a living cell without the cyst, i.e. incompletely. The lorica is spindle-shaped, but less pronounced than shown in Starmach. The spine is hollow but much narrower than shown in Starmach. Therefore, according to the original description, *Dinobryon korshikovii* does not fit perfectly either, but better than according to Starmach (1985).

The species in video No. 6 could be determined as *Discostella stelligera* (Cleve & Grunow) Houk & Klee in Houk et al. (2010: p47: Tab. 303, 304) or under its objective synonym *Cyclotella stelligera* Cleve & Grunow in Krammer & Lange-Bertalot (1991: 2/3: Plate 49: Fig. 3). The shell structure (marginal/central field clearly separated) is visible as a generic feature. The girdle view, but above all the shell structure (arrangement of the punctae in the central field) is visible as a species feature. The illustrations from the original description, which can be seen at https://diatoms.org/species/discostella_stelligera, are beautiful.

The indication of the diameter could lead to an incorrect determination. In addition to size, other exclusion criteria should always be considered, e.g. the structures of *Cyclotella pseudostelligera* are finer than those of *Cyclotella stelligera*: 18-22 radial stripes/10µm or 10-14 radial stripes/10µm, respectively. Another difficulty was the chain formation. In the identification book, point 14 in the key (p. 42) states: "Cells form colonies → *Cyclotella glomerata*". Although no chain formation is listed for *Cyclotella stelligera* in the key, the determination of *Cyclotella glomerata* is incorrect because *Cyclotella glomerata* should have columnar processes (which are not visible in the video) and the cells in the chain should be closer together. Also, the striae of *Discostella glomerata* are somewhat narrower than those seen in the video.

The genus in video No. 7 was identified as *Merismopedia* sp. Meyen. The species was probably *Merismopedia marssonii* Lemmermann in Komárek & Anagnostidis (1999: p. 172, Fig. 214). According to John et al. (2011) no species identification is possible, and according to Joosten (2006) and Hindák (2008) no clear identification is possible. Therefore, only a determination at genus level was required. The rectangular cell plate with typical Cyanobacteria structure is visible to determine the genus.

The species in video No. 8 could be determined as *Cryptomonas curvata* Ehrenb. with John et al. (2011: p. 246, plate 63: fig. B) or with Huber-Pestalozzi (1950: p. 61, fig. 43). The video shows a large cell with a clear pharynx and all the characteristics of the Cryptophyceae. The size and outline of the cell in side view can be used to determine the species. As many participants have correctly noted, taxonomic identification under the microscope is not feasible for many Crytomonads. However, the species in question is one of the few that can be determined microscopically using the identification literature.

The species in video No. 9 could be determined as *Goniochloris mutica* (A. Braun) Fott with Ettl (1978: p. 230, fig. 280) or John et al. (2011, p. 327, plate 84, fig. C). The video shows a triangular cell without green algae features (Xanthophyta). The only moderately concave sides and triangular shape are in favour of *Goniochloris mutica*. The chloroplasts are about four, which speaks in favour of *Goniochloris pulchra* Pascher. The video shows a cell in the size and with a cell wall sculpture of both *Goniochloris* species. The appearance of both species is too similar to separate them from each other using the identification key.

The species in video No. 10 could be determined as *Euastrum denticulatum* F.Gay with Růžička (1981: p. 488, plate 80: fig. 8-17), Coesel & Meesters (2007: p. 76, plate 47: fig. 10-16), Lenzenweger (1996: p. 79, plate 11: fig. 8), Förster (1982: p. 318, plate 41: fig. 5) or with John et al. (2011: p. 680, plate 167: fig. F). The genus can be determined from the green algae /Desmidiaceae characteristics with two lobed semi-cells. The species is identificied by the outline of the lobes, the incision between the lobes, the morphology of the sinus, the acute granules or short spines at the apical angles, and the central inflation furnished with 3-5 bean-shaped verrucae arranged in a circle.

3.3.3. Scores

The scores assigned for the taxonomic identification of the taxa shown in the 10 videos followed the qualitative analysis in Schilling et al. (2006), which we extended by a qualification when only the genus level was required (Table 2). In the current rating scheme, naming the correct genus is rated higher (0.83) than misidentification of the species within the correct genus (0.67). The reason for this choice of rating is that the correct evaluation of lakes is thought to be more accurate if only the correct genus is provided rather than if a, incorrect species had been identified.

In Table 19 below, we show the results of the taxonomic determinations and their assigned scores (following the qualitative assessment given in Table 2).

Table 19. Results of the taxonomic identification of component (3) and their assigned scores.

Video number	Determination of the participant	Number of participants	Score
1	*Botryococcus braunii*	58	1
1	*Botryococcus* sp.	1	0.67
1	*Woronichinia naegeliana*	1	0
2	*Lagerheimia genevensis*	59	1
2	*Lagerheimia quadriseta*	1	1
3	*Bitrichia chodatii*	56	1
3	*Bitrichia ohridana*	1	0.67
3	*Ankyra sp.*	1	0
3	*Schroederia setigera*	1	0
3	Keine Identifikation	1	0
4	*Stauridium tetras*	45	1
4	*Pediastrum tetras*	12	1
4	*Pediastrum obtusum*	1	0.67
4	*Pediastrum angulosum*	2	0.67
5	*Dinobryon crenulatum*	30	1
5	*Dinobryon korsikovii*	12	1
5	*Dinobryon* sp.	5	0.83
5	*Dinobryon suecicum*	1	0.67
5	*Dinobryon acuminatum*	1	0.67
5	*Dinobryon bavaricum*	2	0.67
5	*Dinobryon divergens*	4	0.67
5	*Dinobryon divergens var. schauinslandii*	1	0.67
5	*Dinobryon sertularia*	1	0.67
5	*Dinobryon sociale*	3	0.67
6	*Discostella stelligera*	39	1
6	*Cyclotella stelligera*	4	1
6	*Discostella* sp.	1	0.83
6	*Discostella glomerata*	9	0.67
6	*Discostella pseudostelligera*	3	0.67
6	*Cyclotella comensis*	1	0.67
6	*Cyclotella meneghiniana*	2	0.67
6	*Cyclotella striata*	1	0.67
7	*Merismopedia* sp.	59	1
7	*Crucigeniella* sp.	1	0
8	*Cryptomonas curvata*	54	1
8	*Cryptomonas rostratiformis*	1	1
8	*Cryptomonas reflexa*	3	1
8	*Cryptomonas* sp.	1	0.83
8	*Cryptomonas ovata*	1	0.67
9	*Goniochloris mutica*	28	1
9	*Goniochloris pulchra*	23	1
9	*Fragilaria brevistriata*	1	0

Video number	Determination of the participant	Number of participants	Score
9	*Staurastrum punctulatum*	1	0
9	*Tetraedron triangulare*	6	0
9	*Triceratium favus*	1	0
10	*Euastrum denticulatum*	45	1
10	*Euastrum amoenum*	6	1
10	*Euastrum* sp.	2	0.83
10	*Euastrum bidentatum*	5	0.67
10	*Euastrum binale*	1	0.67
10	*Euastrum gayanum*	1	0.67

In Fig. 25, we show the identification success rate per video, revealing that the species shown in video 9 was the most difficult species to identify (85%). The success rate for all videos was above 80%.

All participants recognised the species in video 2 (100%) and almost all (99%) recognised the species in video 4 and video 8. The score for the species in video 1 and video 7 was also very high (98%).

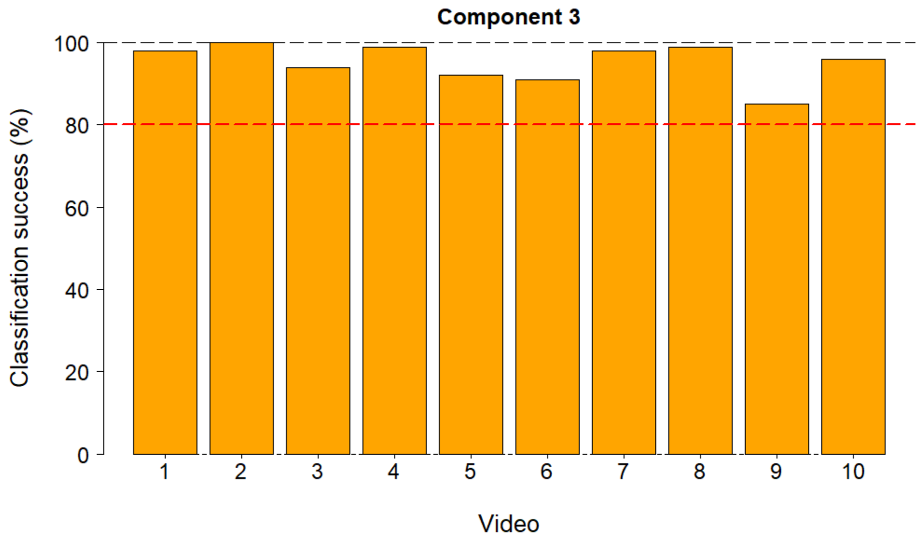


Figure 25: The success rate of taxa identification for each video in component 3. The 80% success rate is indicated by the dashed red line.

The total score for component 3 for each participant is shown in Fig. 26. The 80% success rate is indicated by a red dashed line and the 100% score is indicated by a black dashed line. The scores are ordered by ascending laboratory code and show that only 4 of the 60 participants who took part in this component of the test failed to achieve the 80% quality target.

There were 29 participants who achieved the maximum score of 100%. In addition, there were twenty-one participants who achieved a score of > 90% (only minor errors).

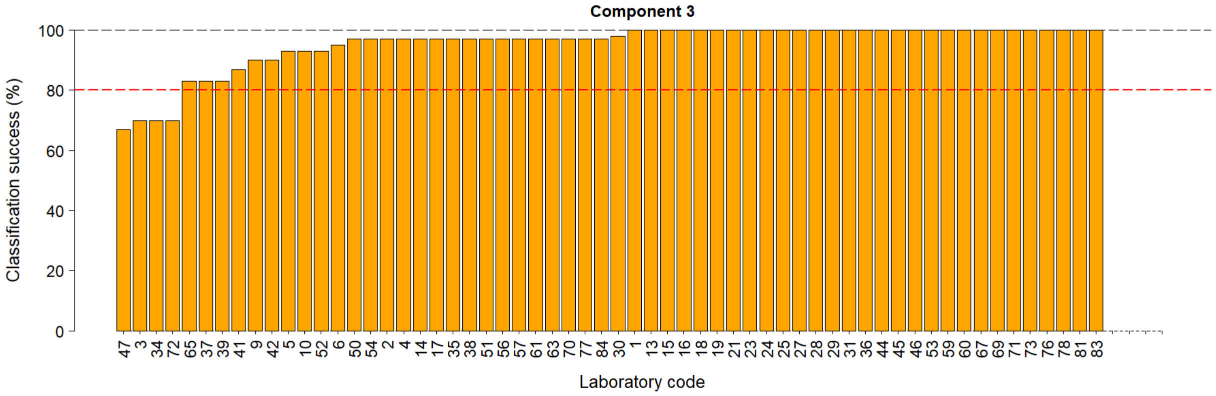


Figure 26: The total score for the taxonomy component (3) for every participant. In the figure also the maximum score (100%, dashed black line) and the quality target (80%, dashed red line) is depicted.

The majority of participants performed very well in component 3. Only 4 participants out of 60 failed this component (6.7%). A total of 10 points could be achieved, whereby we set the success level at 80%. This means that a minimum of 8 points was tolerated in order to pass this component.

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5. Appendix 1: Total cell and biovolume concentrations of the phytoplankton sample (component 2)

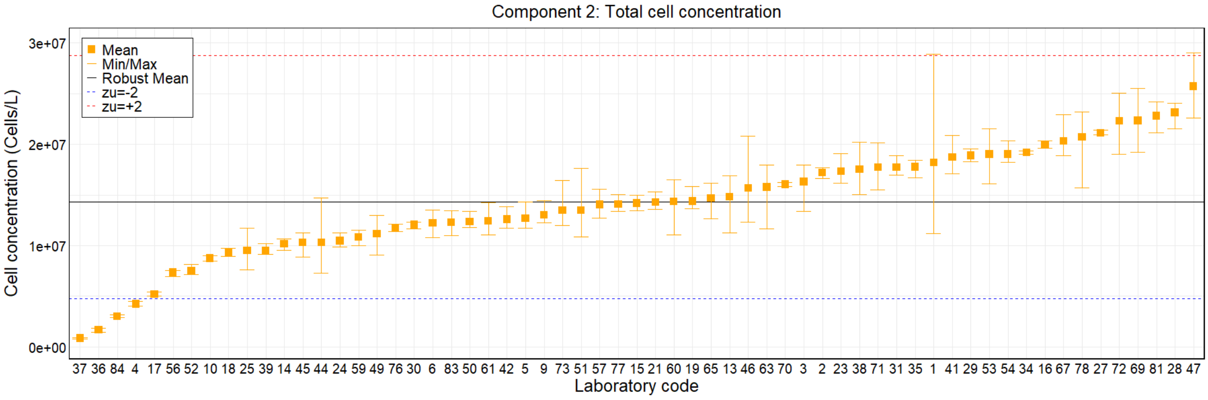

Figure 27: Total cell concentration of the phytoplankton sample. The robust mean, lower and upper tolerance limits were 1.43 10^7; 0.47 10^7 and 2.88 10^7 cells/L, respectively. The standard deviation of reproducibility was 39.65% and the repeatability standard deviation 9.38%. The specific measurement uncertainty (U) was 78.4%.

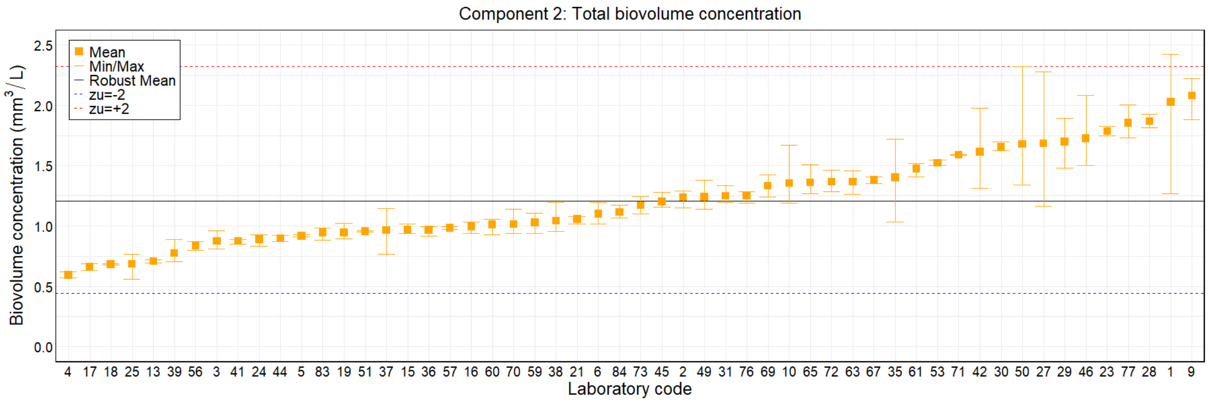

Figure 28: Total biovolume concentration of the phytoplankton sample. Off-scale values are from laboratory 14 (60 mm^3/L), 52 (6 mm^3/L), 54 (1630 mm^3/L), and 81 (3331 mm^3/L). The robust mean, lower and upper tolerance limits were 1.209; 0.442 and 2.325 mm^3/L, respectively. The standard deviation of reproducibility was 36.83% and the repeatability standard deviation 7.178%. The specific measurement uncertainty (U) was 72.6%.

6. Appendix 2: Results of component 1

Table 20. Results of the particle concentration (PC, in particles/L) of the large particles (LP) and medium particles (MP) in the reference counting chamber for every participant (LC).

LC	PC_1 LP	PC_2 LP	PC_3 LP	PC_1 MP	PC_2 MP	PC_3 MP
1	7300	7000	6700	290858	285844	279180
2	7500	7500	7500	273581	275545	270309
3	7	7	7	231	259	279
4	7100	7500	7500	275897	292126	296763
5	7600	7500	7400	369709	316199	277282
6	7400	7400	7400	278037	259222	292670
9	7000	13000	13000	286000	320000	325000
10	7400	7400	7400	300820	327781	302239
13	7000	8000	8000	317000	301000	326000
14	7400	7400	7400	279256	285508	285508
15	7400	7600	7600	301952	355872	266904
16	7200	7400	7400	283140	318780	283140
17	7600	7400	7900	283368	285507	297276
18	7500	7500	7500	318000	325950	312700
19	7500	7400	7500	32600	29400	30400
21	8160	6120	8160	354960	273360	265200
23	9444	10000	10556	296667	311667	300000
24	7100	7400	7300	289680	303960	289680
25	7100	7200	7600	273896	298824	293270
27	6810	15890	6810	340500	265590	342770
28	9722	9028	9028	296667	282222	277778
29	8100	4100	8100	349600	357700	292700
30	7700	7700	7700	350615	354692	358769
31	7500	7500	7500	333318	307056	303016
34	6400	6500	6600	301640	278440	260800
35	7400	7600	7600	6600	6600	6700
36	7300	7500	7600	285000	365000	305000
37	2300	2300	2300	25600	29300	30800
38	7000	7000	8000	280000	290000	290000
39	7000	6000	6000	297000	265000	281000
41	7200	7200	7400	316940	322258	318004
42	7400	7500	7500	292675	291669	292675
44	7000	7100	7600	321512	284414	304200
45	8014	7413	7713	270882	302138	275050
46	7500	7500	7500	295212	280216	275934
47	6400	7600	7900	589031	598532	592198
49	6800	6900	7200	340000	312800	374000
50	6900	6300	7000	308260	324400	302660
51	7400	7300	7400	259804	337745	311765
52	51925	25962	25962	519248	467324	545211
53	7500	7500	7500	345725	345725	360595
54	7500	7400	7500	327316	332783	331416

LC	PC_1 LP	PC_2 LP	PC_3 LP	PC_1 MP	PC_2 MP	PC_3 MP
56	7200	7400	7000	285885	286813	287741
57	7500	7500	7500	302302	297310	307849
59	7013	7113	7013	313494	315537	288987
60	7500	7500	7500	299359	313762	324049
61	7490	7790	7790	331330	318580	322830
63	7400	7500	7400	295800	288660	313140
65	6800	6600	6800	292604	289286	299239
67	7100	7400	7500	273700	320450	293250
69	7500	7600	7700	265050	312759	319827
70	6988	7188	7188	325600	341428	305250
71	7500	7500	7500	288442	319019	282327
72	7500	7500	7200	315560	305900	286580
73	7600	7500	7500	302000	298000	293000
76	7400	7300	7500	310288	316238	318789
77	7100	6800	7100	291204	299121	298242
78	1081	1032	774	32726	34336	30206
81	7555	7211	7211	269782	290220	261606
83	7600	7800	7800	299586	301624	299586
84	7600	7600	7600	288284	277196	288284

Table 21. Results of the volume concentration (VC, in mm^3/L) of the large particles (LP) and medium particles (MP) in the reference counting chamber for every participant (LC).

LC	VC_1 LP	VC_2 LP	VC_3 LP	VC_1 MP	VC_2 MP	VC_3 MP
1	0.094	0.09	0.086	1.063	1.045	1.02
2	0.093	0.093	0.093	0.88	0.887	0.87
3	0.096	0.096	0.096	0.883	0.99	1.066
4	0.094	0.1	0.1	0.896	0.949	0.964
5	0.096	0.094	0.093	1.255	1.073	0.941
6	0.092	0.092	0.092	0.936	0.873	0.986
9	0.09	0.15	0.15	0.91	1.02	1.04
10	0.119	0.119	0.119	1.26	1.373	1.266
13	0.088	0.09	0.091	0.986	0.935	1.011
14	0.077	0.077	0.077	0.745	0.762	0.762
15	0.096	0.098	0.098	1.008	1.188	0.891
16	0.08	0.083	0.083	0.826	0.93	0.826
17	0.099	0.096	0.102	0.99	0.998	1.039
18	0.088	0.088	0.088	0.985	1.01	0.969
19	0.094	0.093	0.094	1.09	0.98	1.01
21	0.109	0.082	0.109	1.356	1.044	1.013
23	0.119	0.126	0.133	1.078	1.132	1.09
24	0.084	0.088	0.087	0.947	0.993	0.947
25	0.1	0.094	0.099	1.004	1.11	1.089
27	0.09	0.21	0.09	1.314	1.025	1.322
28	0.119	0.11	0.11	1.017	0.968	0.952
29	0.113	0.057	0.113	1.341	1.372	1.122
30	0.091	0.091	0.091	1.112	1.125	1.138
31	0.476	0.476	0.476	0.618	0.569	0.562
34						
35	0.094	0.097	0.097	1.063	1.063	1.079
36	0.099	0.096	0.096	0.888	1.144	0.941
37	0.013	0.013	0.013	0.914	1.015	1.145
38	0.093	0.093	0.106	1.009	1.045	1.045
39	0.088	0.076	0.076	1.069	0.954	1.011
41	0.081	0.081	0.083	1.043	1.06	1.046
42	0.092	0.093	0.093	1.029	1.026	1.029
44	0.092	0.094	0.1	1.176	1.04	1.112
45	0.098	0.091	0.095	0.878	0.979	0.892
46	0.103	0.103	0.103	0.994	0.944	0.93
47						
49	0.092	0.093	0.098	1.284	1.181	1.412
50	0.088	0.08	0.089	1.042	1.096	1.022
51	0.094	0.092	0.094	0.926	1.203	1.111
52	0.663	0.332	0.332	1.811	1.63	1.901
53	0.089	0.089	0.089	1.075	1.075	1.121
54	95.567	94.293	95.567	1097.589	1115.92	1111.337

LC	VC_1 LP	VC_2 LP	VC_3 LP	VC_1 MP	VC_2 MP	VC_3 MP
56	0.101	0.104	0.098	1.174	1.178	1.181
57	0.096	0.096	0.096	1.064	1.046	1.083
59	0.093	0.095	0.093	1.302	1.311	1.201
60	0.103	0.103	0.103	1.213	1.271	1.313
61	0.104	0.108	0.108	1.302	1.252	1.269
63	0.101	0.103	0.101	1.01	0.985	1.069
65	0.117	0.114	0.117	1.429	1.413	1.461
67	0.098	0.103	0.104	1.123	1.315	1.204
69	0.096	0.097	0.099	0.851	1.005	1.027
70	0.085	0.088	0.088	1.105	1.159	1.036
71	0.093	0.093	0.093	1.073	1.186	1.05
72	0.097	0.097	0.093	1.023	0.991	0.929
73	0.098	0.097	0.097	1.04	1.03	1.01
76	0.09	0.088	0.091	0.947	0.966	0.973
77	0.084	0.08	0.084	0.958	0.984	0.982
78	6.244	5.961	4.471	48.283	50.659	44.564
81	102.248	97.6	97.6	1067.682	1148.566	1035.327
83	0.111	0.114	0.114	1.304	1.313	1.304
84	0.092	0.092	0.092	1.001	0.963	1.001

Table 22. Results of the diameter (in µm) of the large particles (LP) and medium particles (MP) in the reference counting chamber for every participant (LC).

LC	LP_1	LP_2	LP_3	LP_4	LP_5	LP_6	LP_7	LP_8	LP_9	LP_10
1	29.36	29.19	29.3	28.98	29.14	28.94	28.92	29.16	29.03	29.17
2	28.88	28.55	29.37	28.88	28.88	28.88	28.55	28.38	28.38	28.55
3	29.85	29.43	29.68	29.59	29.57	29.45	29.05	29.65	29.54	29.22
4	28.9	29.3	29.3	29.3	29.3	29.3	29.8	29.3	29.3	29.3
5	28.6	28.6	28.8	28.7	29	29	29	29	28.8	28.7
6	28.8	28.9	28.6	28.7	28.7	28.5	28.3	28.6	28.7	28.7
9	28.4	28.12	28.38	28.4	28.71	28.14	28.32	28.6	28.28	27.9
10	31.73	30.89	30.89	30.89	30.89	31.73	30.89	31.73	31.73	31.73
13	28.37	28.96	27.96	28.73	28.67	28.22	28.2	28.29	28.72	28.47
14	26.83	26.76	27.39	26.34	26.47	27.92	26.74	27.48	27.05	26.83
15	29.9	29.08	28.99	28.8	28.8	29.2	29.6	28.8	29.2	29.6
16	27.73	27.87	27.55	28.2	27.52	27.7	27.66	27.59	27.74	27.78
17	28.56	28.82	28.19	28.73	28.52	28.91	28.55	29.92	29.8	28.41
18	28.54	28.53	28.45	28.3	28.21	28.25	28.06	28.34	28.3	27.95
19	28.5	28.6	28.3	29.5	29.2	28.4	28.5	29	29.6	28.6
21	29.6	29.9	29.4	29.2	29.7	29.4	29.5	29.8	29.6	29.4
23	28.49	28.58	28.77	29.1	28.91	28.53	28.8	28.9	28.83	28.97
24	28.53	28.42	28.17	28.25	28.16	28.49	28.22	28.47	27.94	28.29
25	29.7	29.1	29.2	29.3	29.2	29.3	29	29	29.3	29.1
27	29.88	29.06	29.25	29.06	29.43	29.52	29.34	29.15	28.79	29.7
28	28.15	29.03	28.81	28.37	29.03	28.81	28.37	28.59	28.59	29.03
29	30.19	29.77	30.19	28.74	29.56	29.13	29.71	30.38	30.58	29.93
30	28.41	28.6	28.18	28.18	28.46	28.19	28.35	28.46	28.17	28.17
31	28.45	28.51	28.67	28.89	28.49	28.49	28.45	28.15	28.28	28.64
34										
35	29.24	28.99	28.8	29.31	29.04	28.96	29.96	29.04	29.7	28.67
36	30.6	30.6	30.6	29.33	29.33	28.05	29.33	30.6	30.6	30.6
37	29.14	29.44	29.13	29.54	29.02	29.01	29.04	29.21	29.2	29.44
38	29.67	29.84	29.28	29.16	29.52	29.74	29.44	29.13	29.08	29.13
39	29.03	29.54	29.12	28.78	28.91	29.03	28.43	29.18	28.94	28.67
41	27	26	26.5	27	27	27	27	27	27	27
42	28.77	29.08	28.77	28.46	29.08	28.77	28.77	28.77	29.39	29.08
44	28.83	29.63	29.39	29.3	29.17	29.79	28.9	28.9	29.46	29.06
45	27.2	27.61	27.76	28.06	28.1	28.37	28.39	28.39	28.39	28.62
46	29.63	30.28	29.4	29.96	30.03	29.48	29.85	29.75	29.44	29.77
47	28.5	28.3	28.5	26.14	29.5	27.2	29.2	28.1	28.6	29.6
49	30.32	29.83	30.16	29.72	29.32	30.32	29.19	29.99	29.51	29.22
50	28.57	29.04	28.83	28.57	28.57	28.57	28.41	28.87	29	29.39
51	29.1	28.4	29.4	28.7	28.4	28.4	28.7	28.9	28.9	29.1
52	28.68	29.01	29.07	28.98	29.04	28.93	29.08	29.33	28.87	29.07
53	28.5	28.1	28.3	28.1	28.3	28.5	28.3	28.3	28.3	28.3
54	28.96	28.9	28.77	28.8	29.08	28.56	29.01	29	29.14	28.85

LC	LP_11	LP_12	LP_13	LP_14	LP_15	LP_16	LP_17	LP_18	LP_19	LP_20
1	28.99	29.05	28.99	29.18	29.17	28.96	29.06	28.9	29.11	28.96
2	28.05	28.88	28.55	28.88	28.88	28.88	28.55	28.88	28.22	28.38
3	29.12	29.54	29.9	29.8	30.19	30.89	30.21	29.99	29.55	29.62
4	29.3	29.8	29.3	29.3	29.8	29.3	29.3	29.8	29.3	29.3
5	28.8	28.8	28.8	28.7	29	29	29	28.9	29	28.8
6	28.8	28.6	28.6	28.7	29.1	28.8	28.8	28.9	28.9	28.6
9	27.95	28.35	27.9	28.4	28.18	27.95	28.63	28.2	28.37	28.41
10	31.73	30.89	30.89	30.89	30.89	31.73	30.89	31.73	31.73	31.73
13	28.32	28.36	28.33	28.05	28.31	27.98	27.82	28.03	28.45	28.66
14	27	27.08	27.8	27.42	27.32	27.16	27.3	26.72	27.62	27.46
15	28.8	28.8	28.99	29.2	28.8	29.6	29.6	29.6	28.8	29.6
16	27.48	27.5	27.91	27.39	27.8	27.74	27.82	27.93	27.73	28.07
17	30.15	29.6	29.78	30	28.99	29.19	29.28	28.42	28.79	28.56
18	27.95	27.72	28.13	28.3	28.31	28	27.96	27.74	27.97	28.24
19	28.8	29.4	28.6	28.4	29.1	28.3	29.1	29.1	29	29.1
21	29.6	29.5	29.4	29.7	29.1	29.3	29.3	29.3	29.7	29.7
23	28.94	29.06	28.94	28.55	28.15	28.87	28.77	29.27	28.98	28.82
24	28.27	28.15	28.08	27.91	28.29	28.63	28.22	28.28	28.61	28.6
25	29.2	29.3	29.3	29.4	29	29.2	29.2	29.2	29.2	29.2
27										
28	28.15	28.59	28.37	28.15	28.37	28.81	28.81	28.81	28.37	28.15
29	30.01	29.46	30.34	29.4	29.39					
30	28.46	28.17	28.18	28.17	28.19	28.17	28.17	28.03	28.17	28.02
31	28.26	28.68	28.07	28.23	28.41	28.68	28.08	28.5	28.34	28.4
34										
35	28.64	29.28	28.85	29.45	28.33	28.66	28.64	28.84	28.97	28.06
36	29.33	28.05	30.6	29.33	28.05	28.05	28.05	30.6	30.6	28.05
37	29.51	28.51	29.2	29.62	29.48	29.62	29.37	28.94	29.28	29.42
38	29.23	28.92	29.44	29.03	29.29	29.26	30.02	29.17	29.24	29.12
39	29.13	29.07	28.68	28.86	28.99	29.52	28.72	29.33	29.2	29.27
41	27	27	29.4	28	29.4	28	29.75	29.4	29.4	29.4
42	28.77	28.46	28.77	28.77	29.08	29.08	29.08	29.08	29.08	28.77
44	29.07	29.59	29.48	29.03	29.06	28.5	29.07	29.38	29.53	29.12
45	28.64	28.69	28.81	28.91	29.13	29.13	29.2	29.31	28.83	28.81
46	29.44	30.01	29.9	29.13	29.4	29.46	29.7	30.16	29.73	29.61
47	28.4	28.9	28.4	28.9	28.4	28.4	28.4	28.9	28.4	28.9
49	29.83	29.35	29.56	29.52	29.51	29.51	29.19	29.35	29.2	29.83
50	29.39	29.59	29.27	29.03	29.04	29.23	28.66	28.66	29.6	29.6
51	29.1	29.4	29.1	28.7	28.4	29.1	29.1	29.1	28.9	29.1
52	28.84	28.87	29.13	28.86	28.79	29.06	29.13	29.11	28.89	29.24
53	28	28.7	28.5	28.1	28.1	28.5	28.1	28.1	28.7	28.3
54	29.32	28.91	28.7	28.97	29.22	29.27	28.76	29.17	29.05	29.14

LC	LP_1	LP_2	LP_3	LP_4	LP_5	LP_6	LP_7	LP_8	LP_9	LP_10
56	30.1	29.8	30	30	30	29.9	30	30	29.8	30
57	28.98	28.9	28.98	29.1	29.08	29.02	28.9	29.04	28.94	28.92
59	29	28.5	30	29	29.5	30	29.5	28.5	29	30
60	29.26	29.76	29.76	29.51	30.01	29.76	30.01	29.76	29.76	30.01
61	29.25	30	29.5	29.6	30	29.6	30	29.6	30	30
63	30	30	29	28.75	30	30	30	29.25	29.5	30
65	32.2	32.2	32.3	31.6	32.2	33	32.4	32.2	31.6	32.2
67	29.41	29.26	29.98	28.73	29.78	29.7	29.16	30.47	29.44	29.84
69	28.5	30	28.5	28	28	29	29	30	28.5	30
70	27.9	27.9	27.9	29.7	28.8	28.8	27.9	28.8	28.8	28.8
71	29.6	29	28.8	28.9	28.8	28.4	28.3	28.4	28.5	28.7
72	27.8	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
73	29	28.6	28.7	28.9	29.1	29.8	28.9	28.9	29.1	28.8
76	28.5	28.4	28.9	28.7	28.5	28.5	28.6	28.4	28.4	28.5
77	28.46	28.2	27.95	27.4	27.45	27.93	28.38	28.46	28.31	28.04
78	29.61	27.14	28.91	29.08	29.3	29.15	28.73	29.45	29.31	29.01
81	29.23	30.06	28.39	30.06	30.06	30.06	30.06	29.23	29.23	30.06
83	30.21	30.46	30.37	30.29	30.5	30.42	30.56	30.24	30.36	30.26
84	28.62	28.63	28.92	28.62	28.73	28.83	28.53	28.72	28.64	28.72

LC	LP_11	LP_12	LP_13	LP_14	LP_15	LP_16	LP_17	LP_18	LP_19	LP_20
56	30	29.9	30	30	30	29.8	30	29.8	29.8	29.8
57	28.94	29.02	28.92	28.8	29	29.02	29	29.14	29.18	29.16
59	29.5	29	30	30	30	30	29.5	29	29	29
60	29.51	29.76	29.51	29.51	29.76	29.76	30.01	29.51	29.76	29.76
61	30	30	29.5	29.6	30	30	30	29.7	30	30
63	30	30	30	30	30	27.5	29.75	30	30	29.75
65	31.3	31.6	33	32.3	31.3	32.2	32.2	31.3	32.2	32.1
67	31.1	30.28	29.59	30.31	29.42	30.03	29.81	29.81	29.98	29.7
69	29	28.5	28.5	29	29	29	29	30	29	30
70	27.9	27.9	28.8	28.8	28.8	28.8	28.8	27.9	28.8	28.8
71	29.3	29.2	29.1	28.9	28.7	29	28.9	29.1	29.3	28.9
72	29.1	29.1	29.1	29.1	29.1	30.4	29.1	29.1	29.1	29.1
73	29.5	29.1	28.9	28.8	29.4	30.1	29.2	29.4	28.6	29
76	28.5	28.4	28.5	28.7	28.5	28.5	28.3	28.4	28.3	28.6
77	28.39	28.76	28.87	28.47	28.67	28.47	28.17	28.06	28.4	28.11
78	28.94	28.96	29.4	29.08	28.58	28.89	29.09	27.62	28.58	30.29
81	28.39	28.39	30.06	30.06	30.06	29.23	29.23	30.06	29.36	30.06
83	30.28	30.54	30.27	30.4	30.47	30.13	30.32	30.43	30.57	30.35
84	28.32	28.62	28.62	28.54	28.12	28.12	28.82	28.32	28.43	28.32

LC	MP_1	MP_2	MP_3	MP_4	MP_5	MP_6	MP_7	MP_8	MP_9	MP_10
1	19.15	19.31	19.35	19.3	18.92	19.26	19.34	19.29	19.01	19.16
2	18.65	18.15	18.15	18.15	18.15	18.98	18.98	18.65	18.65	18.48
3	19.59	19.5	19.24	19.24	19.44	18.91	19.38	18.84	18.4	18.99
4	17.9	18.1	17.9	18.4	18.1	18.1	17.6	18.4	19.1	19.1
5	18.5	18.5	18.4	18.7	18.5	18.5	18.7	18.5	18.8	18.8
6	18.9	18.4	18.4	18.3	18.5	18.4	18.4	18.4	18.6	18.6
9	18.19	18.31	17.95	18.5	18.4	18.4	18.3	18.4	18.15	18.4
10	20	20	20	20	20	20	20	20	20	20
13	17.71	17.8	18.07	18.11	18.12	18.06	18.1	18.34	18.24	17.81
14	17.64	17.35	17.43	16.96	17.14	16.81	16.66	17.61	17.1	16.96
15	18.24	16.62	19.2	18.24	18.7	18.7	18.43	19.2	18.7	18.43
16	18.25	17.97	17.95	17.98	18.07	17.67	17.6	17.35	17.22	17.6
17	18.42	18.22	18.25	18.09	18.42	18.42	18.77	19.5	20.12	20
18	17.74	18.06	17.88	17.94	18.28	18.33	18.3	18.14	18.32	18.19
19	18.3	18.2	18.1	19	18.6	18.7	18.3	18.3	19	19.1
21	18.9	19	19.8	19.3	18.9	19.4	19.1	19.4	19.4	19.3
23	18.89	19.04	19.07	19.03	18.84	19.07	19.17	19.05	19.07	18.8
24	18.59	18.36	18.25	18.83	18.45	18.04	18.42	18.41	18.39	18.48
25	19.3	19.2	19.1	18.9	19.1	19.1	19.1	18.8	18.9	19.3
27	19.65	19.47	19.56	19.38	19.74	19.29	19.01	18.74	19.1	19.74
28	18.36	19.14	18.48	18.48	18.7	18.48	18.7	18.7	18.92	18.92
29	19.34	18.68	19.79	19.23	19.87	20.13	19.04	19.18	19.32	19.5
30	18.3	18.2	18.2	18.2	18.2	18.3	18.3	18.2	18.2	18.3
31	18.39	18.32	18.21	18.21	18.33	18.14	18.59	18.33	18.34	18.03
34										
35	18.68	18.88	18.65	18.88	18.88	18.64	18.64	18.4	18.89	18.89
36	17.85	17.85	17.85	18.36	17.85	18.36	17.85	18.36	17.85	18.36
37	19.02	18.98	19.57	19.03	18.93	18.43	19.11	19.1	18.64	18.81
38	19.06	18.84	19.04	19.11	19.03	19.27	19.05	19.01	19	19
39	18.99	19.06	19.16	19.33	18.45	18.61	18.61	18.56	18.87	18.89
41	17.5	19.6	18.2	18.9	18.2	17.85	18.9	18.9	18.9	17.5
42	18.87	18.56	18.56	19.18	18.25	18.25	18.87	19.18	18.87	18.87
44	19.38	19.02	19.15	19.08	18.8	18.59	18.89	19.35	19.38	19.15
45	17.24	17.31	17.83	17.86	17.94	18	18.09	18.13	18.18	18.34
46	18.65	18.66	18.75	18.66	18.45	18.41	18.74	18.7	18.53	18.77
47	18.4	18.2	18.9	18.7	18.7	18.2	18.4	18.9	18.9	18.4
49	19.05	19.83	19.67	19.58	19.19	19.03	18.87	19.03	19.21	19.19
50	19.16	18.88	19.02	18.92	19	18.77	18.66	18.43	18.43	18.55
51	19.27	18.53	18.77	18.77	18.53	19.02	19.27	19.27	19.27	19.02
52	19.06	19.02	18.78	19.01	18.74	18.59	18.7	18.73	18.71	18.86
53	18.1	18.1	18.1	17.7	17.9	17.9	17.9	18.2	18.4	18.4
54	18.4	18.55	18.48	18.5	18.4	18.81	18.61	18.52	18.43	18.38

LC	MP_11	MP_12	MP_13	MP_14	MP_15	MP_16	MP_17	MP_18	MP_19	MP_20
1	18.96	18.96	19.22	18.91	19.02	19	19.04	19.04	18.92	19.04
2	18.15	18.15	18.15	18.48	18.65	18.15	18.15	18.65	18.48	18.15
3	20.04	19.83	18.91	19.5	19.68	19.32	19.59	19.78	20.2	19.66
4	19.1	18.4	18.9	19.1	18.1	19.1	17.9	17.9	17.9	18.1
5	18.8	18.8	18.8	18.7	18.8	18.6	18.7	18.5	18.6	18.6
6	18.7	18.7	18.7	18.6	18.7	18.7	18.7	18.7	18.7	18.8
9	17.95	18.1	18.2	18	18.28	18.29	18.17	18.5	18.17	18.28
10	20	20	20	20	20	20	20	20	20	20
13	18.17	18.2	18.17	18.26	17.96	18.06	18.29	18.53	18.31	18.03
14	17.55	17.07	17.87	17.28	17.47	17.1	16.91	17.28	17.12	17.55
15	18.7	18.62	18.24	18.24	18.7	19.2	18.43	18.6	18.7	19
16	17.39	17.72	17.64	17.73	17.57	17.81	17.88	17.77	17.73	18.03
17	18.71	19.63	19.04	19.4	18.33	18.42	18.67	18.37	19.06	18.31
18	18.45	18.04	18.06	18.07	17.9	17.88	18.19	18	17.88	18.07
19	19.2	18.1	18.5	18.7	18.4	18.2	18.4	18.4	18.4	18.7
21	19.8	19.4	19.2	19.5	19.7	19.6	19.8	19.5	19.3	19.5
23	19.24	19.07	19.17	19.42	19.02	18.99	19.13	19.34	18.96	19.09
24	18.33	18.38	18.43	18.52	18.48	18.44	18.47	18.26	18.27	18.43
25	19.4	19.5	19.1	19.1	19.4	19.2	19.1	19.1	19	18.9
27	19.1	19.2	19.92	20.19	19.56	19.56	19.74	19.29	19.29	19.74
28	19.14	18.48	19.14	18.48	18.92	18.48	18.48	18.7	18.7	18.7
29	19.07	19.41	19.48	19.81	19.5	20.08	18.99	18.68	19.62	19.59
30	18.2	18.3	18.2	18.2	18.2	18.2	18.2	18.3	18.2	18.2
31	18.05	18.22	18.1	18.06	18.06	17.83	17.86	17.99	18.11	18.2
34										
35	18.64	19	19.13	18.77	18.77	18.88	18.64	18.65	18.76	19.13
36	17.85	17.85	18.36	17.85	18.36	18.36	19.13	17.85	17.85	18.36
37	19.23	19.18	19.24	19.48	18.96	19.73	19.63	18.89	19.05	18.81
38	18.79	19.05	19	19.11	19.1	19.06	19	19.02	18.84	19
39	19.15	18.9	19.01	18.9	18.82	19.17	19.29	18.97	19.23	18.79
41	18.9	18.9	18.9	17.5	18.9	19.25	18.9	17.5	17.85	17.5
42	18.87	18.87	18.87	18.56	18.87	18.87	18.87	18.87	19.18	19.18
44	19.4	19.31	18.98	19.23	19.3	19	19.89	19.49	18.95	18.89
45	18.38	18.39	18.4	18.45	18.52	18.53	18.59	18.6	18.88	18.94
46	18.45	18.73	18.68	18.55	18.43	18.66	18.59	18.66	18.45	18.44
47	18.5	18.7	19.6	18.1	19.2	19.4	19.3	19.3	18.5	18.6
49	19.69	19.68	19.19	19.35	19.19	19.03	19.68	19.52	18.83	19.51
50	18.17	18.32	18.42	18.43	18.32	18.55	18.34	18.55	18.66	18.73
51	18.77	19.27	19.02	18.77	18.77	19.27	19.27	19.02	18.53	18.53
52	18.56	18.57	18.68	18.71	18.9	18.97	18.99	18.87	18.92	18.91
53	18.2	18.1	18.2	18.6	18.4	18.1	18.1	18.2	17.9	17.7
54	18.56	18.53	18.47	18.61	18.51	18.69	18.54	18.81	18.79	18.82

LC	MP_1	MP_2	MP_3	MP_4	MP_5	MP_6	MP_7	MP_8	MP_9	MP_10
56	20	20	19.7	19.7	20	19.8	19.9	20	19.7	19.9
57	19.12	18.98	18.82	19	18.78	18.84	18.76	18.76	18.98	18.8
59	19.6	19.7	19.9	20	19.8	20.5	20.1	20	20	19.8
60	19.84	19.59	19.84	19.59	19.84	20.09	19.84	19.84	19.59	19.59
61	19.5	19.5	19.7	19.5	19.6	20	19.4	19.5	20	19
63	18.2	19	18	18.1	18.6	18.5	18.8	18.6	18.6	19
65	20.6	20.6	21.5	21.5	21.5	20.6	21.5	20.6	21.5	20.6
67	20	19.03	20.6	20.11	19.95	19.5	20.18	20.27	19.37	19.37
69	18	18	18	18	18	18.5	18.5	18.5	18.5	18
70	18.9	18.9	18.9	18.9	18.9	19.8	18.9	18	18	18.9
71	19.2	19	19.7	19.4	19.2	19.4	18.8	19	19	18.9
72	17.7	17.7	19	19	19	19	19	19	17.7	17.7
73	18.5	18.7	18.6	19.4	18.9	18.3	18.3	18.5	18.9	18.3
76	18	17.9	18	17.9	17.9	17.9	17.9	18	18	18.2
77	18.6	18.26	18.26	18.65	18.51	18.4	18.65	18.63	18.44	18.4
78	17.99	18.51	18.07	18.76	18.35	18.07	18.48	18.54	17.7	18.48
81	20.04	18.37	20.04	20.04	20.04	19.21	18.37	19.21	20.04	20.04
83	20.24	20.45	20.63	20.24	20.09	20.43	20.49	20.19	20.4	20.12
84	18.71	18.71	18.71	18.61	18.81	19.01	18.71	18.71	18.71	18.61

LC	MP_11	MP_12	MP_13	MP_14	MP_15	MP_16	MP_17	MP_18	MP_19	MP_20
56	19.9	20	20.2	19.8	20	19.8	19.6	19.4	19.9	20
57	18.96	19.04	18.86	18.88	18.72	18.78	18.88	18.98	18.88	18.78
59	19.8	19.8	20.2	19.8	19.8	19.8	20.5	19.6	20.2	20
60	20.09	19.34	19.84	20.09	19.84	19.84	19.84	19.34	19.84	19.84
61	19	19.5	19.6	19.5	19.6	19.5	19.6	19.6	20	20
63	18.9	18.5	18	18.8	18.9	19	19	19.1	19	19
65	20.6	21.5	21.5	20.6	21.5	20.6	20.6	21.5	21.5	20.6
67	19.95	20.01	19.55	19.51	19.4	19.8	20.2	20.18	21.02	19.06
69	18	18	18	18.5	19	18.5	18	18.5	18.5	19
70	18	18.9	18.9	18	18	18.9	18	18	18.9	18.9
71	19.8	19.2	19.4	18.8	19.3	19.1	19.4	19.4	19.6	19.4
72	17.7	17.7	17.7	17.7	19	19	17.7	17.7	19	19
73	18.5	18.6	18.7	19.5	18.8	18.9	19	18.8	18.7	18.6
76	18.1	18.1	18.1	18.1	17.9	18.1	18.1	18.1	18.2	18.2
77	18.52	18.27	18.37	18.86	18.51	18.61	18.5	18.14	18.13	18.42
78	18.48	18.77	18.48	19.08	18.19	18.36	18.28	18.91	18.34	18.74
81	20.04	20.04	20.04	19.21	20.04	18.37	19.21	20.04	20.04	20.04
83	20.1	20.2	20.36	20.13	20.1	20.07	20.3	20.07	20.28	20.31
84	18.71	19.01	18.61	18.91	18.81	18.71	18.91	18.83	18.91	18.94

7. Appendix 3: Results of component 2

Table 23. Results of cell densities (CC, in cells/L) of every phytoplankton species (sp) for every participant (LC).

LC	CC_1 Sp. 1	CC_2 Sp. 1	CC_3 Sp. 1	CC_1 Sp. 2	CC_2 Sp. 2	CC_3 Sp. 2	CC_1 Sp. 3	CC_2 Sp. 3	CC_3 Sp. 3
1	194449	562854	129757	7023	5888	7389	894467	469045	308173
2	140247	104185	164291	6800	7600	5400	294522	322572	276490
3	51000	85000	54000	8000	8000	8000	531000	483000	657000
4	82269	93000	86740	4769	4849	4729	118038	161855	153807
5	93004	106482	92330	5400	4300	5700	261060	281945	219291
6	134399	156278	137525	5900	6800	6500	251087	297970	264631
9	342000	228000	176000	14000	14000	18000	352000	321000	487000
10	143341	147599	262555	6101	7001	6701	422927	332097	468342
13	72000	76000	59000	7000	6000	6000	148000	143000	196000
14	101595	116596	97948	7300	8600	8600	254248	287592	206316
15	87815	75656	97344	6400	6700	6900	209760	209760	226320
16	91540	90545	91540	5600	7400	8600	378473	384480	318398
17	77667	68068	64286	5400	4400	5500	149226	155043	176787
18	87482	83677	94151	6634	5942	6057	332919	375352	332006
19	117000	117000	129000	4800	4300	6200	231000	325000	243000
21	168990	196500	176850	6400	6000	7200	353250	329700	314000
23	108443	85134	101506	20815	19646	19311	375770	450775	436586
24	125460	99960	127500	7900	7100	7900	265200	295800	269280
25	81660	86550	93333	5050	5200	3090	241022	248986	240903
27	280170	261000	171000	10600	9080	6810	407520	333000	306000
28	104781	111329	120061	10020	8841	8055	425671	454049	403842
29	77200	89400	126000	16300	12200	16300	731700	487800	731700
30	149600	166400	162400	8400	7800	8000	332100	299300	385400
31	155081	136955	142997	4400	5900	4100	325469	213589	223760
34	153450	159640	147260	101480	107660	96530	539550	549450	532130
35	251387	192701	77080	9809	8761	9428	395037	539563	423942
36	113880	66760	147830	5100	7300	6400	274890	333800	276580
37	9000	5300	4500	800	1500	1500	61700	48100	59400
38	93000	103000	99000	7000	7000	6000	190000	410000	210000
39	109000	177000	123000	4000	3000	3000	204000	252000	252000
41	157407	178678	179741	2800	1700	2600	235046	273335	213775
42	123760	82160	188240	8900	6100	8200	284960	355680	343200
44	111178	116586	91947	6300	7200	5200	262019	278846	278846
45	172253	152805	161140	7300	6700	5300	329226	347979	293803
46	114326	81987	212742	8829	7669	7455	277649	344344	343660
47	112898	130896	109625	72811	76083	61357	337057	369781	330512
49	81600	108800	142800	95200	122400	68000	578000	510000	455600
50	384085	158152	204415	4199	4102	4785	1061880	519640	449710
51	73839	104605	94350	6408	8095	9444	260047	194003	210514
52	48986	195943	244930	12246	12246	36738	306163	428628	575586
53	98555	113885	113885	6000	8500	7500	249781	232252	249781
54	222775	212582	203846	7200	6700	6600	311593	259176	345082
56	99317	95604	111384	4800	4000	4300	227408	234834	256183

LC	CC_1 Sp. 4	CC_2 Sp. 4	CC_3 Sp. 4	CC_1 Sp. 5	CC_2 Sp. 5	CC_3 Sp. 5
1	26834014	12711110	10185940	933357	734837	583907
2	16807389	15766744	16414693	442785	438777	414735
3	16683000	17071000	12416000	293000	279000	255000
4	3740442	3994104	3577067	210144	214615	188682
5	10841317	11153416	13666630	492787	542066	328525
6	9980033	12574423	11553405	405897	472849	456111
9	11078000	13459000	10975000	507000	445000	580000
10	7778730	7655258	7976285	306210	355599	306210
13	10771000	15933000	16339000	236000	188000	264000
14	8617240	9899616	9605568	516708	370683	429201
15	12720578	13185965	14271868	436001	612609	375292
16	18802000	19397000	18683000	520650	483243	504630
17	4684165	4846471	4471165	247537	346641	291379
18	8303544	9015611	8528103	218706	227124	208123
19	12700000	12700000	14800000	566000	525000	670000
21	12622090	12975430	14290640	424116	439824	486948
23	15717092	18074656	15225933	469917	480244	364549
24	9547848	9105818	10431908	336960	378560	386880
25	8445850	11057775	6962025	378209	330900	273849
27	20121300	19818000	20106000	551850	495000	396000
28	22593320	20039293	22495088	903733	923379	805501
29	17669400	18617900	16856400	325200	341500	536600
30	11396700	10732500	11234700	401800	430500	418200
31	17952262	16261196	16524659	467862	349879	406836
34	18170990	17984810	18431640	170780	188100	163350
35	15550100	17188936	17188936	502774	462483	423942
36	586650	592500	825320	431980	751050	557920
37	806100	691800	766300	21800	29300	17300
38	14200000	19100000	16700000	570000	570000	360000
39	8508000	9489000	8577000	286000	265000	225000
41	17480090	20134776	16397795	290351	277589	316940
42	10694840	11266320	12613380	577230	544710	662595
44	8197115	6490385	13822115	360577	379808	507211
45	9918454	7959768	10335196	358398	372984	460500
46	11497930	12691554	19735896	391975	852663	474578
47	22020249	24917807	28463894	47450	46632	44177
49	380800	428400	333200	10322400	11791200	8085200
50	11002893	10325096	10772656	926321	745576	511037
51	16701275	11295082	10136612	602648	321963	400389
52	6515102	5853795	6564088	269422	641481	744118
53	20703125	18593750	15234375	508326	420684	486415
54	17037162	17234886	19146212	663354	743070	629190
56	6785787	6159751	6707533	435990	469527	424810

LC	CC_1 Sp. 1	CC_2 Sp. 1	CC_3 Sp. 1	CC_1 Sp. 2	CC_2 Sp. 2	CC_3 Sp. 2	CC_1 Sp. 3	CC_2 Sp. 3	CC_3 Sp. 3
57	98855	108852	105520	6600	7200	6900	308784	293233	287680
59	95808	75565	100073	6488	6612	7113	226269	232823	300219
60	128591	129619	125505	6900	7000	6600	269526	291130	243808
61	202710	206970	215470	5800	6300	6400	372820	338800	372820
63	139360	143520	147680	8000	8800	7400	262400	284950	239850
65	111495	114150	124768	7200	8100	7400	347740	212360	220324
67	90600	103800	107800	7300	8500	8700	326400	269450	266050
69	137835	141919	115373	5400	5300	5700	283192	348544	343098
70	113290	154684	108932	4545	4720	5070	318083	398693	313725
71	173573	156216	180720	7400	6600	6100	259338	271591	259338
72	85200	84500	86000	6100	7100	6300	225760	239040	267260
73	177000	132000	129000	6000	5400	6200	335000	253000	284000
76	128878	161770	161422	6481	6054	6040	257755	224497	191688
77	281856	327962	282412	4331	5128	3649	254579	327962	364402
78	160949	181067	179046	10974	18290	23103	256055	224963	248354
81	369689	291032	319873	7000	8600	7000	209753	293654	285788
83	163360	155192	175612	4100	5300	5200	259334	242998	212368
84	119959	116997	108111	6400	5900	5800	251765	242880	238437

LC	CC_1 Sp. 4	CC_2 Sp. 4	CC_3 Sp. 4	CC_1 Sp. 5	CC_2 Sp. 5	CC_3 Sp. 5
57	14790193	13050170	11845539	392621	334620	490776
59	10843034	10348413	9130952	344946	329334	430980
60	15684553	14564228	10255285	421778	456755	411491
61	10237210	13448888	11040130	250910	267920	229650
63	10705920	16711680	17146880	554090	554090	396960
65	11308290	15293116	14216136	861584	538490	646188
67	22004016	18110544	18435000	477700	360400	384200
69	21407022	24635065	18348876	383943	367605	424788
70	15000000	14630952	15333333	551924	642702	493827
71	14457605	19113444	16540480	592190	600358	494172
72	21866698	24169849	18054586	561150	564375	628875
73	10900000	15500000	11100000	542000	519000	506000
76	10516307	11019384	11320205	447680	442390	406918
77	14147331	12772287	12198355	372777	428172	501053
78	22181807	22291346	14682175	584212	474672	576525
81	21197735	19488240	22451365	1276423	1037094	1116870
83	10278829	12657401	11553064	273628	400232	416568
84	2483382	2286424	2243607	293233	288790	282866

Table 24. Results of the biovolume concentrations (BVC in in mm³/L) of every phytoplankton species (sp) for every participant (LC).

LC	BVC_1 Sp. 1	BVC_2 Sp. 1	BVC_3 Sp. 1	BVC_1 Sp. 2	BVC_2 Sp. 2	BVC_3 Sp. 2	BVC_1 Sp. 3	BVC_2 Sp. 3	BVC_3 Sp. 3
1	0.442	1.279	0.295	0.3	0.25	0.32	0.807	0.423	0.278
2	0.571	0.424	0.669	0.272	0.305	0.216	0.122	0.134	0.115
3	0.176	0.294	0.187	0.402	0.402	0.402	0.024	0.022	0.03
4	0.232	0.262	0.244	0.19	0.193	0.188	0.049	0.067	0.064
5	0.294	0.336	0.292	0.251	0.2	0.265	0.127	0.138	0.107
6	0.456	0.53	0.466	0.192	0.221	0.212	0.133	0.158	0.14
9	0.681	0.454	0.35	0.406	0.406	0.522	0.774	0.705	1.07
10	0.516	0.532	0.946	0.248	0.284	0.272	0.21	0.165	0.232
13	0.242	0.255	0.198	0.251	0.213	0.223	0.052	0.05	0.069
14	1.129	1.13	1.089	0.242	0.285	0.285	59.251	67.021	48.081
15	0.337	0.291	0.374	0.212	0.222	0.229	0.117	0.117	0.126
16	0.291	0.288	0.291	0.223	0.294	0.342	0.127	0.129	0.107
17	0.246	0.216	0.204	0.243	0.198	0.247	0.056	0.058	0.066
18	0.216	0.207	0.233	0.218	0.196	0.199	0.12	0.135	0.119
19	0.326	0.326	0.36	0.132	0.118	0.17	0.118	0.166	0.124
21	0.443	0.515	0.463	0.216	0.202	0.243	0.138	0.129	0.122
23	0.303	0.238	0.284	0.589	0.556	0.547	0.41	0.492	0.476
24	0.309	0.246	0.314	0.28	0.252	0.28	0.136	0.151	0.138
25	0.258	0.206	0.21	0.217	0.185	0.11	0.082	0.092	0.114
27	0.902	0.639	0.536	0.592	0.451	0.252	0.249	0.146	0.138
28	0.274	0.291	0.314	0.554	0.489	0.446	0.464	0.495	0.44
29	0.256	0.297	0.418	0.602	0.451	0.601	0.449	0.299	0.449
30	0.619	0.689	0.672	0.36	0.334	0.343	0.23	0.207	0.267
31	0.673	0.594	0.62	0.143	0.191	0.133	0.127	0.083	0.087
34									
35	0.862	0.66	0.26	0.269	0.24	0.259	0.195	0.129	0.102
36	0.289	0.151	0.335	0.2	0.268	0.231	0.35	0.452	0.334
37	0.107	0.275	0.08	0.383	0.641	0.672	0.088	0.078	0.081
38	0.331	0.367	0.352	0.204	0.204	0.175	0.104	0.224	0.115
39	0.295	0.48	0.333	0.135	0.101	0.101	0.092	0.113	0.113
41	0.421	0.479	0.482	0.085	0.052	0.079	0.079	0.092	0.072
42	0.64	0.425	0.973	0.297	0.204	0.274	0.24	0.299	0.289
44	0.323	0.339	0.267	0.194	0.222	0.16	0.138	0.146	0.146
45	0.642	0.569	0.6	0.308	0.283	0.224	0.164	0.173	0.146
46	0.366	0.263	0.682	0.386	0.335	0.326	0.322	0.399	0.398
47									
49	0.34	0.453	0.594	0.396	0.509	0.283	0.182	0.161	0.144
50	0.804	0.331	0.428	0.215	0.21	0.245	0.882	0.432	0.374
51	0.261	0.37	0.334	0.18	0.227	0.265	0.168	0.125	0.136
52	0.361	1.443	1.804	0.887	0.887	2.647	1.334	1.868	2.509
53	0.26	0.321	0.291	0.24	0.33	0.297	0.587	0.533	0.574
54	678.498	647.456	620.848	287.378	267.421	263.429	241.209	200.632	267.134
56	0.287	0.276	0.322	0.217	0.181	0.194	0.113	0.116	0.127

LC	BVC_1 Sp. 4	BVC_2 Sp. 4	BVC_3 Sp. 4	BVC_1 Sp. 5	BVC_2 Sp. 5	BVC_3 Sp. 5
1	0.609	0.289	0.231	0.233	0.183	0.146
2	0.237	0.223	0.232	0.066	0.065	0.061
3	0.168	0.171	0.125	0.077	0.073	0.067
4	0.052	0.055	0.049	0.045	0.046	0.041
5	0.155	0.159	0.195	0.084	0.092	0.056
6	0.172	0.216	0.199	0.063	0.073	0.07
9	0.223	0.271	0.221	0.053	0.046	0.06
10	0.149	0.147	0.153	0.065	0.075	0.065
13	0.123	0.182	0.187	0.027	0.022	0.03
14	0.077	0.088	0.085	0.077	0.055	0.064
15	0.203	0.21	0.227	0.072	0.101	0.062
16	0.237	0.245	0.236	0.059	0.056	0.058
17	0.106	0.11	0.102	0.036	0.05	0.042
18	0.1	0.108	0.102	0.032	0.033	0.03
19	0.201	0.201	0.234	0.115	0.107	0.136
21	0.17	0.174	0.193	0.051	0.053	0.058
23	0.368	0.423	0.357	0.113	0.115	0.087
24	0.116	0.11	0.126	0.063	0.071	0.072
25	0.156	0.2	0.087	0.054	0.045	0.038
27	0.431	0.312	0.161	0.105	0.067	0.074
28	0.445	0.394	0.443	0.19	0.194	0.17
29	0.369	0.388	0.352	0.044	0.047	0.073
30	0.327	0.308	0.322	0.091	0.097	0.095
31	0.325	0.294	0.299	0.066	0.049	0.058
34						
35	0.309	0.342	0.342	0.087	0.08	0.073
36	0.014	0.017	0.027	0.066	0.101	0.067
37	0.156	0.106	0.125	0.032	0.047	0.024
38	0.234	0.315	0.276	0.084	0.084	0.053
39	0.136	0.151	0.137	0.048	0.045	0.038
41	0.224	0.226	0.21	0.041	0.039	0.044
42	0.24	0.253	0.283	0.138	0.13	0.158
44	0.158	0.125	0.266	0.061	0.064	0.084
45	0.118	0.095	0.123	0.047	0.049	0.061
46	0.315	0.348	0.541	0.113	0.245	0.136
47						
49	0.063	0.071	0.055	0.161	0.184	0.126
50	0.212	0.199	0.208	0.21	0.169	0.116
51	0.278	0.188	0.169	0.076	0.041	0.051
52	0.093	0.083	0.093	0.67	1.596	1.851
53	0.209	0.188	0.154	0.208	0.173	0.199
54	321.793	325.527	361.628	132.312	148.213	125.498
56	0.142	0.129	0.14	0.089	0.096	0.087

LC	BVC_1 Sp. 1	BVC_2 Sp. 1	BVC_3 Sp. 1	BVC_1 Sp. 2	BVC_2 Sp. 2	BVC_3 Sp. 2	BVC_1 Sp. 3	BVC_2 Sp. 3	BVC_3 Sp. 3
57	0.245	0.27	0.261	0.247	0.269	0.258	0.222	0.211	0.207
59	0.428	0.338	0.447	0.23	0.233	0.252	0.132	0.136	0.175
60	0.392	0.395	0.382	0.184	0.187	0.176	0.144	0.156	0.131
61	0.665	0.679	0.706	0.25	0.272	0.276	0.175	0.159	0.175
63	0.493	0.507	0.522	0.247	0.272	0.228	0.147	0.16	0.135
65	0.257	0.263	0.288	0.237	0.267	0.244	0.596	0.364	0.378
67	0.266	0.305	0.316	0.329	0.383	0.392	0.16	0.132	0.131
69	0.498	0.513	0.417	0.231	0.227	0.244	0.129	0.158	0.156
70	0.384	0.524	0.369	0.155	0.161	0.173	0.146	0.184	0.144
71	0.688	0.619	0.716	0.331	0.296	0.273	0.136	0.143	0.136
72	0.291	0.288	0.293	0.176	0.205	0.182	0.13	0.138	0.154
73	0.4	0.298	0.292	0.176	0.159	0.182	0.281	0.213	0.239
76	0.492	0.618	0.616	0.317	0.296	0.295	0.115	0.1	0.086
77	1.063	1.237	1.065	0.143	0.169	0.12	0.285	0.367	0.408
78									
81	2209.771	1725.182	1893.937	336.409	413.302	336.409	271.555	380.177	369.994
83	0.395	0.375	0.425	0.162	0.209	0.205	0.092	0.086	0.075
84	0.302	0.294	0.272	0.187	0.172	0.169	0.199	0.192	0.188

LC	BVC_1 Sp. 4	BVC_2 Sp. 4	BVC_3 Sp. 4	BVC_1 Sp. 5	BVC_2 Sp. 5	BVC_3 Sp. 5
57	0.222	0.196	0.178	0.053	0.046	0.067
59	0.177	0.169	0.149	0.068	0.065	0.085
60	0.261	0.243	0.171	0.07	0.076	0.068
61	0.272	0.357	0.293	0.048	0.051	0.044
63	0.261	0.408	0.418	0.112	0.112	0.08
65	0.156	0.211	0.196	0.262	0.164	0.196
67	0.564	0.465	0.473	0.09	0.068	0.072
69	0.392	0.451	0.336	0.08	0.076	0.088
70	0.206	0.2	0.21	0.07	0.071	0.043
71	0.32	0.423	0.366	0.111	0.113	0.093
72	0.67	0.74	0.553	0.09	0.09	0.101
73	0.272	0.388	0.278	0.115	0.111	0.108
76	0.188	0.197	0.203	0.076	0.076	0.07
77	0.193	0.174	0.166	0.049	0.057	0.066
78						
81	287.418	264.239	304.416	446.912	363.116	391.048
83	0.197	0.243	0.222	0.037	0.054	0.056
84	0.447	0.412	0.404	0.036	0.036	0.035

8. Appendix 4: Results of component 3

Table 25. Results of the taxonomic determinations for every video and participant. The final %-score for every participant is also provided.

LC	Video 1	Video 2	Video 3	Video 4	Video 5	Video 6	Video 7	Video 8	Video 9	Video 10	%-score
1	1	1	1	1	1	1	1	1	1	1	**100**
2	1	1	1	1	1	0.67	1	1	1	1	**96.7**
3	1	1	0	1	0.67	1	1	0.67	0	0.67	**70.1**
4	1	1	1	1	1	0.67	1	1	1	1	**96.7**
5	1	1	1	1	0.67	0.67	1	1	1	1	**93.4**
6	1	1	1	1	0.83	0.67	1	1	1	1	**95**
9	1	1	1	1	1	1	1	1	0	1	**90**
10	1	1	1	1	0.67	0.67	1	1	1	1	**93.4**
13	1	1	1	1	1	1	1	1	1	1	**100**
14	1	1	1	1	0.67	1	1	1	1	1	**96.7**
15	1	1	1	1	1	1	1	1	1	1	**100**
16	1	1	1	1	1	1	1	1	1	1	**100**
17	1	1	1	1	0.67	1	1	1	1	1	**96.7**
18	1	1	1	1	1	1	1	1	1	1	**100**
19	1	1	1	1	1	1	1	1	1	1	**100**
21	1	1	1	1	1	1	1	1	1	1	**100**
23	1	1	1	1	1	1	1	1	1	1	**100**
24	1	1	1	1	1	1	1	1	1	1	**100**
25	1	1	1	1	1	1	1	1	1	1	**100**
27	1	1	1	1	1	1	1	1	1	1	**100**
28	1	1	1	1	1	1	1	1	1	1	**100**
29	1	1	1	1	1	1	1	1	1	1	**100**
30	1	1	1	1	0.83	1	1	1	1	1	**98.3**
31	1	1	1	1	1	1	1	1	1	1	**100**
34	1	1	0	1	0.67	0.67	1	1	0	0.67	**70.1**
35	1	1	1	1	1	1	1	1	1	0.67	**96.7**
36	1	1	1	1	1	1	1	1	1	1	**100**
37	1	1	0	1	0.67	1	1	1	1	0.67	**83.4**
38	1	1	1	0.67	1	1	1	1	1	1	**96.7**
39	1	1	1	1	0.67	1	1	1	0	0.67	**83.4**
41	1	1	1	1	1	0.67	1	1	0	1	**86.7**
42	1	1	1	1	1	1	1	1	0	1	**90**
44	1	1	1	1	1	1	1	1	1	1	**100**
45	1	1	1	1	1	1	1	1	1	1	**100**
46	1	1	1	1	1	1	1	1	1	1	**100**
47	0	1	1	0.67	0.67	0.67	1	1	0	0.67	**66.8**
50	1	1	1	1	1	1	1	0.83	1	0.83	**96.6**
51	1	1	1	1	1	0.67	1	1	1	1	**96.7**
52	1	1	0.67	1	1	0.67	1	1	1	1	**93.4**
53	1	1	1	1	1	1	1	1	1	1	**100**

LC	Video 1	Video 2	Video 3	Video 4	Video 5	Video 6	Video 7	Video 8	Video 9	Video 10	%-score
54	0.83	1	1	1	1	0.83	1	1	1	1	**96.6**
56	1	1	1	1	0.67	1	1	1	1	1	**96.7**
57	1	1	1	1	0.67	1	1	1	1	1	**96.7**
59	1	1	1	1	1	1	1	1	1	1	**100**
60	1	1	1	1	1	1	1	1	1	1	**100**
61	1	1	1	1	1	0.67	1	1	1	1	**96.7**
63	1	1	1	1	1	0.67	1	1	1	1	**96.7**
65	1	1	1	1	0.83	0.67	1	1	0	0.83	**83.3**
67	1	1	1	1	1	1	1	1	1	1	**100**
69	1	1	1	1	1	1	1	1	1	1	**100**
70	1	1	1	1	1	0.67	1	1	1	1	**96.7**
71	1	1	1	1	1	1	1	1	1	1	**100**
72	1	1	1	1	0.67	0.67	0	1	0	0.67	**70.1**
73	1	1	1	1	1	1	1	1	1	1	**100**
76	1	1	1	1	1	1	1	1	1	1	**100**
77	1	1	1	1	1	0.67	1	1	1	1	**96.7**
78	1	1	1	1	1	1	1	1	1	1	**100**
81	1	1	1	1	1	1	1	1	1	1	**100**
83	1	1	1	1	1	1	1	1	1	1	**100**
84	1	1	1	1	0.67	1	1	1	1	1	**96.7**