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Student perspective of "Infection Microbiology" for Veterinary Students

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Background

We want students to build up knowledge, which they will be able to use for practical problem solving in their future career. Knowledge can be categorized in different levels, Declarative and functioning knowledge are two different levels of knowledge. Declarative knowledge describes when students are able to recognize and describe e.g. a microorganism with own words. Functional knowledge is when students are able to use the knowledge for problem solving, for example designing a diagnostic test to identify specific traits of the microorganism (Biggs, 2011). We aim for deep learning in our teaching and can apply different approaches in the didactic situation to achieve this. One way is the problem-based approached described by Dewey (Dewey, 1998). In problem-based learning the students are presented for a realistic problem which they will work maybe in teams to solve. The problem will motivate the students to identify and learn the theories, methods and techniques which are necessary to solve the given problem. Active learning is another approach, which is always a part of the problem-based learning, to facilitate deep learning. Active learning can be described as a method that engage the students in the learning process (Prince, 2004). Collaborative learning where students work in groups is another strategy towards deeper learning. It cannot be claimed that collaborate learning will always be advantageous. However Norman and Schmidt, 2000 showed positive effects of collaborative learning in the academic environment. The advantages of collaborative learning is for example that students have a forum for discussion, misunderstandings can be corrected, explain-

ing things to others help the learning process and many students will have a stronger feeling of attachment to the institution when belonging to a group.

Aim

In the course "Infection Microbiology" (SVEB13026U) the above mentioned methods have been used to design a course with theoretical and practical parts to stimulate deep learning. In this assignment, I aim at evaluating the course mainly from the student's perspective. Do the course stimulate deep learning as intended?

Description of the course

Infection microbiology (SVEB13026U) is a mandatory course in the veterinary curriculum. The course is 15 ECTS and placed in block 1 and 2 on the second year. The capacity is 186 students who are divided in three teams for the laboratory exercises. The course consist of lectures, e-lectures, laboratory exercises and theoretical exercises.

Infection microbiology consists of three parts namely; microbiology, virology and parasitology which are taught by three different teams of teachers. The teaching is built so a lecture in a topic is followed by a practical exercise in that topic. However, since students are divided into three teams in the laboratory exercises and only two teams can attend these per day there is not a 100continuity in the theoretical and practical teaching. Furthermore, some laboratory exercises take several days to perform which means that different topics/experiments will be running at the same time in the laboratory.

The first part of the course is bacteriology, followed by parasitology and then virology. The laboratory exercises are somewhat different in the three parts of the course. The parasitology part of the exercises make up 8 sessions of 3 hours and are structured as spot demonstrations where students in groups circulate between the different demonstrations in the laboratory. They have a fixed time (e.g. 5 min) at each spot where a parasite is demonstrated in the microscope and a poster is explaining the lifecycle, hosts, transmission routes etc. In virology the exercises are case-based and there is a focus on the interpretation of the tests more than the actual performance

of the tests. The students have 3 sessions of 3 hours of exercises. In bacteriology students have 12 sessions of 3 hours of laboratory exercises. The initial part of the exercises are planed so students can follow a detailed "cook book" with step-by-step the instructions so students learn how to perform the tests which will, in the end, lead to the identification of the bacteria. The second part of the course is problem-based learning where students receive a sample and a description of the diseased animal from where the sample was taken. The student should then be able to choose the right tests, based on the description of the symptoms and the host from where the sample was isolated. The results of the tests should lead to the identification of the bacteria. The approach includes problem based, active and collaborative learning.

Course goals

Exerpts of the goals of the course are described in the Intended Learning Outcomes (Appendix A, B and C). These are divided in separate descriptions for bacteriology, parasitology and virology. In addition, the overall Learning Outcomes of the course which are found on the UCPH website can be found here: https://kurser.ku.dk/course/sveb13026u/

Approach and method of analysis

Student evaluations and a focus group interview with seven students were used for identification of the main challenges for students in the course. A semi-structured interview with one teacher from each part of the course was conducted to elucidate the teachers view on which part of the course were the most challenging for the students.

In total 85% of the students submitted the evaluation survey at the end of the course which is a merged evaluation of the three parts (bacteriology, parasitology and virology). The focus group interview with students were conducted at the end of a question hour before the exam. Seven students volunteered to meet and answer questions about the course. Two male and five female students in the age of 20-30 years participated in the focus group interview.

Two of the teachers who were interviewed had 12 and 15 years of experience in teaching the course while one had 3 years of experience.

Results and discussion

From the course evaluations, the following were identified as the most challenging parts for the students:

1. The ILO´s caused confusion.
2. The students experienced work overload.

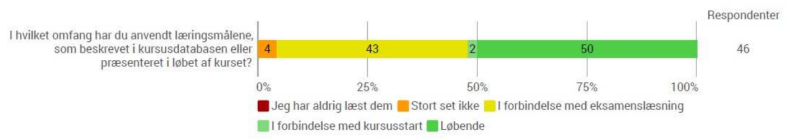
In addition, some students mention "The quality of the e-lectures". Some (four) ask for better sound and more "motivated" e-lectures with a uniform structure. This will not be further discussed in this report. Three students mention that it would be helpful to have access to the correct answers to the previous written exams when preparing for their own exam.

From the focus group interview, it was concluded that the most challenging part of the course was to navigate in Absalon, low quality e-lectures and too much to learn in a short time were the main comments on the negative side. On the positive side students mentioned that they learned a lot from the spots in parasitology and the quiz in bacteriology, and overall they appreciated the link between the theory and practical exercises.

Intended Learning Outcomes

In the survey, students are asked to what extend they use the intended learning outcomes (ILO´s) described in the course database or presented during the course. In figure 8, it is found that 43 % used the ILO´s in relation to the exam and 50 during the course. When students were asked to propose improvements six students gave comments to the ILO´s. One student wrote: "Bedre læringsmål (de er tæt på umulige at afkode, hvilket var en voldsom stressfaktor)".

	Observeret minimum	Observeret maksimum	Gennemsnit	Respondenter
I hvilket omfang har du anvendt læringsmålene, som beskrevet i kursusdatabasen eller præsenteret i løbet af kurset?	2,00	5,00	3,98	46



The Intended Learning Outcomes are presented on Absalon (see appendix). Furthermore, ILO´s have been presented in the beginning of e-lectures, lectures and exercises. Unfortunately, it seems to cause confusion that ILO´s are presented at more than one occasion since students stress that there is a lack of congruence between the ILO´s in Absalon and the ILO´s presented during teaching.

When reading the ILO´s presented in Absalon I find these rather detailed. They include lists of microorganisms which should be known. Rote learning (meaningless repetition to remember facts) are unavoidable in this course and necessary to some extend to be able to know that many microorganisms in the given time. However, it is important that the deep learning not is lost because of overloaded students.

Workload

There were no question in relation to workload in the survey but six students' comments on this when they were asked to propose improvements of the course. One student gives the following comment:

"Jeg ved godt at det er svært at ændre, men det er seriøst umuligt at huske alle de forskellige ting det kræves af en til eksamen. Der er ikke rigtig nogen rød tråd og enten så ved man det eller også har man ingen ide. Så selvom jeg har brugt gud ved hvor mange timer på at læse op og følge med løbende og dukket op til alle øvelser og forelæsninger, er jeg stadig i tvivl om jeg er bestået. Og misforstå mig ikke, det har været en af de mest spændende kurser vi har været igennem. Det er bare ærgerligt, at det eneste jeg husker, når jeg tænker tilbage på det er, at det føles som om, at jeg var ved at drukne".

Another student: *"pensum er fuldstændig uoverskueligt, ingen kan på nogen måde nå at forberede sig ordentligt til en eksamen med så stort pensum".*

The students are clearly frustrated and have a feeling of being overloaded. In addition, the three teachers lists the large syllabus as the main challenge for the students. However, one teacher turns it upside down and describes the main challenge as the students focusing on the exam and not on learning. She describes that students are less mature maybe because the course is earlier in the curriculum than previously. A student somehow supports this theory:

"Det er meget frustrerende at få så mange ting at vide om patogener, der ikke står i læringsmålene – ja "vi skulle lære til livet", men nu er ud-

dannelsen lavet sådan at, at man skal igennem eksaminer, for at komme videre, og vi sidder i forvejen med virkelig meget læsning, og ting vi skal prøve at huske, så hjælper det ikke med ekstra ting, vi måske ikke bliver spurgt om".

The last part of the sentence – '"it does not help with extra things that we might not be asked about" - indicates that the student is focused on passing the exam and less focused on what he/she can learn from the exercise/lecture.

Regardless of the reason for the students feeling of being over loaded it is described that the process of deep learning is not stimulated when students are feeling overloaded. Students may take shortcuts and turn to surface approaches in learning when the workload seems too high (Entwistle & Ramsden, 2015; Kember, 2004). In the light of this, it could be discussed if/how the perceived workload could be reduced, leaving more time for the students to focus on learning / understanding essential concepts of the course material. Laboratory exercises may facilitate deep learning, motivate students, gives practical skills and enhance the ability to collaborate, solve problems and critically assess results. It has been described that learning depends on experiencing the variation (Marton et al., 2004) which is particularly true for this course. For example, when interpreting a motility test in bacteriology the students will see that the tube with the inoculated media will have a different appearance with different bacteria due to different growth requirements of each bacteria. Some bacteria need oxygen, some tolerate oxygen and others cannot grow if oxygen is present. Factors which will affect the appearance of the test tube and which are not easy to learn by reading. In addition, when interpreting the described motility test the students may simultaneously understand the oxygen requirement/tolerance/intolerance of the tested bacteria. This learning is based on the experience of variation of the test. However, students who are stressed will often have a more narrow focus and I have experienced that they often (only) seek the answer to the test which may be a yes/no answer (motile/not motile). They do not always take the time to reflect on **why** the motility test appears different with different bacteria but they are satisfied as long as they can read if the bacteria is motile or not. In such situations, parts of the advantages of the lab exercises are lost. When taking into account how much effort is spend on organizing the exercises this "lost learning" is a problem. During the lab exercises, the students will experience that identification of bacteria is not as easy and predictable as it seems when reading about it.

The lab exercises are not “only” there to facilitate deep learning. From the interview with the three teachers, it was described that during the exercises the students will obtain skills that they will need as veterinarians. For example, be the ability to perform a McMaster egg count on a faeces sample or the ability to analyze a milk sample for bacterial pathogens, are skills that some will need later in their career. Most students are not aware that some skills are taught because they are necessary for their further careers and some skills are mainly taught because they will facilitate deep learning.

It is interesting to find out why the students feels overloaded in the course. One teacher mention in the interview that the requirements for passing the exam (parasitology) have been lowered over the years. The students are not able to acquire as much knowledge as previously. She explains that the syllabus is being changed since new diseases and pathogens are becoming important. The teachers may not be good enough to focus the lectures so the less relevant stories are skipped. Indicating that the syllabus are extended slightly over the years.

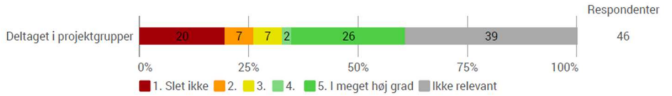
Other reasons for feeling overloaded could be other large courses running simultaneously. As seen in the curriculum below the Immunology, pathology and pathophysiology is being taught at the same time. This course is another large course which may be one of the explanations for the students feeling of a very high work load.

<table>
<tr><td rowspan="3">2. År</td><td>Blok 1 + 2</td><td>Immunologi, almen patologi og patofysiologi (15 ECTS)</td><td>Infektionsmikrobiologi (15 ECTS)</td></tr>
<tr><td>Blok 3</td><td>Basal statistik og epidemiologi (7,5 ECTS)</td><td rowspan="2">Veterinær farmakologi og toksikologi (15 ECTS)</td></tr>
<tr><td>Blok 4</td><td>Mikrobiel fødevaresikkerhed (7,5 ECTS)</td></tr>
</table>

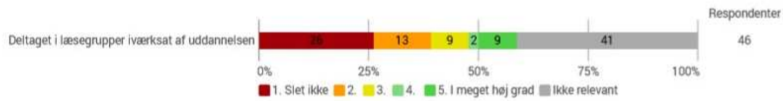
It might not be the only explanation for the feeling of high workload. What is interesting when reading the evaluations is that only 26 in project groups (Figure 8). This confuses me a bit, since I would claim that the groups which are formed during the laboratory exercises are project groups. In this case all student should answer that they have participated in project groups. There might be a misunderstanding here.

In figure 8, students are asked if they participated in study groups arranged by the institution. Only 11 % reply positive to this. It is unknown to me if only 11 % are participating in study groups or if only 11 % are participating in study groups which are **arranged by the institution**. To my knowledge the institution does not form study groups for the students. This question may be misinterpreted. From other teachers I have been informed that veterinary students does not form study groups to the same extend as earlier. When I was a veterinary student myself study groups were widely used (only few students were not part of a group). In these study groups students shared notes, helped each other to understand the difficult parts of the syllabus and helped each other before the exams. These groups does not exist to the same extend now, according to this student evaluation. I think this could be one part of the explanation for the feeling of overload during the course. There is a lot to learn and a lot to remember. It may be easier to be a small group where participants can help each other by discussion of the technical things in relation to bacteriology, parasitology and virology but also help each other to navigate in the more practical aspects of the course and exams.

	Observeret minimum	Observeret maksimum	Gennemsnit	Respondenter
Deltaget i projektgrupper	1,00	5,00	3,14	28



	Observeret minimum	Observeret maksimum	Gennemsnit	Respondenter
Deltaget i læsegrupper iværksat af uddannelsen	1,00	5,00	2,22	27



So why do the veterinary students not study in groups as they did previously? It may be explained by increased competition. Today the exam marks are more important since they need the high marks to be enrolled at the differentiation that they prefer.

Other reasons for the feeling of overload could be that the course is now placed earlier in the veterinary curriculum than previously.This has the disadvantage that students are not familiar with practical laboratory work and they will spend more mental resources on learning this. In addition, students may be less experienced in the task of "being students" at this timepoint. To gain the most from "infection microbiology" understanding of concepts as, aetiology, anamneses, pathogenesis and patho-anatomical descriptions would be helpful for the students. This knowledge will be obtained later in the curriculum (e.g. speciel patologi, medicin, kirurgi og reproduction) and in these courses the knowledge they have gained from infection microbiology will help the students to have a deeper understanding of the content in those courses.

Conclusion and future recommendations

In order to reduce the perceived workload different initiatives could be considered. The amount of laboratory exercises could be reduced to include only the exercises where students gain knowledge which are necessary for the future career and the exercises, which best facilitates deep learning. Learnings as focusing the microscopes, correct inoculation of test tubes/plates, handling waste and chemicals correctly, using pipettes etc. are things, which students will only learn by doing it. It requires time to learn and many of these skills are necessary to become a veterinarian. However, some of it might not be necessary to learn at this particular course when

taking into account that a feeling of overload may compromise students learning. A suggestion could be to construct theoretical exercises to replace some of the practical exercises since waste handling and microscopes which are out of focus will not take the resources from students in the theoretical exercise. As an example, students could be asked to draw a picture and explain the motility test of a specific bacteria instead of inoculating the real bacteria in a motility test tube. More time should be spend on describing and discussing different outcomes of the test. The bacteria in a real motility test could be demonstrated to the students in the theoretical exercise not to miss out the experience of the variation, which is still important. This way the students could focus their resources on understanding the test and the principle behind it. They would then miss to fail the practical test which happens for some students and which is also where students learn. E.g. when they inoculate with a shaky hand, inoculate with a mixed culture, forget to write the sample numbers on the test tubes or simply forget to inoculate the tube before incubation.

The course could also include a theoretical exercise training the students in combining the different microorganisms with the diseases they cause and the hosts and organs they affect. Such an exercise could be built as a game the students could play. It could for example be cards naming a microorganism which the students should then place on the right host and on the organ(s) the microorganism may affect. In this way active learning could help students with the rote learning necessary in the course. This exercise should then replace something (e.g. some practical exercises) not to add more to the course.

Also, it could be suggested that the students form study groups. During the laboratory exercises the students work in the groups of 5-6 students and students could be encouraged to extend these groups to study groups. When students study together in groups, they often have a better learning because they need to explain things to each other, they may avoid misunderstandings through discussions, some get a higher commitment to the study because of the engagement in the study group. It can be discussed how the groups should be formed – formally or non-formally established groups. Since we do not know, the students in advance and the groups have to be established at the first day it is difficult to use formally established groups based on strong / less strong students, student's expectations to the course etc. So far, the laboratory groups have been non-formally established which may work very good for some groups but there is a risk that some students are excluded and have to join groups where they do not thrive.

Increased congruence in the course could also be a way to reduce the workload. Some of the molecular typing methods which are taught in the course are repeated. E.g. the PCR technique are taught at bacteriology and again touched upon in virology. However, sometimes repetition is beneficial for the understanding and the students will understand that it is a general technique used for different purpose with different targets. Instead, it could be discussed if a more similar way of structuring both exercises and lectures could be beneficial for the students. Some students mention that they appreciate how the virology lectures were structured. This made it easy for the students to follow and they got all necessary information in the PowerPoint slides. All lectures basic lectures (the teaching about the specific microorganisms) could be built on the same template to ensure the necessary information is there and that there is not too much which is "nice to know/story telling" which they seem to dislike.

At last, I think that moving the course to the third or fourth year would help the students. However, since not all courses can be the last in the curriculum and they cannot all run in parallel, I am not able to suggest a solution for the best order of the courses. Instead, I will suggest that the most important definitions as, aetiology, anamneses, pathogenesis and pathoanatomical descriptions which are used in the course should be defined in an e-lecture (of high quality, off course) or in a traditional lecture. I think there is no available time in the schedule for a "real" lecture. It would require that somebody took the time to prepare such e-lecture but it can then be used in the following years. In the end, the perception of workload is a result of the student's ability to plan and prioritize the tasks. These skills will be trained throughout the veterinary curriculum but the courses need to be adjusted to the capability of the students not to push them towards surface learning.

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A Intended leaning outcomes for bacteriology (Exerpt)

Område	Generelle læringsmål	Detaljerede læringsmål
Morfologi af bakterieceller	Bakteriecellens opbygning og strukturelle komponenter	Form, størrelse og opbygning i Gram positive og Gram negative bakterier, samt i Spirochaeter. Molekylære strukturer i cellemembran, cellevæg, kapsel. Opbygning af sporer. Dannelse af sporer.
Funktion af cellekomponenter	Bevægelighed, adhæsion	Struktur, opbygning og placering af flageller. Struktur, opbygning og funktion af fimbrier
Bakteriegenetik	Genetiske elementer associeret med virulens og antibiotikaresistens. Overførsel af DNA mellem bakterier	Kromosomer i prokaryoter Genetiske elementer i bakterier Genetisk variation ved mutationer eller overførsel af DNA mellem bakterier (konjugation, transduktion, transformation) Bakteriophager
Bakterievækst og død	Vækst, død og inaktivering.	Celledeling i bakterier, Vækst som funktion af biokemiske og fysiske faktorer (ilt, pH, temperatur). Minimum, maksimum og optimum temperatur Vækstkurver og generationstid Inaktiveringskurver Biofilm Metoder til inaktivering anvendt i det bakteriologiske laboratorium
Antibiotikaresistens	Definitioner. Mekanismer bag antibiotikaresistens De særligt betydende typer af resistente bakterier Betydning på et overordnet plan. God praksis ved anvendelse af antibiotika	Definere MIC, MBC, breakpoint, krydsresistens, coresistens. Cellulære mekanismer bag antibiotikaresistens. Overordnet betydning af antibiotikaresistens ESBL, MRSA Overordnet forståelse af elementer i god praksis for anvendelse af antibiotika
Værts-parasit interaktion	Definitioner Generelle virulensfaktorer i bakterier	Definere virulens, patogenitet, virulensfaktor, patogenitetsfaktor, parasit, kommensal, opportunistisk patogen. Variation i mekanismer ved adhæsion hos Gram positive og Gram negative bakterier. Invasionsmekanismer. Mekanismer til overlevelse i

B Intended leaning outcomes for parasitology (Exerpt)

Læringsmål i Infektionsmikrobiologi: Parasitologi-delen, 2019-20
(PARx henviser til nummerering af forelæsninger, men husk at ikke alle relevante områder er blevet gennemgået til forelæsning)

Område	Generelle læringsmål	Detaljerede læringsmål (angivet på slægts-/artsniveau eller højere)
Parasitters systematik og taksonomi (PAR1+2)	• Overblik over dyreriget og den zoologiske systematik • Anvendelse af det zoologiske taksonomiske system • Invertebraters livscyklus og symbiotiske/parasitiske livsformer	
Parasitter som patogener (PAR2)	• Værtsdefinitioner og begrebet værtsspecificitet • Forstå forskellige former for livscyklus og optagelse af parasitter i værten • Forstå forskellige typer af immunitet og patogenese i relation til parasitaktivitet og værtsreaktioner	
Protozoologi		
Protozoers biologi (PAR1+3+4+5)	• Redegøre for definitionen af protozoer og overordnet systematik • Kendskab til og forståelse af visse grundbegreber og fællestræk ved protozo-infektioner i husdyr • Redegøre for overordnede karakteristika for hver af de fire væsentligste grupper af protozoer	Grupper af protozoer: flagellater, apicomplexa, ciliater og amøber • Detaljeret forklare og redegøre for livscyklus og livsstadier for Apicomplexa
Flagellater (PAR3)	• Kendskab til ætiologi, identifikation, livscyklus, væsentlige kliniske symptomer, diagnostik og diagnostiske stadier, patogenese, immunitet, epidemiologi (herunder udvikling i det fri) og eventuelle zoonotiske aspekter	Giardia Tritrichomonas Trichomonas Histomonas Leishmania Begrænset kendskab til: Trypanosoma Entamoeba
Apicomplexa – tarmcoccidier og cryptosporidier (PAR4)	• Kendskab til ætiologi, identifikation, livscyklus, væsentlige kliniske symptomer, diagnostik og diagnostiske stadier, patogenese, immunitet, epidemiologi (herunder udvikling i det fri) og eventuelle zoonotiske aspekter	Eimeria Isospora/Cystisospora Cryptosporidium
Apicomplexa – cystedannende coccidier	• Kendskab til ætiologi, identifikation, livscyklus, væsentlige kliniske symptomer, diagnostik og	Toxoplasma Neospora Sarcocystis

C Intended leaning outcomes for virology (Exerpt)

LÆSEVEJLEDNING OG LÆRINGSMÅL (LOI) VIROLOGI 2019-20

(rev190921)

BESKRIVELSE AF TEMAER OG LÆRINGSMÅL

Tema	Beskrivelse	LÆRINGSMÅL…den studerende skal kunne:
Basal virologi	Omfatter kapitlerne i *section V* (kapitel 54-60) samt udvalgte afsnit fra *section 1*. Vigtig del af pensum da det beskriver basale forhold vedr. virus med hensyn til struktur, taxonomi, replikation, patogenese; samt epidemiologi, forebyggelse og diagnostik. Vigtigt at læse disse kapitler med henblik på forståelse mere end udenadslære – få virologien ind under huden☺. Få styr på termerne – slå dem op igen og igen da de vil blive anvendt i resten af kurset	Se beskrivelse under hvert modul
Alvorlige virus	De virus der omtales i dette tema er typisk eksotiske virus som Danmark og Europa er fri for og som vil få fatale konsekvenser for eksporten hvis de indføres i Danmark – Basale ting om disse virus **skal terpes og læres på rygraden**!	- Gøre detaljeret rede for basale ting ved virus – virus familie, nukleinsyre type, replikation overordnet - Beskrive epidemiologien – udbredelse i verden og i DK, hvordan smitte den fra land til land og dyr til dyr, modtagelige dyrearter, zoonotiske aspekter, er infektionen akut eller kronisk, er der persistens? - Beskrive patogenesen og de kliniske symptomer– hvilke væv rammes, hvordan spredes den i dyret, kliniske symptomer, dødelighed, morbiditet - Gøre rede for hvordan virus infektionen kan diagnosticeres – hvilke dyr, hvilke prøvemateriale, hvilken laboratorie test; hvilke differential diagnoser er der? - Beskrive hvilke kontrol muligheder der er både nationalt og i besætningen – beskrive om der er mulighed for vaccination og hvordan der kan vaccineres
Vigtige virus trusler	Typisk virus der ikke findes i Danmark, men i lande tæt på os – disse virus vil få stor betydning enten produktionsmæssigt eller som en trussel mod mennesker (zoonoserne). Endvidere omfatter temaet vektor bårne virus som i fremtiden kan komme til Danmark som følge af klimaforandringer – en del af disse er også zoonoser	- Gør overordnet rede for basale ting ved virus – virus familie, evt. nucleinsyre type - Beskrive epidemiologien – udbredelse i verden og i DK, hvordan smitte den fra land til land og dyr til dyr, modtagelige dyrearter, zoonotiske aspekter, er infektionen akut eller kronisk, er der persistens? - Beskrive de væsentlige forhold ved patogenesen og de vigtigste kliniske symptomer– dødelighed og morbiditet - Gøre overordnet rede for hvordan virus infektionen kan diagnosticeres - hvilke differential diagnoser er der?