Master Biomedical Sciences

Na de eerste multidisciplinaire blokken, kiezen studenten voor een van de volgende specialisaties


Master's Open Dag Registreer hier

# Biomedical Imaging

### Introductie

Beeldvorming wordt steeds breder toegepast in biomedisch onderzoek en de klinische praktijk. Beeldvorming is de toepassing van geavanceerde visualisatietools om de kloof te overbruggen tussen de biomoleculaire routes naar menselijke ziekten. In deze unieke specialisatie word je getraind om geavanceerde beeldvormingstechnieken toe te passen, zoals Mass Spectrometry Imaging, Nanoscopy, Advanced Microscopy, PET en MRI in biomedisch onderzoek.

Met beeldvorming kunnen we biologische processen begrijpen, diagnoses ondersteunen, de effectiviteit van huidige behandelingen beoordelen en bijdragen aan de ontwikkeling van nieuwe behandelingen. We hebben de unieke kans om orgaanfuncties te bestuderen, zoals de beweging van het hart. En we kunnen een ziekteproces in de tijd volgen, zelfs voordat klinische symptomen optreden.

Als biomedisch wetenschapper, gespecialiseerd in beeldvorming, ben je een sleutelpersoon bij het oplossen van fysiologische vraagstukken met nieuwe beeldvormingsmethoden. Je communiceert zowel met clinici als ingenieurs en past state-of-the-art beeldvormingsmethoden toe op klinische behoeften. Je zorgt ervoor dat nieuwe beeldvormingsmethoden direct kunnen worden toegepast in een (pre)klinische (onderzoeks)omgeving.

### Is dit de juiste specialisatie voor je?

Deze specialisatie is bedoeld voor studenten met een sterke interesse in het veld van biomedische beeldvorming en de brede toepassing ervan in het biomedische veld. Samen met experts op dit gebied richt je je op de toepassing van een breed scala aan beeldvormingstechnieken in biomedisch en (translationeel) klinisch onderzoek en gebruik je deze technieken om specifieke vragen te beantwoorden met betrekking tot oncologie, neurologie, cardiovasculaire ziekten en metabole aandoeningen, om er maar een paar te noemen.

Tijdens stages krijg je de kans om bij te dragen aan projecten gerelateerd aan kanker, neurodegeneratieve, cardiovasculaire en metabole ziekten. De uitmuntendheid van de beeldvormingsinfrastructuur en expertise bij Maastricht UMC+ wordt wereldwijd erkend.

### Wat zal je leren?

In deze specialisatie leer je nieuwe technologieën toe te passen op biomedische wetenschappen om zo biomedische onderzoeksvragen op te lossen. Je leert ook de basisprincipes van beeldvormingsmodaliteiten, zodat je de juiste beeldvormingsmethode kan kiezen voor specifieke vragen. De focus ligt voornamelijk op het biomedische probleem en niet zo zozeer op de onderliggende methodologie/technologie.

De cursussen binnen de specialisatie bieden interactieve leermethodes om te leren van expert onderzoekers, praktische experimenten tijdens practica, lab bezoeken, workshops, projecten, interacties met clinici en stages in onze onderzoekslaboratoria

**Wat zijn de carrièreperspectieven?**

Hooggeschoolde wetenschappers zijn nodig om  beeldvorming toe te passen op wetenschappelijk onderzoek en in een ziekenhuis. Deze specialisatie bereidt je voor op een carrière bij een universiteit, in verschillende onderzoeksinstituten verbonden met een academische organisatie, biomedische en farmaceutische bedrijven en universiteitsziekenhuizen.

**Programma**

Cursus 1: Preklinische Beeldvorming
Deze eerste cursus richt zich op preklinische beeldvorming, variërend van ex vivo beeldvorming van een enkel molecuul tot in vivo beeldvorming van diermodellen. De cursus heeft tot doel inzicht te geven in de basisprincipes en biomedische toepassingen van ex vivo en niet-invasieve in vivo beeldvormingstechnieken. Beeldvormingstechnieken die worden besproken, zijn massaspectrometrie beeldvorming (MSI), elektronen- en lichtmicroscopie (EM en LM), echografie, Magnetische Resonantie Beeldvorming (MRI), Computertomografie (CT) en nucleaire beeldvorming (Single Photon Emission Computertomografie (PECT) en Positron Emissie Tomografie (PET)).

e leert monsters voorbereiden, verwerven, transformeren, analyseren en verschillende beeldvormingsmodaliteiten gebruiken om subcellulaire structuren tot gehele dierbeeldvorming te visualiseren. Samen leggen deze preklinische onderzoeksmethoden de weg vrij voor nieuwe diagnostische benaderingen die nodig zijn voor gepersonaliseerde en systemische geneeskunde.

Binnen deze cursus ontwerp je een project om te leren hoe je een biomedische onderzoeksvraag kunt oplossen met geavanceerde beeldvorming. De onderscheidende (moleculaire) beeldvormingsinfrastructuur bij Maastricht UMC+ staat ter beschikking van studenten, die de kans krijgen om experts op het gebied van beeldvorming te ontmoeten en ermee in gesprek te gaan.

**Cursus 2: Klinische Beeldvorming**
Detweede cursus in deze specialisatie richt zich op de toepassing van beeldvorming om fysiologische en pathologische ziekteprocessen bij mensen in een klinische (onderzoeks)omgeving aan te pakken. Beeldvormingstechnologieën bieden steeds nauwkeurigere informatie over de morfologie, structuur, functie en dynamiek van levende systemen. In de levenswetenschappen en (translationeel) klinisch onderzoek is het gebruik van (diagnostische) beeldvormingstechnologieën steeds meer verspreid geworden en heeft het nu ook zijn intrede gedaan op het gebied van preventie en therapiebewaking.

Deze cursus richt zich op beeldvorming bij behandelingsbeslissingen op basis van moleculaire klinische diagnostische informatie en patiëntbeelden. Klinische beeldvorming richt zich op in vivo beeldvorming, beeldgestuurde interventies/bioptie en moleculaire weefselpathologie en morfologie. Deze cursus behandelt translationele aspecten van systeembiologie tot in vivo beeldvorming van de patiënt met MRI/MRS en andere radiologische methoden.

Je wordt geïntroduceerd in het concept van radiomica, waarbij beeldkenmerken worden geëxtraheerd uit medische beelden. Intraoperatieve diagnostiek en beeldgestuurde chirurgie worden bestudeerd als innovatieve benaderingen die moleculaire analytische informatie in handen van medische professionals brengen. Deze cursus leert biomedische wetenschappers om de schakel te zijn tussen beeldvormingstechnologie en de kliniek. Bovendien biedt deze cursus een translationele/klinische omgeving om studenten te leren samen te werken met clinici aan innovaties in de systeemgeneeskunde.

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

## Vraag het aan een student

Mike koos de specialisatie Biomedical Imaging. Hij post wekelijks over zijn ervaringen op Instagram.

Hij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, zijn specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie *Biomedical Imaging*. Drie personen die op de een of andere manier te maken hebben met deze specialisatie vertellen je er graag meer over: dr Tiffany Porta Siegel, student Rob Janssen en senior principal scientist bij Janssen Pharma Rob Vreeken.

## Master BMS, specialisation Biomedical Imaging

## Genetics and Genomics

**Introductie**

Genetica en genomica spelen beide een rol in gezondheid en ziekte. Genetica helpt ons begrijpen hoe ziekten worden overgeërfd en welke screening- en testopties of behandelingen beschikbaar zijn. Genomica helpt ons ontdekken waarom sommige mensen ziek worden door bepaalde infecties, omgevingsfactoren en gedragingen, terwijl anderen dat niet doen.

**Is deze specialisatie geschikt voor mij?**
Deze specialisatie is ontwikkeld om studenten een sterke basis en expertise te bieden op het gebied van genetica. De belangrijkste focus ligt op de toepassing van principes van genetica en genomica in wetenschappelijk onderzoek en in de kliniek, met specifieke aandacht voor kanker, cardiogenetica, neurogenetica, modelsystemen, forensische en gepersonaliseerde geneeskunde.

**Wat ga ik leren?**
Je zult:

- kennis opdoen over technologieën voor het verzamelen van 'omics'-gegevens op grote schaal en over modellen die worden gebruikt voor genetische manipulatie of complexe menselijke aandoeningen;

- leren over de concepten en beperkingen van genetische tests, genetische diversiteit en de invloed van epigenetica op de fundamentele regulatie van genexpressie;
- gegevens analyseren en ethische en maatschappelijke kwesties met betrekking tot genetica en genomica definiëren;
- de concepten van moleculaire genetica toepassen in het kader van onderzoek en behandeling van ziekten (kankerprogressie, cardiogenetica en neurogenetica);
- genetische en biologische paden identificeren in complexe ziekten;
- en genetica en genomica toepassen in de persoonlijke geneeskunde.

**Wat zijn mijn carrièreperspectieven?**
Deze specialisatie bereidt je voor op een toekomst gericht op onderzoek op het gebied van genetica en genomica in de academie, biomedische bedrijven en in de kliniek.

**Programma**
In de eerste cursus worden de basisprincipes van genetica en genomica onderwezen. Deze cursus dient als basis voor het werk in de tweede cursus, die zich richt op de vertaling en toepassing van de kennis die is opgedaan in de eerste cursus om uitdagende klinische problemen op te lossen.

**Cursus 1: Geavanceerde Principes van Genetica en Genomica**
In deze cursus worden de moleculaire mechanismen van genetische en milieueffecten op genexpressie en eiwitfunctie behandeld. Daarnaast worden de principes van verschillende algoritmen en de databases en analytische programma's die beschikbaar zijn in het publieke domein besproken. Tot slot zal de impact van genetica en genomica op onderzoek en de samenleving met betrekking tot gepersonaliseerde geneeskunde en ethische kwesties worden besproken.

**Cursus 2: Klinische en Toegepaste Genetica en Genomica** Deze cursus gaat dieper in op de toepassing van de principes van genetica en genomica in wetenschappelijk onderzoek en klinische toepassingen, met specifieke aandacht voor kanker, cardiogenetica, neurogenetica, modelsystemen, forensica en gepersonaliseerde geneeskunde.

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

# Vraag het aan een student

Leela koos de specialisatie *Genetics and Genomics*. Zij post wekelijks over haar ervaringen op Instagram.

Zij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, haar specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie Genetics and Genomics. Drie personen die op de een of andere manier te maken hebben met de specialisatie vertellen je er graag meer over: prof.dr Ronit Shiri-Sverdlov, student Jasper Germeraad en laboratorium specialist in Klinische Genetica bij MUMC+ dr Bianca van den Bosch.

# Master BMS, specialisation Genetics and Genomics

## Inflammation and Pathophysiology

**Introductie**

Onze vergrijzende samenleving staat voor vele bedreigingen, waaronder oncologische, neurologische en cardiovasculaire problemen. Vaak hebben deze problemen een inflammatoire aard of worden ze veroorzaakt door infecties. Daarom heeft deze specialisatie tot doel een grondig, klinisch relevant begrip te ontwikkelen van verschillende mechanismen van ziekteontwikkeling. De specialisatie beschrijft ook actuele relevante diermodellen.

**Is dit de juiste specialisatie voor mij?**
We bereiden je voor om bij te dragen aan het begrijpen van ontsteking en pathologische bedreigingen, en nieuwe behandelingsstrategieën te ontwikkelen. De ontwikkeling omvat het manipuleren van het immuunsysteem om celtherapieën, antilichaamtherapie, vaccinatie, medicijnontwikkeling en gentherapie te ontwikkelen.

**Dit is de specialisatie voor jou:**

- als je geïnteresseerd bent in het manipuleren van het immuunsysteem, en
- als je een carrière wilt nastreven in de industrie (biotechnologie) of in de academische wereld.

**Wat ga ik leren?**
Je zult:

- de pathofysiologie van relevante organen leren,
- technieken leren voor de studie van moleculen, cellen en organismen, klinisch relevant begrip krijgen van verschillende ziektemechanismen,
- leren om immunologische bedreigingen aan te pakken,
- nieuwe therapeutische strategieën ontwikkelen gericht op het immuunsysteem,
- worden voorbereid op werk in de academie en industrie,
- kritisch lezen en denken,
- onderzoek ontwerpen, uitvoeren, analyseren, uitleggen en verdedigen (via onderzoeksartikelen, essays, presentaties),
- samenwerken in kleine teams.

**Doelen van deze specialisatie zijn:**

- begrijpen van pathofysiologie: de studie van structurele en functionele veranderingen in weefsels en organen die leiden tot ziekte;
- evalueren van verschillende soorten therapieën, vaccinatie en immuunsysteemeffectoren;
- het manipuleren van het immuunsysteem,
- behandeling van ziekte.

**Wat zijn mijn carrièreperspectieven?**
Deze specialisatie bereidt je voor op een onderzoekscarrière op het gebied van ontsteking en pathofysiologie in de academische wereld, ziekenhuizen en de industrie (biomedische bedrijven), enzovoort (bijv. PhD, R&D).

**Programma**

Deze specialisatie combineert een opleiding in concepten met een geavanceerde training in immunologische technieken.

**Cursus 1: Ontsteking en pathofysiologie**

- leer steriele ontsteking en andere pathologische bedreigingen die leiden tot degeneratie
- leg hypersensitiviteitsstoornissen uit
- leg immuniteit tegen tumoren uit
- beoordeel immuniteit tegen microben

**Cursus 2: Ontsteking en pathofysiologie - Manipulatie van het immuunsysteem, behandeling van ziekte**

- leg antilichaamtechniek uit en ontwerp deze
- leg celtherapie uit en ontwerp deze
- evalueer en ontwerp vaccinatie
- bespreek orgaantransplantatie
- beoordeel gentherapietechnieken
- beoordeel het potentieel van microbiome-doelstellingen

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

# Vraag het aan een student

Konstantina koos de specialisatie *Genetics and Genomics*. Zij post wekelijks over haar ervaringen op Instagram.

Zij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, haar specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie Inflammation and Pathophysiology. Drie personen die op de een of andere manier te maken hebben met de specialisatie vertellen je er graag meer over: prof.dr Pilar Martinez, student Jan Gaede and dr. René Hoet (VP Biologics Research bij Bayer AG en professor in Biopharmaceutics aan UM).

# Inflammation and Pathophysiology - Biomedical Sciences

# Neuromodulation

**Introductie**

De neurowetenschap heeft ons onschatbare inzichten gegeven in de organisatie van het centrale zenuwstelsel. Gebaseerd op decennia van fundamenteel en klinisch onderzoek, is neuromodulatie

onlangs naar voren gekomen als een zeer veelbelovend vakgebied dat het landschap van de neurowetenschap kan veranderen. Uitgerust met gedetailleerde kennis van neuroanatomie en neurofysiologie zijn er een breed scala aan invasieve en niet-invasieve technieken ontwikkeld die manipulatie van het centrale zenuwstelsel op micro- tot macroniveau mogelijk maken. Dit biedt ongekende mogelijkheden voor wetenschappelijk onderzoek en opent de deur voor nieuwe klinische toepassingen bij verschillende ziekten/aandoeningen van het centrale zenuwstelsel. Ter illustratie kan diepe hersenstimulatie specifieke kernen in de hersenstam richten om trillingen bij de ziekte van Parkinson direct te verminderen. Transcraniële magnetische stimulatie heeft bewezen effectief te zijn bij medicijnresistente depressie met vrijwel geen bijwerkingen. Ruggenmergstimulatie kan chronische pijnklachten verlichten. Deze en vele andere voorbeelden zullen worden belicht in deze specialisatie in neuromodulatie.

Universiteit Maastricht heeft een sterke traditie in onderzoek en toepassing van neuromodulatie, over een breed spectrum van neuromodulatietechnieken. Ingebouwd in dit unieke neuromodulatienetwerk bieden we deze unieke specialisatie aan als onderdeel van de masteropleiding Biomedical Sciences. Deze specialisatie is interdisciplinair van inhoud en interdepartementaal van structuur, ontworpen om state-of-the-art theoretische en methodologische training te bieden. Studenten kunnen kiezen tussen stages in onderzoekslaboratoria en/of klinische stages en/of industriële omgevingen. Studenten worden voorbereid om de mechanismen van de menselijke hersenen te ontrafelen en het volledige therapeutische potentieel van neuromodulatie in verschillende klinische gebieden te ontketenen.

**Is dit de juiste specialisatie voor mij?**
Deze specialisatie is ontwikkeld voor studenten die enthousiast zijn over het potentieel van neuromodulatie in wetenschappelijk onderzoek. We hopen nieuwsgierige en creatieve geesten aan te trekken die de principes van neuromodulatie willen leren, geïnspireerd willen raken door huidige klinische toepassingen en vervolgens willen bijdragen aan dit zeer interdisciplinaire veld.

**Wat ga ik leren?**

Je zult:

- essentiële kennis hebben over neuroanatomie en neurofysiologie om de basisprincipes van de huidige neuromodulatietechnieken te begrijpen,
- een uitgebreid overzicht hebben van state-of-the-art neuromodulatiebenaderingen en hun huidige klinische toepassingen,
- begrijpen hoe inzichten in de pathofysiologie van het centrale zenuwstelsel kunnen worden vertaald naar klinische toepassingen van neuromodulatie in de neurologie en psychiatrie,
- en op de hoogte zijn van huidige trends, ontwikkelingen, beperkingen en toekomstige uitdagingen op het gebied van neuromodulatie.

**Wat zijn mijn carrièreperspectieven?**

Het vakgebied van neuromodulatie is steeds relevanter in wetenschappelijk onderzoek, klinische omgevingen en de industrie. Er is veel vraag naar deskundige experts die bestaande methodologie verder kunnen ontwikkelen, nieuwe toepassingen kunnen verkennen en de implementatie van neuromodulatietechnieken in de klinische praktijk kunnen bevorderen. Deze specialisatie bereidt je voor op een toekomst in het vakgebied van neuromodulatie bij een academische instelling, klinische instelling of biomedisch bedrijf (bijv. PhD-kandidaat, R&D).

**Programma**

Deze specialisatie biedt een uitgebreid overzicht van de fundamentele principes en toepassingen van huidige neuromodulatietechnieken.

**Cursus 1: Invasieve neuromodulatie**

De eerste cursus begint met het verstrekken van essentiële kennis over neuroanatomie en neurofysiologie die nodig is om de basisprincipes van de huidige neuromodulatietechnieken te begrijpen. Op basis van deze principes worden verschillende state-of-the-art invasieve neuromodulatietechnieken in detail onderzocht, met een bijzondere focus op diepe hersenstimulatie, ruggenmerg- en sacrale neuromodulatie. Bovendien laat de cursus zien hoe inzichten in de pathofysiologie van het centrale zenuwstelsel kunnen worden vertaald naar klinische toepassingen van neuromodulatie in de psychiatrie en neurologie. Prominente voorbeelden zijn de toepassing van diepe hersenstimulatie bij de ziekte van Parkinson en OCD. Deze en vele andere voorbeelden worden besproken, waarbij het potentieel van invasieve neuromodulatie in de klinische praktijk wordt onthuld. Aan het einde van deze cursus hebben studenten een goed begrip van de huidige invasieve neuromodulatietechnieken en zijn ze op de hoogte van recente trends en ontwikkelingen voor zowel fundamentele als klinische toepassingen.

**Cursus 2: Niet-invasieve neuromodulatie**
Deze cursus zal verschillende state-of-the-art niet-invasieve neuromodulatietechnieken in detail onderzoeken, met een bijzondere focus op transcraniële magnetische en elektrische stimulatie (TMS/TES). Bovendien laat de cursus zien hoe inzichten in de pathofysiologie van het centrale zenuwstelsel kunnen worden vertaald naar klinische toepassingen van niet-invasieve neuromodulatie in de psychiatrie, neurologie en neurorevalidatie. Prominente voorbeelden zijn de toepassing van TMS bij depressie en beroerte. Deze en vele andere voorbeelden worden besproken, waarbij het potentieel van niet-invasieve neuromodulatie in de klinische praktijk wordt onthuld. Aan het einde van deze cursus hebben studenten een goed begrip van de huidige niet-invasieve neuromodulatietechnieken en zijn ze op de hoogte van recente trends en ontwikkelingen voor zowel fundamentele als klinische toepassingen.

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

# Vraag het aan een student

Sara koos de specialisatie *Neuromodulation*. Zij post wekelijks over haar ervaringen op Instagram.

Zij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, haar specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie Neuromodulation. Drie personen die op de een of andere manier te maken hebben met de specialisatie vertellen je er graag meer over: onderzoeker Alix Thomson, prof.dr Alexander Sack en prof.dr. Yasin Temel.

## MSc Biomedical Sciences: specialisation Neuromodulation

# Nutrition, Physical Activity and Metabolism

### Introductie

Een levensstijl gekenmerkt door overvoeding van macronutriënten en ondervoeding van micronutriënten, samen met lichamelijke inactiviteit, leidt tot ontsporingen in metabole gezondheid en uiteindelijk tot verslechterde functie en gezondheid. Een breed scala aan huidige voorkomende aandoeningen in westerse samenlevingen vindt gemeenschappelijke grond in metabolisme dat ontspoort.

Het doel van deze specialisatie is om de fysiologie en de mechanismen die aan deze ontsporingen ten grondslag liggen te begrijpen, als basis voor het ontwerpen en optimaliseren van preventieve en therapeutische voedings- en levensstijlinterventies die de metabole gezondheid verbeteren en de ziektetoestand verlichten.

### Is dit de juiste specialisatie voor mij?

- Als je oprecht geïnteresseerd bent in hoe voeding, lichamelijke activiteit en een sedentaire levensstijl van invloed zijn op de gezondheid...
- Als je geïnteresseerd bent in de mechanismen (van molecuul tot mens) die de (mal)adaptieve reacties van het menselijk lichaam op veranderingen in energiebeschikbaarheid en -vraag reguleren...
- Als je wilt weten hoe lichaamsbeweging en fysieke activiteit de gezondheid kunnen bevorderen...
- Als je enthousiast bent om de kennis op te doen die nodig is om nieuwe levensstijlinterventies te ontwerpen om de gezondheid te bevorderen...

Dan is dit de specialisatie voor jou!

### Wat ga ik leren?

In deze specialisatie zul je dieper ingaan op:

- de integratieve en interorgaanfysiologie van belangrijke metabole processen;
- de biochemische en cellulaire basis voor veranderingen in de gezondheid veroorzaakt door voeding en lichaamsbeweging;
- de biochemische en cellulaire basis voor de gezondheidsbedreigende effecten van een sedentaire levensstijl;
- hoe voeding en lichaamsbeweging van invloed zijn op niet-overdraagbare ziekten;
- identificatie van routes die fundamenteel zijn voor het ontwerpen van levensstijlinterventies die de energieomzet en gezondheid bevorderen.

### Wat zijn mijn carrièreperspectieven?

Om de progressieve toename van aandoeningen die gemeenschappelijke grond vinden in verstoorde stofwisseling te stoppen, hebben we hoogopgeleide mensen nodig om potentiële succesvolle doelen en routes voor interventie via wetenschappelijk onderzoek te identificeren. Dit omvat onderzoek in de academische wereld, ziekenhuizen en de industrie (variërend van biomedische en farmaceutische bedrijven tot bedrijven die wearables ontwikkelen om gezondheid en fysieke activiteit te monitoren). Je kunt ook de opgedane kennis toepassen in (academisch) onderwijs of in de volksgezondheid om nieuwe wetenschappelijke achtergrond te bieden voor nieuwe

gezondheidsbevorderingsprogramma's.

**Programma**

**Cursus 1: Voeding, Lichamelijke Activiteit en Metabolisme: Fundamentele Aspecten**

Deze cursus biedt diepgaand inzicht in de belangrijkste systemen van menselijke voedings- en oefenfysiologie en metabolisme. Met basiskennis over voedingsstofopname door het maagdarmkanaal als uitgangspunt, zal de cursus zich richten op cellulaire en orgaanspecifieke routes voor de omzetting van macromoleculen in hun oxideerbare derivaten. De centrale rol van tussenliggend metabolisme, metabolieten en kleine circulerende hormonen zoals peptiden in metabole controle en interorgaankruisgesprek (spier-lever-vetweefsel-cardiovasculair systeem-hersenen) zal grondig worden bestudeerd in de nuchtere, postprandiale en geoefende toestand. Deze cursus biedt de mechanistische basis om te begrijpen hoe afwijkingen in energie- en substraatmetabolisme de gemeenschappelijke noemer kunnen zijn bij meerdere zeer voorkomende aandoeningen zoals de ziekte van Alzheimer, Parkinson, sommige soorten kanker of uitzaaiingen, COPD, sarcopenie, obesitas, type 2 diabetes en gerelateerde hart- en vaatziekten. Veranderingen in de energiestatus, energieperceptie en energieomzet zijn allemaal geassocieerd met deze aandoeningen. Deze veranderingen kunnen voortkomen uit aangetaste signalering van nucleaire receptoren, post-transcriptionele modulatie via bijv. micro RNA's, post-translationele modificatie (acetylering, glycosylering, fosforylering) die de eiwitfunctie en metabole processen belemmert en metabole processen die de energiestatus van de aangetaste cellen veranderen in termen van NAD+/NADH en ADP/ATP-gerelateerde energiestatus. Aangezien mitochondriën de subcellulaire hub zijn in de energieomzet, wordt gedetailleerde kennis over de dynamiek van het mitochondriale netwerk als een essentieel onderdeel van deze cursus beschouwd.

**Cursus 2: Levensstijlinterventies en Metabolisme; een Translationeel Perspectief**

In deze cursus wordt de rol van voeding en lichamelijke activiteit bij het voorkomen van chronische ziekten bij mensen overwogen. Levensstijlfactoren die metabolisme op micro- (cellulair) en macro- (orgaan) schaal moduleren, worden bestudeerd via een translationele benadering. Deze cursus tilt conventionele strategieën om de gezondheid te bevorderen (zoals voedings- en oefeninterventies) naar een hoger niveau door de onderliggende mechanismen te verkennen en hoe deze interventies chronische ziekten zoals hart- en vaatziekten, kanker, chronische luchtwegaandoeningen en diabetes kunnen voorkomen. Interventies zoals gewichtsverlies, (voedings)stoffen, lichaamsbeweging, sedentair gedrag, slaap, stressmanagement ter bevordering van metabolisme zullen studie-onderwerpen zijn. De basis voor interindividuele verschillen in responsiviteit, inclusief genetica, wordt bestudeerd in het kader van gepersonaliseerde interventies om de gezondheid te bevorderen en ziekten te voorkomen.

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

# Vraag het aan een student

Elisa koos de specialisatie *Nutrition, Physical Activity and Metabolism*. Zij post wekelijks over haar ervaringen op Instagram.

Zij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, haar specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie Nutrition, Physical Activity and Metabolism. Drie personen die op de een of andere manier te maken hebben met de specialisatie vertellen je er graag meer over: prof.dr Matthijs Hesselink, student Marvin Feldmann en voedings-en bewegingsonderzoeker bij UM Marlies de Ligt.

## Master BMS, specialisation Nutrition, Physical Activity and Metabolism

# Regenerative Medicine

### Introductie

Een toenemend verouderende bevolking in de geïndustrialiseerde wereld gaat gepaard met een aantal nieuwe uitdagingen. Zo neemt met de vergrijzing en een actievere levensstijl ook de vraag naar behandelingen voor beschadigde en zieke organen en weefsels toe. De interventies die worden gebruikt om met succes de functie van beschadigde organen of weefsels te herstellen, zijn de afgelopen decennia ook veranderd. Terwijl zo'n dertig jaar geleden implantaten werden gebruikt om passief de functie van slecht functionerend weefsel over te nemen, ligt de focus tegenwoordig op het ontwikkelen van methoden die het lichaam tijdelijk 'triggeren' om zichzelf te repareren of te regenereren. Bovendien moeten dergelijke interventies betaalbaar zijn, omdat de last voor ons gezondheidszorgsysteem ook groeit.

Om succesvolle en betaalbare regeneratieve strategieën te kunnen ontwikkelen, moet kennis worden geïntegreerd uit verschillende disciplines. Een actieve samenwerking tussen chemici, materiaalwetenschappers, natuurkundigen, biologen, computationele wetenschappers en clinici is nodig om daadwerkelijk het verschil te maken in het biomedische veld.

### Is dit de specialisatie voor mij?

Deze specialisatie is ontwikkeld voor studenten met interesse in een multidisciplinair veld dat tot doel heeft oplossingen te creëren voor het herstellen van de structuur en de functie van permanent beschadigde weefsels en organen door gebruik te maken van een combinatie van wetenschap en technologie. Regeneratieve geneeskunde (RG) is inherent translationeel en gebruikt basiskennis om echte klinische problemen op te lossen. Binnen deze specialisatie zullen de onderwerpen zich richten op zowel de moleculair-biologische (inclusief stamcelbiologie en gentherapie) als de technologische (inclusief weefseltechniek en biofabricagetechnologieën) aspecten, en de combinatie daarvan binnen een klinische context.

### Wat ga ik leren?

Je zal:

- een overzicht krijgen van de wetenschap en technologie op het gebied van RG;
- worden blootgesteld aan de essentie van multidisciplinariteit binnen RG;
- het verschil begrijpen tussen basisonderzoek en translationeel onderzoek;
- leren hoe je nieuwe uitvindingen op het gebied van RG naar de markt kunt brengen;
- de wetenschappelijke reis maken van basisonderzoek en technologie naar een klinische toepassing; en

- leren om gespecialiseerde kennis over te brengen naar een groep wetenschappers met verschillende achtergronden en specialisaties.

**Wat zijn mijn carrièreperspectieven?**

Deze specialisatie bereidt je voor op een toekomst gericht op onderzoek op het gebied van regeneratieve geneeskunde in de academische wereld, biomedische bedrijven, enzovoort (bijv. PhD, R&D).

**Programma**

In de eerste cursus worden de basisprincipes van RG onderwezen. Deze cursus dient als basis voor het werk in de tweede cursus, die zich richt op de vertaling en toepassing van de kennis die is opgedaan in cursus 1 om uitdagende klinische problemen op te lossen.

**Cursus 1: De Wetenschap en Technologie van Regeneratieve Therapieën**

Deze cursus gaat over blootstelling aan de essentie van multidisciplinariteit binnen RG. Je zult je kennisniveau over de technologie en wetenschap achter regeneratieve geneeskunde zoals celtherapie, materiaalkunde, fabricagetechnologieën en combinaties daarvan, binnen een klinische context, verhogen.

**Cursus 2: Therapieën Vertalen naar de Kliniek en de Markt**

In deze cursus maken we de wetenschappelijke reis van wetenschap en technologie naar de kliniek en producten. Met behulp van werkelijke klinische uitdagingen moet je een nieuwe oplossing uitwerken voor dat klinische probleem, ondersteund door experts in het veld. Je zult weten waar je biomedische oplossingen in de Technology Readiness Level-keten moet plaatsen en je leert hoe je het verder kunt brengen en gespecialiseerde kennis kunt overbrengen naar een groep wetenschappers uit verschillende disciplines.

**Meer informatie**

Voor meer informatie over toelating kun je contact opnemen met ons master toelatingsbureau.

# Vraag het aan een student

Jarod koos de specialisatie *Regenerative Medicine*. Hij post wekelijks over zijn ervaringen op Instagram.

Hij beantwoordt ook graag vragen over het masterprogramma in Biomedical Sciences, zijn specialisatie en het (studenten)leven in Maastricht op Instagram.

Deze video geeft je een idee van de specialisatie Neuromodulation. Drie personen die op de een of andere manier te maken hebben met de specialisatie vertellen je er graag meer over: prof.dr Jan de Boer, student Daphne Eussen en ondernemer Niloofar Tahmasebi.

# Master BMS, specialisation Regenerative Medicine

First year courses

# Biomedical Sciences Year 1

Fac. Health, Medicine and Life Sciences

# Biomedical Challenges

## Full course description

Biomedical Sciences help us to better understand how the human body works. The insights and lessons learned can then be used in understanding, diagnosing, treating and preventing human diseases. Biomedical Sciences specifically translate knowledge from the natural sciences to medical applications. In this first course of the master program, students will be introduced to the diverse topics Biomedical Sciences deal with. The course will tackle the pathophysiology, diagnostic, therapy and current research of several diseases, with a focus on their biomedical challenges. Understanding of these fundamental principles is necessary to facilitate the development of diagnostics and therapies to better cope with the diseases.

The focus of this course lies with current biomedical challenges. Several diseases have been selected for this course, giving students ample opportunity to discuss a wide range of challenges to be tackled in unraveling the pathophysiology, diagnostic, therapy and current research of these diseases. The course is divided into 3 themes (mitochondrial disorders, neurological and mental disorders, metabolic disorders) and a Biomedical Project. The 3 themes will be addressed during lectures, PBL cases, journal clubs, workshops and practicals. For the Biomedical Project, students will choose a topic to work on during the course in a team of 3 to 4 students. The state-of-the-art biomedical knowledge and challenges will be presented for this topic. The Biomedical Project focuses on defining a single biomedical challenge, and will be presented during a symposium, as well as described in the project report. Finally, regular meetings with biomedical professionals and a site visit to the Chemelot campus will offer the students perspective on the employment and challenges in various biomedical fields.

## Course objectives

The course’s Intended Learning Goals (ILOs):

ILO1 Distinguish different mechanisms and factors behind molecular dysfunction in

1. Neuromuscular and mitochondrial disorders
2. Mental and neurodegenerative disorders
3. Metabolic disorders including obesity and diabetes mellitus
4. Disease of choice in the context of the group work

ILO2 For aforementioned disorders describe the current knowledge of

1. Etiology of disease including risk factors and lifestyle
2. Biomolecular basis of disease
3. Manifestation of the molecular dysfunction in the form of phenotype

4. Diagnostics (including molecular read-outs)
5. Innovative and personalized treatment options

ILO3 Elucidate challenges in aforementioned aspects of disease

ILO4 Work according to the scientific method

ILO5 Synthesize and present complex scientific information on state-of-the-art knowledge and challenges in biomedical field

ILO6 Explore future applications of biomedical knowledge

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1001
Period 1
4 Sep 2023
27 Oct 2023
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- L.C.C. de Nijs

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), PBL, Presentation(s), Working visit(s), Skills
Assessment methods:
Assignment, Attendance, Final paper, Presentation, Take home exam
Keywords:
biomedical breakthroughs, biological systems, natural sciences, medical applications, disease
Fac. Health, Medicine and Life Sciences

# Biomedical Approaches

### Full course description

The course teaches to apply core biomedical skills, methods and techniques in determining, analysis, designing interventions and preventative strategies targeting pathological and age-related cellular processes.

Core biomedical techniques are utilized to address ageing and age-related diseases:

- biomedical imaging
- neurological
- regenerative medicine
- inflammation and pathophysiology

- genetics and genomics
- nutrition, physical activity and metabolism

## Course objectives

2022-2023 MBS1002• genetics and genomics• inflammation and pathophysiology• regenerative medicine• neuromodulation• nutrition, physical activity and metabolism• biomedical imagingsix core biomedical perspectives:preventative strategies addressing hallmarks of ageing and age-related disorders fromApply core biomedical skills to determine, analyse, design interventions and ILO4.• immuno-ageing and immunosenescence• neurodegenerative disorders• cancer development• deregulated nutrient sensing• (epi-)genetic alterations, genomic instability and telomere attrition• cellular senescence and stem cell exhaustiondifferent types of damage and compensatory responses:homeostasis and determine the ageing process, as well as interconnections between theGain understanding of the following hallmarks of ageing that contribute to loss of ILO3.and alleviate detrimental changes associated with ageing. Familiarize students with the whole spectrum of interventions to postpone, delayILO2. Teach students hallmarks of ageing and the concept of ageing as a diseaseILO14 2022-2023 MBS1002• genetics and genomics• inflammation and pathophysiology• regenerative medicine• neuromodulation• nutrition, physical activity and metabolism• biomedical imagingsix core biomedical perspectives:preventative strategies addressing hallmarks of ageing and age-related disorders fromApply core biomedical skills to determine, analyse, design interventions and ILO4.• immuno-ageing and immunosenescence• neurodegenerative disorders• cancer development• deregulated nutrient sensing• (epi-)genetic alterations, genomic instability and telomere attrition• cellular senescence and stem cell exhaustiondifferent types of damage and compensatory responses:homeostasis and determine the ageing process, as well as interconnections between theGain understanding of the following hallmarks of ageing that contribute to loss of ILO3.and alleviate detrimental changes associated with ageing. Familiarize students with the whole spectrum of interventions to postpone, delayILO2. Teach students hallmarks of ageing and the concept of ageing as a diseaseILO1

**ILO1. Teach students hallmarks of ageing and the concept of ageing as a disease**

**ILO2. Familiarize students with the whole spectrum of interventions to postpone, delay and alleviate detrimental changes associated with ageing**

**ILO3. Gain understanding of the following hallmarks of ageing that contribute to loss of homeostasis and determine the ageing process, as well as interconnections between the different types of damage and compensatory responses:**

- immuno-ageing and immunosenescence• neurodegenerative disorders• cancer development• (epi-)genetic alterations, genomic instability and telomere attrition • deregulated nutrient sensing• cellular senescence and stem cell exhaustion

**ILO4. Apply core biomedical skills to determine, analyse, design interventions and preventative strategies addressing hallmarks of ageing and age-related disorders from six core biomedical perspectives:**

- biomedical imaging
- nutrition, physical activity and metabolism
- neuromodulation
- regenerative medicine
- inflammation and pathophysiology

Master Biomedical Sciences

- genetics and genomics

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1002
Period 2
30 Oct 2023
22 Dec 2023
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- R.J. Szklarczyk

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, PBL, Presentation(s), Skills, Paper(s)
Assessment methods:
Assignment, Attendance, Computer test, Presentation, Participation
Keywords:
Practical skills
Fac. Health, Medicine and Life Sciences

# Biosafety

### Full course description

This course is an introduction to the principles of biosafety, how to work safely with biological agents, microorganisms and genetic modified organisms in laboratory.

In Hospitals and (Biomedical) Science biological materials (micro-organisms, eukaryotic cells, tissues, body fluids, faeces…) are intensively used in both basic research and diagnostics. In many situations these biological materials are genetically modified or originated from genetic modified organisms.

The biological materials can be pathogenic and therefore one should know the rules how to handle these material in a safe way to avoid any harm to yourself or the environment. For working with genetic modified organisms additional legislation applies. In this course the importance of working safely and responsibly with biological materials and genetically modified materials are stressed.

Guidelines and regulation, decontamination and disinfection, disposal and sterilization, facility and equipment design will be discussed.

During the online training in LabBuddy, in which experiments with biological agents (wild-type and genetically modified) are described, all kinds of aspects of working safely with biological agents will be adressed.

Master Biomedical Sciences

If you have passed the course successfully you can perform microbiological work at Biosafety/Microbiological laboratory Level I (BSL-I/ML-I)

### Course objectives

- know the principles of biosafety
- know the general biosafety rules and be able to work according to them
- know the legislation related to (genetic modified)microorganism
- know how to handle when spills/incidents occur

MBS1103
Period 2
30 Oct 2023
22 Dec 2023
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- R.J. Szklarczyk

Teaching methods:
Assignment(s), Lecture(s)
Fac. Health, Medicine and Life Sciences

# Advanced Principles of Genetics and Genomics

### Full course description

The genome is the fundament of life. In this course, various aspects of the composition of the genome will be addressed, such as unique vs repetitive DNA and transcribed vs non-transcribed segments. Another important aspect is the dynamic nature of the genome, especially in regard to epigenetic modification and of the various types of genetic variation. Epigenetic responses and genetic variation partly underlie complex traits and explain the individual susceptibility to influences from the environment.
In this course the molecular mechanisms of genetic and environmental influences on gene expression and protein function are addressed with special attention for deviation from Mendelian inheritance as well as complex regulatory mechanisms in case of both single-gene and multifactorial traits and disorders.
Considerable attention in this course goes to analytical methods for genomics and genetics. A technological revolution has taken place since the start of the unravelling of the human genome, leading to the development of techniques to rapidly sequence a complete genome, but also to perform functional analysis of gene expression and protein function and to incorporate the influence of genetic variation and epigenetic modification into these expression data.
These technological applications lead to huge amounts of data demanding specific algorithms for data analysis to be developed by researchers working in bioinformatics. Throughout the course students will obtain experience with several such algorithms, databases and analytical programs available in the public domain.
Finally, the large increase in knowledge on genomics and genetics together with the still growing

potential of analytical possibilities impact research, society and the individual's way of life. A time slot in the course will be reserved to discuss these developments.

## Course objectives

In this course we address advanced principles of Genetics and Genomics according to specific Themes, which correspond with the Intended Learning Outcomes (ILOs). For each Theme there will be tutorial sessions, a journal club, an expert lecture and career-related sessions, in which researchers will explain the research that they are performing. During site visits students will go to some of the laboratories for genetics and genomics to get insight into the technological requirements for genetic and genomics in daily practice. In addition, several computer sessions are scheduled to introduce and train students in data handling and analysis. Finally, students are requested to write an essay on a specific topic of genetics or genomics. The ILOs of this course are:

- Describe human genetic diversity and its dynamics based on the principles of population genetics.- ILO1
- Integrate the influence of epigenetics with the fundamental regulation of gene expression. ILO2
- Explain the impact of genetic variation on gene expression and protein function.- ILO3
- Explain deviations from fundamental genetics in eukaryotes.- ILO4
- Apply advanced analytical methods of genetics and genomics. - ILO5
- Analyze data handling in genetics and genomics. - ILO6
- Define ethical and societal issues concerning genetics and genomics.- ILO7

## Recommended reading

This is the link to Keylinks, our online reference list.

MBS1101
Period 3
8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- L.M.T. Eijssen

Teaching methods:
Assignment(s), Lecture(s), Paper(s), PBL, Skills, Working visit(s)
Assessment methods:
Assignment, Final paper, Participation, Written exam
Keywords:
advanced genetics genomics bioinformatics epigenetics gene-environment interaction gene expression analytical techniques data handling/analysis ethical/societal issues
Fac. Health, Medicine and Life Sciences

# Pathophysiology of Disease

## Full course description

During the course, an introduction to normal immune system physiology will be given in the form of overview lectures to ensure the same (bachelor) level of knowledge. In addition, during weeks 2 to 7, the focus will be on understanding inflammation during pathophysiology of disease. Every week has a different theme and the students will be challenged with different diseases where immune system dysregulation plays a role. Students will be given their weekly assignments at the beginning of each week, with a prediscussion session where the expected learning goals of the week will be outlined. Thereafter, they will start pre-discussing a case in smaller groups. During the week, they will have expert lectures, e.g. workshops, technical and practical/training skills and journal club discussions. Time will be given for self-study during the week, for both team and individual work. At the end of the week the students will discuss the case they have been working on and the practical/training skill assignment. Theme week 1: Introduction to the immune system: normal physiology. Theme week 2: Immunity to bacteria. Theme week 3: Immunity to viruses. Theme week 4: Sterile inflammation and other pathological threats. Theme week 5: Immunity to tumors. Theme week 6: Hypersensitivity disorders and autoimmunity. Theme week 7: Microbe-host interactions in (immune) homeostasis. Week 8 consists of reflection, poster presentation and exam.

## Course objectives

B-ILO1202.1 Explain immunity to microbes and viruses a) Recognize and compare innate and adaptive immunity to extracellular and intracellular bacteria and viruses. b) Explain immune evasion by extracellular and intracellular bacteria and viruses. c) Know how the functional output of the microbiota regulates metabolic and immune homeostasis d) Recognize microbial dysbiosis and its role in immune-mediated disease predisposition  b) Recognize the induction of (innate) immune responses by microbes at mucosal interfaces a) Discuss interplay between microbial colonization and the development of the immune system/induction of tolerance B-ILO1202.5 Explain microbe-host interactions in (immune) homeostasis c) Explain IgE and mast cell-dependent reactions and allergic reactions in humans: pathogenesis and therapy. b) Discuss immunological diseases, their pathogenesis and current therapy. a) Recognize diseases caused by antibodies against membrane receptors and extracellular antigens, immune-complex mediated diseases and disease caused by T-lymphocytes. B-ILO1202.4 Explain hypersensitivity disorders and autoimmunity d) The role of the immune system in promoting tumor growth/tumor progression. c) Effect of the tumor microenvironment on anti-tumor immune responses. b) Explain evasion of the immune response by tumors.a) Differentiate tumor immunity, tumor antigens and immune response to tumors. B-ILO1202.3 Explain immunity to tumors b) Discuss pathological threats such as neurodegeneration, atherosclerosis, and metabolic inflammation. a) Analyze the role of sterile inflammation in trauma and ischemia–reperfusion. B-ILO1202.2 Explain sterile inflammation and other pathological threats c) Discuss injurious effects of immune responses to extracellular bacteria: inflammation, septic shock.

## Recommended reading

This is the link to Keylinks, our online reference list.

MBS1201
Period 3

Master Biomedical Sciences

8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- K.A.M. Wouters

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations, Research, Skills, Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Presentation, Written exam, Participation
Keywords:
Pathophysiology/Animal models Infections: virus, bacteria Sterile inflammation Microbiota Metastasis, tumor evasion Exosomes Innate/Adaptive immune responses Auto-antibodies/Autoimmunity Allergy
Fac. Health, Medicine and Life Sciences

# Nutrition, Physical Activity and Metabolism; Fundamental Aspects

## Full course description

This course aims to provide a solid fundament to understand the mechanisms underlying the metabolic aberrations that are commonly observed in many of the current no-communicable disorders. A proper understanding of these mechanisms is essential to design, optimize, apply and examine interventions that aim to alleviate the metabolic aberrations and to slow down disease progression. To this end this course will encompass studying the major systems involved in human (nutritional) physiology and metabolism. This ranges from the process of nutrient uptake across the gastrointestinal tract to cell and organ specific routes for conversion of macromolecules into their oxidizable derivatives.
The pivotal role of intermediary metabolism and (subcellular) energy sensing and of metabolites and small circulatory hormone like peptides (e.g., adipocytokines) will be studied. This course will, therefore, further deal with the important notion of inter-organ cross-talk and designates how to convey this knowledge to the development of whole body metabolic control. It will provide a basis for targeted treatment of aberrations in (energy) homeostasis, substrate metabolism, inter-organ cross talk as related to macronutrients (fat, carbohydrates, and protein) and specific nutritional components. Special attention will be given to the metabolic routes that are altered in acute and chronic metabolic disorders and the putative role of the biological clock herein. More specifically, these disorders are discussed in relation to the role of nutrition in preventing and treating these disorders.
Nutrients play a role in the regulation of gene transcription, translation, and signal transduction. This, of course, affects cellular pathways. If these pathways become disturbed, it may ultimately result in disease, which may require special dietary interventions. In this course, the molecular basis and cellular mechanisms by which nutrients affect metabolic control is studied at the cellular level.

### Course objectives

1. Describe the function and interaction of the listed organs in nutritional physiology and physical activity: Liver, stomach and gut, adipose tissue, brain and muscle.
2. Explain and predict the uptake, storage, degradation, and the intermediary metabolism of nutrients and substrates on organ, cellular and subcellular level.
3. Characterize the transport, uptake and metabolism of macro- and micronutrients.
4. Explain competition and selection of nutrients and substrate flux in pre- and post -prandial states.
5. Explain competition and selection of nutrients, and substrate flux during rest and exhaustive exercise in a trained and untrained state.
6. Apply the concepts above to healthy and chronic disease scenarios.
7. Characterize metabolic aberrations in chronic disease and come-up personalized interventions for intervention.
8. Argue the translational aspects of nutritional and physical activity related model systems.
9. Argue the scientific basis for policy making on human nutrition, physical activity, and dietary guidelines.
10. Critically evaluate recent manuscripts discussing aspects of health related to nutritional status and physical activity.

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1301
Period 3
8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- M.K.C. Hesselink

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentation(s)
Assessment methods:
Assignment, Attendance, Final paper, Written exam
Fac. Health, Medicine and Life Sciences

# Science and Technology of Regenerative Therapeutics

### Full course description

This is the first course for the Regenerative Medicine (RM) specialization within the Biomedical Sciences (BMS) Master's program. This first block will provide the student with a solid foundation of knowledge in the interdisciplinary field of RM. At its core, RM aims to replace, engineer, or regenerate tissues and organs in order to establish normal function in the human body. Not falling

completely within a traditional discipline, researchers and teams within RM combine fundamental physical and biomedical sciences with technology and engineering in order to discover novel methods of regenerating the body. With successes, scientists within RM must also be able to effectively translate this scientific knowledge into a useful clinical therapy. In this first course, students will learn the basics in not only the biological science of regeneration, including stem cell biology and pathophysiology, but also the technology behind RM, including materials science, chemistry, biofabrication, and computational modeling. This intensive course employs a variety of educational forms in order to both give an overview of the field and allow students to dig into topics of interest. Students will learn to work in teams, to think critically utilizing the scientific method, and to communicate across the borders of traditional disciplines. Already in this first block, the acquired knowledge will directly be applied to propose new solutions for state-of-the-art RM case studies.

## Course objectives

- Understand the molecular processes of wound healing and modulation of tissue homeostasis, and how these mechanisms can be leveraged in the development of regenerative therapies.
- Obtain working knowledge of both a cell's (or tissue's) immediate natural environment, and the current uses of biomaterials to provide artificial environments for tissue growth.
- Understand the successes and failures of current (stem) cell regenerative approaches.
- Understand the different applications of organoid technology for studying development, homeostasis, tissue repair, and diseases.
- Be able to describe the composition and organization of ECM (the original biomaterial) and understand the synthesis, structure, and degradation of therapeutic biomaterials.
- Be able to describe processing technologies used to fabricate biomaterials into 3D scaffolds for tissue engineering, and be able to identify what the important factors of scaffold design are.
- Understand the basics of microfabrication techniques and the working concepts of bioreactors and organ-on–a-chip.
- Understand the importance of the cell-material interface for tissue engineering, and be able to explain how Materiomics approaches can aid in the designing of this interface.
- Be able to critically assess the quality aspects of a research question, methodology, and results. Be able to make supported decisions when designing a regenerative medicine experiment.
- Be able to clearly present and discuss scientific research in the field of regenerative medicine to those within and outside of the field.

## Recommended reading

This is the link to Keylinks, our online reference list.

MBS1401
Period 3
8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

Master Biomedical Sciences

- F.H.J. van Tienen

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentation(s), Training(s), Working visit(s)
Assessment methods:
Final paper, Participation, Presentation, Written exam
Keywords:
Organ and tissue regeneration Biomaterials Tissue engineering Stem cell therapy Interdisciplinary Regenerative medicine
Fac. Health, Medicine and Life Sciences

# Pre-clinical Imaging

## Full course description

Imaging is increasingly and widely applied in biomedical studies and clinical practice. Imaging enables visualisation of key (molecular) players of health and disease at the molecular, cellular, tissue, and organ levels. Imaging also gives the unique opportunity to study animal models noninvasively at multiple time points and to obtain functional information (e.g. contraction of the heart and blood flow) in order to provide more insight in health and disease, to assess the effectiveness of treatment and to develop new treatments . This course focuses on pre-clinical imaging, which ranges from ex vivo imaging of a single molecule to in vivo imaging of animal models.
You will be prepared for a future in a multidisciplinary biomedical research environment. We will train the students as a key person, linking physiological questions to novel imaging methods. You will be able to communicate within an interdisciplinary team including clinicians and engineers. You will be able to apply state-of-the art imaging methods to biomedical research questions related to oncology, cardiovascular diseases, neuro sciences or metabolism. You will make sure that novel imaging methods can be directly applied in a preclinical research environment.
The course aims to give insight into the basic principles and the biomedical applications of imaging techniques. Techniques that will be discussed are mass spectrometry imaging (MSI), electron and light microscopy (EM and LM), ultrasonography, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), nuclear imaging (Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET)) and hybrid and correlative imaging.
Students will be taught to acquire, analyze and utilize complex images at multiple spatial scales that originate from various imaging modalities. Combined, these preclinical research methods pave the way for new diagnostic approaches required for personalized and systems medicine.

## Course objectives

The focus is really on the biomedical problem and not so much on the underlying physical methodology/technology. The main question is how we can use advanced imaging modalities to understand biomedical problems? Within this couse, students will learn how to apply novel technologies to biomedical sciences to solve a biomedical research question. You will learn the basic principles of the imaging modalities, to be able to make correct choices of imaging methods for specific questions.

This course offers interactive teaching, hands-on experiments through practicals, lab visits, workshops, project and interactions with experts.

In the region and the Netherlands, no other integrative courses on imaging for biomedical scientists exist. This is a unique course encompassing all type of advanced imaging techniques like Mass spectrometry imaging, Nanoscopy, Advanced Microscopy, PET and MRI imaging. All these technologies are used with the biggest emphasis on biomedical applications.

Within this course you will perform a project to learn how to solve a biomedical research question with advanced imaging.

Students have the opportunities to learn from expert researchers from each discipline and interact with professionals from the Maastricht University Medical Center. The unique molecular imaging infrastructure at the MUMC+ will be available for the students, who will have the opportunity to meet and interact with professionals and experts in preclinical imaging.

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1501
Period 3
8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- L.J. Dubois

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), PBL, Presentations, Skills, Working visit(s), Training(s)
Assessment methods:
Assignment, Observation, Participation, Presentation, Written exam
Keywords:
preclinical imaging, MSI, EM, LM, MRI, US, SPECT, PET, CT
Fac. Health, Medicine and Life Sciences

# Invasive Neuromodulation

### Full course description

At the end of this course, students will have a detailed understanding of neuromodulation approaches, and they will be aware of recent trends and developments in the field. Building on this foundation, various state-of-the-art neuromodulation approaches will be explored in detail, with a particular focus on deep brain stimulation, spinal and sacral neuromodulation, and transcranial magnetic stimulation. This course starts by providing essential knowledge about neuroanatomy and neurophysiology required to understand the basic principles of neuromodulation techniques. To ensure that the entry-level is comparable we give an introductory explanation in week 1 to reactivate the prior knowledge. The students are expected to have general knowledge about the normal

functioning of the CNS. MBS1601 will build on the knowledge obtained during the first 8-weeks in the course, Biomedical Challenges. This prevents the current and following courses from being too abstract and allows episodic experiences to connect the discussions and scientific literature. The practicals add depth and practical experience to this overview of methods since students will actively use and see in use these various techniques. It is important to provide and develop this basis, to allow the following courses to build on a broad, but still the relatively superficial treatment of, or meta-perspective on, a young and burgeoning field. These approaches span invasive and non-invasive modulation, from animal to human brains. In the following weeks, we provide an overview of the wide range of available neuromodulation approaches. Each week contains three different forms of teaching, to meet the range of ILOs that span theoretical, applied, and practical knowledge. A practical session in the middle of the week provides concrete knowledge, examples, and helps develop skills.

## Course objectives

Intended Learning Outcomes (ILOs)

- ILO1601-1: To understand the basic anatomy of the central nervous system (CNS)
- ILO1601-2: To understand the basic physiology of the central nervous system (CNS)
- ILO1601-3: To understand the basics of micro-neuromodulation techniques (optogenetic and DREADD)
- ILO1601-4: To understand and explain the basic principles of invasive neuromodulation and discuss the application of deep brain stimulation (DBS) and spinal cord stimulation in preclinical settings
- ILO1601-5: To describe the current neuroimaging techniques available for neuromodulation.
- ILO1601-6: To understand the basic mechanisms of action of transcranial magnetic stimulation (TMS) and transcranial electrical stimulation (TES)
- ILO1601-7: To understand how TMS and TES can be applied in the experimental context
- ILO1601-8: To gain practical, hands-on knowledge, and experience with TMS and TES

## Recommended reading

This is the link to Keylinks, our online reference list.

MBS1601
Period 3
8 Jan 2024
9 Mar 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- A. Jahanshahianvar

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentation(s), Skills
Assessment methods:
Assignment, Final paper, Presentation, Written exam

Master Biomedical Sciences

Keywords:
Neuroscience; neuromodulation; neurophysiology; neuroanatomy; deep brain stimulation; transcranial magnetic stimulation
Fac. Health, Medicine and Life Sciences

# Clinical and Applied Genetics and Genomics

## Full course description

In conjunction with course 1101 ‘Advanced Principles of genetics and genomics’, course 1102 (Clinical and applied genetics and genomics) makes up the specialization track ‘Genetics and Genomics’. This course aims at providing the students with a broad knowledge and expertise in the field of genetics and genomics, and more specifically how these technologies can be applied to scientific research questions, the diagnosis of human diseases in the clinic, and forensics.

This course will elaborate further on genetic fundamentals discussed in the previous courses (1001 and 1101) and includes amongst others currently applied analyses in the clinic as well as some unusual genetic phenomena. Furthermore, state-of-the-art technologies applied in genetic and genomic studies will be discussed including their applications in clinical practice, which, as students will learn, is not as straightforward as seen in certain popular media (eg. CSI, Flikken Maastricht and other TV-series). Moreover, researchers in the fields of genetics and genomics are confronted with numerous ethical issues restraining their studies. The students will be introduced to some of these ethical problems and challenged how to handle these in practice.

models, cellular models and animal models).in silico An interesting additional skill the student will learn is to implement acquired knowledge from the courses (1001, 1101 and 1102) in the study of different model systems in genetic research (

Based on this knowledge as well as the input of expert staff lectures, the students will get the chance to work in groups on a scientific project application. This will make them aware of the complexities involved in the project writing process, but also will prepare them for a future role in the scientific community.

## Course objectives

- ILO1102.1 Explain genetic and genomic technology used in precision medicine and diagnostics of genetic disorders.
- ILO1102.2 Know the main genomic mechanisms and involved signalling pathways underlying cancer development, cardiovascular and neurological diseases.
- ILO1102.3 Explain advantages/disadvantages when utilizing genetic testing in research and clinical applications.
- ILO1102.4 Know which tools are available to model genetic disorders, and apply them to modelling genetic disorders for research and clinical applications.
- ILO1102.5 Apply the concepts of molecular genetics to design novel research projects in genetics and precision medicine.

Overall Goal: At the end of this course, each student has gained a high level of knowledge on the use of genetic and genomic techniques in research and clinical diagnostics.

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1102
Period 4
11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- M.H.G.M. Gerards

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), PBL, Presentation(s), Skills, Training(s), Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Participation, Presentation, Written exam
Keywords:
advanced genetics genomics epigenetics clinical diagnostics research applications gene expression data analysis ethical societal issues forensics
Fac. Health, Medicine and Life Sciences

# Engineering the Immune System; Treatment of Disease

### Full course description

Building on the knowledge gained by the student in the MBS1201 course, the MBS1202 course will follow roughly the same roadmap through the various areas of research and clinical medicine, covering immunology, inflammation and the pathophysiology of infectious and non-infectious diseases with a focus on therapy. Attention will be given to approaches and technologies in the field of experimental medicine as well as the more general translational aspects related to the topics relevant to the areas of sterile and nonsterile (infectious) inflammation, neurodegeneration, atherosclerosis and vascular disease, autoimmunity and tumor development.

The objective of this course is to provide a basic understanding of various important techniques and technologies in this field and create an awareness of experimental and approved methods for the treatment of immune-related diseases.

### Course objectives

- Summarize, explain and design approaches to modulate the immune system in inflammatory or infectious disease
- Summarize and explain basic pathophysiology, diagnosis and current therapy of sepsis and design novel therapeutic strategies

- Summarize and explain basic pathogenesis and current treatment of viral disease and design novel prophylactic vaccine based strategies for viral disease
- Explain and compare current and experimental therapies to treat/prevent atherosclerosis
- Explain and compare established and experimental types of immunotherapy and design novel therapeutic strategies
- Summarize state of the art diagnosis and treatment of hypersensitivity disorders
- Explain the therapeutic potential of targeting the microbiome for modulation of immunity and health
- Apply both descriptive ethics and normative ethics to a case study relevant within the specialisation

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1202
Period 4
11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- K. Lenaerts

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentation(s), Skills
Assessment methods:
Assignment, Attendance, Final paper, Observation, Participation, Presentation, Written exam
Keywords:
Immunology Therapy Immune response Immune disease Immune modulation Immune suppression Immune therapy Pharmacotherapy Antibody therapeutics Microbiota
Fac. Health, Medicine and Life Sciences

# Lifestyle Interventions and Metabolism; a Translational Perspective

### Full course description

In this course, the central theme is the role of lifestyle changes in both health and disease. Lifestyle factors modulating human metabolism on a micro(cellular) and macroscale (organ) will be studied via a translational approach. This course will focus primarily on the more conventional strategies to promote health by exploring the underlying mechanisms and how these interventions may prevent various non-communicable diseases, including cardiovascular diseases, cancer, chronic respiratory diseases and diabetes. For this, effects of diet and physical activity on gene expression/cellular pathways, organ function and interorgan crosstalk will be studied in depth. However, the impact of lifestyle interventions may differ between individuals (e.g. responders vs. non-responders) indicating

that successful lifestyle interventions may require a more personalized approach. Besides the more conventional strategies, the relevance of weight loss, specific (nutritional) compounds, exercise, sedentary behavior, sleep and stress management in affecting metabolism will be topic of study. Furthermore, core principles of potential interactions between lifestyle factors and drugs will be applied and students will critically evaluate the dietary and physical activity guidelines as defined by the Dutch Health council. The lectures/group meetings and journal club will be planned in the first seven weeks of the course. Throughout the course and in the last week, students will work in small groups on the Academic project. The setup for the academic project intends to promote a largely independent and self-directed form of education that ultimately results in a written report and an oral presentation. The objective of the academic project is that students select a preventable, age-related disease and study possible short term interventions to treat or prevent the disease in humans. Subsequently, students will need to formulate a focused research question to study (i) the most promising lifestyle intervention and (ii) relevant outcome parameters to assess potential treatment effects.

## Course objectives

Course objectives 1. To explain the effects of diet and physical activity: - on cellular pathways involved in health and disease - on (mal)adaptive gene expression involved in health and disease - on (disturbed) organ function involved in health and disease - on (disturbed) interorgan crosstalk involved in health and disease 2. To appreciate the bi-directional routes of how nutritional support can amplify the health and performance benefits of exercise  3. To explain the role of genetics in personalized approaches to prevent disease (responders vs. non-responders) 4. To recall differential effects of different forms of lifestyle interventions on metabolism involved in health and disease 5. To apply the core principles of interactions between lifestyle factors (diet and physical activity) and drugs 6. To argue the dietary and physical activity guidelines as defined by the Dutch health council  7. Critically evaluate recent manuscripts discussing lifestyle interventions in health and disease, also focusing on ethics, integrity and statistics

## Recommended reading

This is the link to Keylinks, our online reference list.

MBS1302
Period 4
11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- P.J. Joris

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), PBL, Presentation(s), Research, Skills, Training(s), Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Participation, Presentation, Written exam

Master Biomedical Sciences

Keywords:
Lifestyle intervention Metabolism Translation approach Personalized approach Diet Exercise
Fac. Health, Medicine and Life Sciences

# Translating Therapies into Clinic and onto the Market

## Full course description

In this course ‘Translating therapies into the clinic and onto the market’ we will make the scientific journey from science and technology to the clinic and products. Using actual clinical challenges, students have to work out a new solution to that clinical problem supported by experts in the field. Students will know where to put biomedical solutions in the Technology Readiness Level chain and learn how to take it a step further and learn to communicate specialized knowledge to a group of scientists from different disciplines.

This course has actual clinical challenges from the field of Orthopedic Surgery, Craniomaxillofacial surgery, Experimental Surgery, Gastrointestinal surgery and Endocrinology. Challenged by an expert doctor, students will have to work in small teams to come up with a new strategy to repair damaged tissue or organs which the body can’t heal itself using a regenerative medicine multidisciplinary combination of materials science, fundamental biology, smart fabrication technology and bioengineering based on knowledge gained in course MBS1401. Additionally, we will pay attention to valorization which is the process of creating value from knowledge, by making this knowledge available and suitable for economic and social exploitation and to translate this knowledge into products, services, processes and new business. This valorization process is of course bound by European and International rules and regulations such as FDA and ISO standards and clinical trial directives.

Students have to write a project proposal with predefined sections and present this to their peers and expert in the field at a mini-symposium. This process is closely guided by an expert in the field and students can gain knowledge (additional to literature) in interactive lectures.

## Course objectives

- Develop and describe a new research strategy together with team members, to solve a clinical problem based on state of the art technology, biomaterials, biology and medical practice
- Explain and discuss scientific background of (chosen/given) clinical problem, current medical practice and ongoing developments in this field.
- Explain when and how to protect a new innovation and what is required to create a patent
- Explain and discuss the regulatory affairs involved in product development for biomedical applications (animal, human, GLP/GMP)
- Design a translational biomedical study, and write a project proposal
- Present and defend a new project proposal
- Adjusts communication written or oral, to specific global audience/readership and international setting
- Communicates professionally with peers and staff originating from diverse cultural and disciplinary backgrounds
- Shows awareness of team roles and takes responsibly her/his position in a diversely composed international team

Master Biomedical Sciences

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1402
Period 4
11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- M.M.J. Caron

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), Presentation(s), Research, Working visit(s)
Assessment methods:
Assignment, Participation, Presentation
Keywords:
Regenerative Medicine Biomaterials Medical practice Innovation Patent Valorization Regulatory affaires Project proposal Biomedical study Clinical trial
Fac. Health, Medicine and Life Sciences

# Clinical Imaging

## Full course description

This second course in the “Imaging from molecule to man” specialization will focus on the application of imaging to address physiological and pathological disease processes in man in a clinical (research) setting. This course focuses on application of imaging in a clinical (research) setting. This means that all imaging modalities discussed during this course can be applied on humans. It is not the intention to go in depth on the physics principles of the imaging techniques, but we will focus on the application of the techniques in daily clinical routine/research. It is important for the student to learn what are advantages and disadvantages of the different imaging modalities, with the aim that students will be able to independently make a (grounded) choice for one or multiple imaging strategies to solve or answer clinical questions or questions arising in a (clinical) research setting.

## Course objectives

After this course the student:

- identifies what imaging modalities are (regularly) being used at the moment in the typical clinical (research) setting and which methodology is state-of-the-art (and/or is being developed)
- knows what information is within an image and can extract this information from the image (image processing and analysis).

- imaging modalities in a clinical (research) setting.in vivo and ex vivo- specifies the opportunities and limitations of
- chooses the appropriate imaging modality/modalities (e.g. MRI/MRS, PET, CT, Ultrasound, microscopy) for specific use in a clinical (research) setting.

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS1502
Period 4
11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- A.M. Blanchet - Smolinska

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), PBL, Presentation(s), Research, Skills, Training(s), Working visit(s)
Assessment methods:
Assignment, Attendance, Oral exam, Participation, Presentation
Keywords:
Clinical imaging, MRI/MRS, CT, US, Radiomics, pathological imaging
Fac. Health, Medicine and Life Sciences

# Non-invasive Neuromodulation

### Full course description

This course will explore various state-of-the-art non-invasive neuromodulation approaches in detail, with a particular focus on transcranial magnetic and electrical stimulation (TMS/TES). In addition, the course showcases how insights into the pathophysiology of the central nervous system can be translated into clinical applications of non-invasive neuromodulation in psychiatry, neurology, and neuro-rehabilitation. Prominent examples include the application of TMS in depression and stroke. These and many other examples will be discussed, revealing the potential of non-invasive neuromodulation in clinical practice. At the end of this course, students will have a proper understanding of current non-invasive neuromodulation techniques and they will be aware of recent trends and developments for both fundamental and clinical applications.

### Course objectives

#### Intended Learning Outcomes (ILO) in this course:

ILO1601-1: To understand the basic mechanisms of action of transcranial magnetic stimulation

(TMS) and transcranial electrical stimulation (TES)

1. To describe the physical foundation of TMS and TES
2. To describe the physiological consequences of TMS and TES protocols
3. To describe, explain, and compare commonly used TMS and TES protocols

ILO1601-2: To understand how TMS and TES can be applied in experimental context

1. To determine and discuss which TMS and TES protocols are suitable to addressing different research questions
2. To interpret outcomes of TMS and TES experiments
3. To gain practical, hands-on knowledge and experience with TMS and TES, including procedural and safety considerations

ILO1602-3: To know about cutting-edge developments and future perspectives of non-invasive neuromodulation

1. To know about advanced concepts of non-invasive neuromodulation
2. To discuss current limitations of the field and identify ways forward
3. To integrate acquired knowledge and skills to reflect on novel applications of non-invasive neuromodulation

ILO1601-4: To describe the current neuroimaging techniques available for neuromodulation.

1. To discuss how neuroimaging can be applied to improve targeting in neuromodulation
2. To gain practical experience in pre-processing fMRI and EEG data in the context of a multimodal NIBS experiment
3. To describe the state of the art in novel research and clinical applications of multimodal NIBS

ILO1602-5: To describe and discuss the applications of TMS in psychiatry

1. To know about the pathophysiology of depression
2. To explain current treatment approaches in psychiatry with TMS
3. To gain practical, hands-on knowledge and experience with the implementation of a TMS treatment session

ILO1602-6: To describe and discuss the applications of TMS in neurology and neurorehabilitation

1. To understand the use of TMS as a diagnostic and prognostic tool
2. To explain current treatment approaches in neuro-rehabilitation with TMS
3. To gain practical, hands-on knowledge and experience with the combination of TMS and electromyographic recordings

## Recommended reading

This course almost exclusively relies on recent scientific articles published in international peer-reviewed journals. On rare occasions, a text book may be used to provide basic knowledge required for a topic.

MBS1602
Period 4

Master Biomedical Sciences

11 Mar 2024
10 May 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- H.P. Leunissen

Teaching methods:
Work in subgroups, Lecture(s), Paper(s), PBL, Presentation(s), Skills, Assignment(s)
Assessment methods:
Attendance, Final paper, Presentation, Written exam, Assignment
Fac. Health, Medicine and Life Sciences

# Designing Scientific Research

## Full course description

The overall goal of this block is to familiarize you with the design of a scientific research strategy and the writing of a research proposal and present their data to a scientific public. Central to the block is practicing the scientific thinking: knowledge/research question /hypothesis /objectives /experimental set up/results /interpretation /new knowledge

The general idea of the block is to design a study based on ongoing fundamental, applied, preclinical or clinical research and to learn how to stress the relevance of the study in a convincing manner. The training in block MBS1005 serves as preparation for the block BMS2104 and BMS2004: the practical training period (Master Internship) which will last the complete 2nd year of the master (BMS2104) and will be concluded with the master thesis (BMS2004).

A tutor will be running/coaching a student tutor group. You will work in small teams on developing your own scientific proposal and learn how to present and defend it in the most convincing way. You will provide and receive feedback from the whole group, followed by comments and feedback from the tutors. All the assignments and writing tasks are closely linked, to each other. Your creativity will further be stimulated during the “Design Sprint” workshops (part of ‘’MBS1006 Managing a Biomedical Innovation’).

On regular time points you will have a task to write part of your research proposal. This means that throughout the course you can revise and improve what you have written and gradually extend the text to the full proposal. The work is designed to dovetail neatly with the proposal requirements for the whole course. To boost your scientific skills and creativity, you will also receive workshops on scientific and business thinking and communication skills. You will participate in a network career event in which you will meet BMS alumni which hold various jobs.

## Course objectives

1. Formulate a novel project based on ongoing research.
2. Interact at a scientific level with peers and coaches.
3. Suggest research strategies to address specific scientific questions.

4. Define feasible deliverables to provide structured research strategies.
5. Critically review other research proposals.
6. Present and defend a research proposal.
7. Help you eliminate characteristic language errors from your scientific writing.
8. Help you improve the style of your written scientific work.
9. Give you practice in presenting your research proposal.
10. Evaluate the business and valorization value of your proposal.

MBS1005
Period 5
13 May 2024
5 Jul 2024
Print course description
ECTS credits:
10.0
Instruction language:
English
Coordinator:

- A. Romano

Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), Presentation(s)
Assessment methods:
Final paper, Participation, Presentation
Keywords:
scientific method, Research proposal
Fac. Health, Medicine and Life Sciences

# Ethics in Biomedical Science

## Full course description

The course 'Historical developments and ethics in biomedical science' invites students to reflect on the emergence of normative frameworks associated with science as they progress through their biomedical curriculum. As part of the course, they will prepare a discussion of the research ethics connected to research they propose and plan themselves. While engaged in research activities, they will discussion and study conventions, standards and guidelines of research integrity. At the end of the year, students will have an active understanding of the frameworks of research ethics and research integrity and how they came into being. Grades are awarded to two written assignments students complete throughout the year, each contributing 50% to a P/F grade.

## Course objectives

1. You have knowledge and understanding of research ethics principles, as well as of practices of evaluating and assessing research ethics;
2. You can discuss and reflect of the research ethics of research you design and/or propose;
3. You have knowledge and understanding of research integrity in its conventions, guidelines, and origins;
4. You can critically reflect on research integrity practices and cultures;
5. You are able to synthesize knowledge on research ethics and integrity and reflection on

positions associated with them into a coherent discussion of actual research practices.
6. You can actively and constructively participate in exchanges on the normative frameworks in biomedical science.

MBS1004
Year
4 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- H. Ismaïli M'hamdi

Teaching methods:
Lecture(s), Assignment(s), Work in subgroups, Paper(s)
Assessment methods:
Assignment
Keywords:
Research Ethics Research Integrity Normative Frameworks Contributory expertise
Second year courses

# Biomedical Sciences Year 2

Fac. Health, Medicine and Life Sciences

# Ethics in Biomedical Sciences

### Recommended reading

This is the link to Keylinks, our online reference list.

MBS2001
Year
4 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
1.0
Coordinator:

- B. Penders

Fac. Health, Medicine and Life Sciences

# Thesis

## Full course description

MBS2104 (Internship) and MBS2004 (Thesis) are intertwined. During the1-year internship (MBS2104) spanning the entire second year of the master, students participate in ongoing scientific research at UM, at other knowledge centres in the Netherlands, or in other countries and will conclude the internship with the master Thesis (MBS2004). The internship project details will be worked out and a preparatory research proposal will be written during course MBS1005 at end of the first year of the master. As a practical, hands-on experience, it offers students a unique opportunity to gain experience in independently carrying out a research project, which they personally designed. The length of the training period ensures the acquisition of valuable, in-depth experience, necessary for students' development into independent researchers. Students work individually and take part in ongoing research projects, supervised by a senior researcher. In this framework, they also participate in the regular meetings of the relevant research team. The internship period concludes with a final presentation to the other students as well as tutors and other experts. The final internship research report is prepared in the form of an extensive scientific paper, which constitutes the master's thesis.

## Course objectives

- Ability to carry out a research project independently in a research environment
- Experience in adhering to a research plan (in terms of content and time management)
- Experience in problem solving during research
- Ability to revise or set up follow-up research (adjusted to the results obtained)
- Ability to process, interpret and report results
- Active participation in regular discussions in the research environment
- Ability to present and discuss interim and final results to and with colleagues and supervisor

MBS2004
Year
4 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
50.0
Instruction language:
English
Coordinator:

- H.R. Gosker

Teaching methods:
Paper(s), Research
Assessment methods:
Final paper
Keywords:
Thesis, Research, biomedical
Fac. Health, Medicine and Life Sciences

# Internship

## Full course description

MBS2104 (Internship) and MBS2004 (Thesis) are intertwined. During the1-year internship (MBS2104) spanning the entire second year of the master, students participate in ongoing scientific research at UM, at other knowledge centres in the Netherlands, or in other countries and will conclude the internship with the master Thesis (MBS2004). The internship project details will be worked out and a preparatory research proposal will be written during course MBS1005 at end of the first year of the master. As a practical, hands-on experience, it offers students a unique opportunity to gain experience in independently carrying out a research project, which they personally designed. The length of the training period ensures the acquisition of valuable, in-depth experience, necessary for students' development into independent researchers. Students work individually and take part in ongoing research projects, supervised by a senior researcher. In this framework, they also participate in the regular meetings of the relevant research team. The internship period concludes with a final presentation to the other students as well as tutors and other experts. The final internship research report is prepared in the form of an extensive scientific paper, which constitutes the master's thesis.

## Course objectives

- Ability to carry out a research project independently in a research environment
- Experience in adhering to a research plan (in terms of content and time management)
- Experience in problem solving during research
- Ability to revise or set up follow-up research (adjusted to the results obtained)
- Ability to process, interpret and report results
- Active participation in regular discussions in the research environment
- Ability to present and discuss interim and final results to and with colleagues and supervisor

MBS2104
Year
4 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:

- H.R. Gosker

Teaching methods:
Work in subgroups, Paper(s), Patient contact, Presentation(s), Research, Skills, Training(s)
Assessment methods:
Assignment, Attendance, Observation, Participation, Presentation
Keywords:
undefined
Fac. Health, Medicine and Life Sciences

# Poster

## Full course description

During the internship (spanning the entire second year of the master, MBS2004), students participate in ongoing scientific research at UM, at other knowledge centres in the Netherlands, or in other countries . The internship project details will be worked out and a preparatory research proposal will be written during course MBS1005 at end of the first year of the master. As a practical, hands-on experience, it offers students a unique opportunity to gain experience in independently carrying out a research project, which they personally designed. The length of the training period ensures the acquisition of valuable, in-depth experience, necessary for students' development into independent researchers.

Students work individually and take part in ongoing research projects, supervised by a tutor or researcher. The internship period concludes with a final presentation (poster, MBS2204) to the other students as well as tutors and other experts. This presentation/defence will take place during the MOSA conference.

The posters are assessed by at least five independent researchers, and their averaged scores will be listed as a separate mark in addition to the thesis score. A pass on the poster is required for a pass on the internship.

## Course objectives

- Process, interpret and report results
- Participate in discussions in the research environment
- Present, discuss and defend final results to and with colleagues and supervisors
- Prepare a poster with internship results/research outcomes

MBS2204
Year
4 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:

- J. Theys

Teaching methods:
Assignment(s), Presentation(s)
Assessment methods:
Assignment, Oral exam, Presentation