



Test Blueprinting II: Creating a Test Blueprint



NBME[®]

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Objectives

By the end of this lesson, you should be able to:

- Understand how course content and **learning objectives** will guide blueprint development
- Develop a **test blueprint** to guide the development of your assessments

Introduction

Consider yourself in the following scenario. You are preparing an end-of-course exam for your immunology course. You want to make sure your students have mastered the important material from the course, and you have a bank of 200 multiple-choice questions (MCQ) on immunology topics from a collaborative project with other immunology course instructors. How do you determine which questions to use on your exam to ensure your test is a high-quality, reliable, and defensible indicator of your students' knowledge?

Creating a **test blueprint** will help you plan which questions to include in your exam and ensure that it adequately assesses the **learning objectives** of the course. A test blueprint defines the knowledge and skills you want to assess and will enable you to build purpose-driven, successful assessments. A blueprint may also help you identify areas where your question pool may be lacking.

What is a Test Blueprint?

A **test blueprint** is a list of key components defining your test, including:

- **The purpose of the test:** It might be something simple, such as assessing knowledge prior to instruction to get a baseline of what students know before taking a course. Alternatively, the test purpose might be more complex, such as assessing retention of material learned across several organ-system courses to determine eligibility for advancement.
- **The content framework:** Start with the schemas or frameworks commonly used to organize and consolidate medical knowledge. For example, basic science (e.g., biochemistry, genetics) or clinical science (e.g., surgery, pediatrics) disciplines are common schemas.

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- **The testing time:** This includes amount of testing time available and the need for breaks, as well as other logistical issues related to the test administration.
 - **The content weighting (aka, number of items per content area):** The number of questions per topic category should reflect the importance of the topic; that is, they should correlate with the amount of time spent on that topic in the course. For example, if there are 20 one-hour lectures, there may be 10 questions from each hour of lecture or associated with each hour of expected study. The number of questions per category can be adjusted up or down to better balance the overall test content and represent the importance of each lecture, as well as the total lecture time.
 - **The item formats (e.g., MCQ, essay question):** The item formats should always be appropriate for the purpose of the assessment.

Benefits of Test Blueprints

Test blueprints will help ensure that your tests:

- Appropriately assess the instructional objectives of the course
- Appropriately reflect key course goals and objectives – the material to be learned
- Include the appropriate item formats for the skills being assessed

Test blueprints can be used for additional purposes besides test construction:

- Demonstrate to students the topics you value, and serve as a study guide for them
- Facilitate learning by providing a framework or mental schema for students
- Ensure consistent coverage of exam content from year to year
- Communicate course expectations to stakeholders (e.g., trainees, other faculty, administration)

Content Frameworks

An outline is one common way to organize a syllabus or plan a lecture. Sometimes, outlines are informal and simply list a few topics; other times, outlines are meticulously detailed with topics and subtopics at multiple levels arranged in a hierarchical manner. A course outline, along with the following list, can serve as starting points for identifying the content frameworks that will be part of a test blueprint:

- Textbook table of contents
- Lecture topics

- Presentation slides
- Patient cases
- Laboratory experiments
- Practice analysis
- Behavioral objectives

Medicine provides several schema per content area, so there are often different ways of organizing the same material inside a given content area. Medical school curricula are frequently organized by discipline or by organ system. Another framework is physician skill or competency, which, in contrast to the discipline and organ system frameworks, focuses on what type of tasks a student should be able to perform. In the following table, every content area within Basic Science also fits into at least one schema.

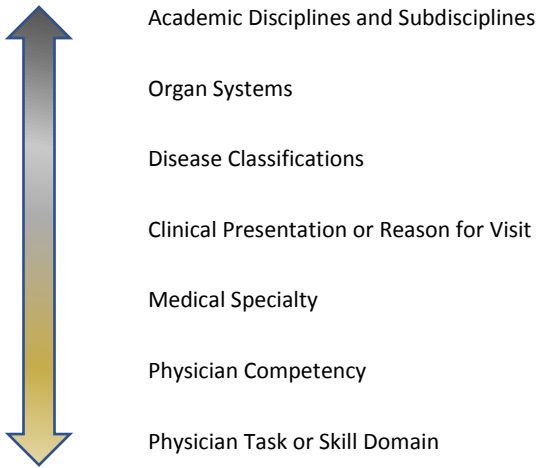
Table 1. Content Areas Within Schema.

Basic Science	Clinical Science	Organ System	Physician Competency
Biochemistry	Internal Medicine	Hematopoietic & lymphoreticular	Interpersonal & communication skills
Genetics	Surgery	Nervous	Medical knowledge
Pharmacology	Pediatrics	Skin & connective tissue	Patient care
Pathology	Psychiatry	Musculoskeletal	Practice-based learning & improvement
Anatomy	Obstetrics & Gynecology	Respiratory	Systems-based practice
Physiology	Family Medicine	Cardiovascular	Professionalism
Microbiology	Neurology	Gastrointestinal	

The following image shows a list of medical frameworks or schemas that could be used in test blueprinting. These schema are arranged in progression from frameworks based on topics to those based on practice skills.

Figure 1. Continuum of Schemas By Knowing/Doing

Knowing / Topic oriented



Doing / Practice oriented

Content Weighting

Once you have identified a framework or schema to organize the test topics, you should consider the importance of each topic in order to determine the best content weighting for the test as a whole. The number of questions for each content area should reflect the importance of that content area. The following questions will help you determine the weight of each topic in the assessment:

- How much of your lecture time do you spend teaching this topic in your course?
- How much time are examinees expected to spend studying each topic area independently?
- How much of the course textbook or lab time is devoted to this topic?
- How much of this topic will your students need to know as they move through their training?
- What other topics should get about the same amount of test time as this topic?

The following table shows one example of a blueprint with content weighting. In this example, there is room for flexibility, that is, some topics have two days of lecture and require five questions, while others have two days of lecture and require eight questions. This flexibility allows for topics of similar importance that may contain content of greater complexity.

Table 2. Content Blueprint for Physiology.

Physiology Subtopic	Lecture Days	# of Test Questions
Chemical comp of body	1	3
Cell structure & genetic control	3	12
Cell respiration & metabolism	2	5
Neurons & membrane potentials	3	12
The nervous system	3	12
Central and autonomic nerv sys	1	4
Muscle	4	16
Blood & blood clotting	2	8
Blood & blood clotting	1	4
Cardiovascular system	4	16
Respiratory physiology	2	8

You are not limited to using only a single framework or schema to plan your test. It is possible to combine frameworks to form a **blueprint matrix**. A blueprint matrix allows you to balance content across more than one framework. The following table shows a blueprint matrix with cardiovascular disease topics and physician tasks. The numbers refer to the number of questions in the test that will address that content. For example, two questions will assess diagnosis of ischemic heart disease.

Table 3. Content Blueprint by Content and Task.

Cardiovascular Content	Health and Health Maintenance	Diagnosis	Management
Infectious and Immunologic	2	1	1
Neoplasm	2	2	1
Dysrhythmias	2	1	2
Heart failure	1		2
Ischemic heart disease		2	1
Diseases of myocardium	1	2	1
Vascular disorders	1	2	

Blueprinting Performance Assessments

The principles described on the previous screens can also be applied to other types of assessments, including Objective Structured Clinical Examinations (OSCEs). Like a test blueprint, an OSCE blueprint will define the purpose of the test, and conditions for sampling, such as the skill being assessed and the organ system problem presented by the patient. The example OSCE blueprint shown below is organized by a framework describing communication challenges. Additional case information is provided to describe the patient's presenting scenario (the main issue).

Table 4. Content Blueprint for OSCE.

Case	Age	Gender	Communication Challenge	Format	Scenario
1	10 months	F	Informed consent	SP encounter	Child need lumbar puncture
2	18	F	Counseling for safe sex	SP encounter	Sexually active teen with herpes diagnosis
3	35	M	Behavior change	SP encounter	Weight loss
4	45	M	Non-adherence	SP encounter	Non-therapeutic drug levels
5	65	M	Behavior change	SP encounter	Smoking cessation
6	75	F	Delivering bad news	2 SPs (mother and daughter)	Dementia diagnosis

Classifying Test Questions

To make creating a test even easier, as you develop and collect test questions or cases, classify them according to the same frameworks you use for your blueprint. This will help you find specific material from your pool more efficiently and keep track of needs during the item or case-writing process. The following table shows some sample test items coded for diagnosis and organ system.

Table 5. Items Coded by Diagnosis and Organ System.

Diagnosis	Organ System	Question
Cancer, skin, squamous cell	Skin & connective tissue	A 72-year-old man who is a retired construction work comes to the physician because of a lesion on his face for 3 months. Physical examination shows...
Cancer, cervical	Reproductive	A 42-year-old woman, gravida 2, para 2, comes for a routine examination. She has a history of vulvar condylomat acuminata...
Cancer, lung	Respiratory	A 74-year-old man has had confusion for 2 weeks. He has smoked two packs of cigarettes daily for 50 years...

Here are some additional ways to classify test material.

- Age (e.g., pediatric, adult)
- Gender
- Site of care (e.g., clinic, emergency department)
- Disease
- Presenting complaint
- Examinee level (e.g., end of course, end of year)
- Task

Putting It All Together

Blueprinting can help **you**:

- Assess the instructional objectives of the course or instructional period
- Avoid over- or under-representing a topic in your test
- Use appropriate formats for the skills being assessed
- Show students the topics you value

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- Ensure similar exam content from year to year
 - Communicate expectations to other stakeholders (e.g., other faculty, administration)

Blueprinting can help **students**:

- Construct meaning of the content by providing a framework or mental schema
- Plan their studying
- See the topics you value most

Resources

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