

## DEPARTAMENTO DE QUÍMICA INORGÁNICA

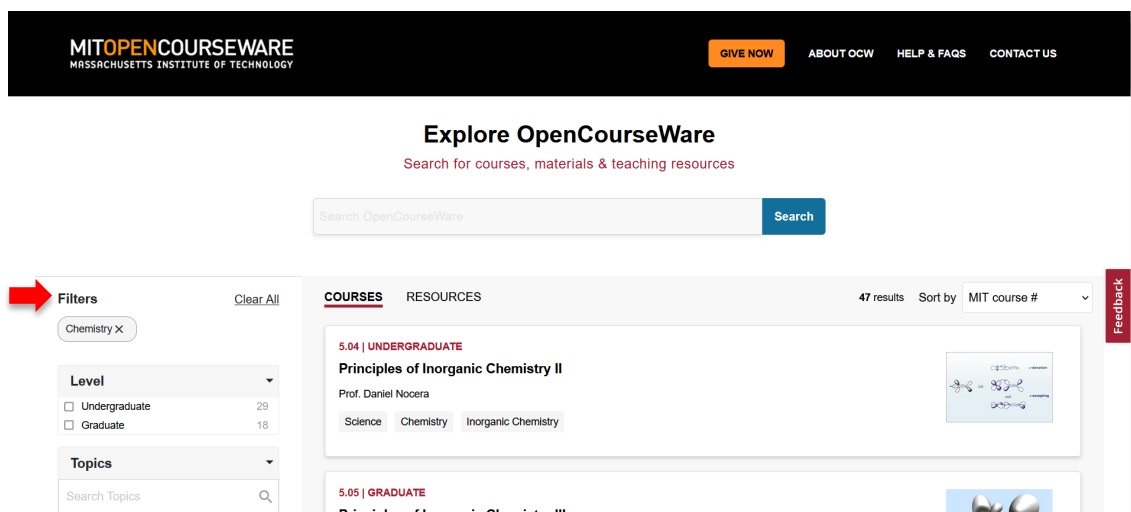
Tutorial sobre [Cursos de libre acceso del MIT](https://ocw.mit.edu/courses/chemistry/)  
(Cursos de Química)

<https://ocw.mit.edu/courses/chemistry/>

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Cursos (o asignaturas) gratuitos del Massachusetts Institute of Technology (MIT) que abordan distintas áreas de la Química (Inorgánica, Orgánica, Experimental, etc.). Estos cursos están destinados tanto a usuarios graduados como no graduados, y pueden servir tanto de aprendizaje como de repaso. La información sólo está disponible en inglés.

Se accede a través de la dirección <https://ocw.mit.edu/courses/chemistry/>, teniendo la página principal el siguiente aspecto:



The screenshot shows the MIT OpenCourseWare website interface. At the top, there is a navigation bar with the MIT OpenCourseWare logo and links for 'GIVE NOW', 'ABOUT OCW', 'HELP & FAQS', and 'CONTACT US'. Below this is a search bar with the text 'Search OpenCourseWare' and a 'Search' button. The main content area is titled 'Explore OpenCourseWare' and includes a search bar with the text 'Search OpenCourseWare' and a 'Search' button. On the left side, there is a 'Filters' section with a 'Clear All' button. The filters include 'Chemistry X', 'Level' (Undergraduate: 29, Graduate: 18), and 'Topics' (Search Topics). The main content area shows search results for 'Principles of Inorganic Chemistry II' by Prof. Daniel Nocera, with 47 results and a 'Sort by MIT course #' dropdown. The results are categorized by '5.04 | UNDERGRADUATE' and '5.05 | GRADUATE'. The '5.04 | UNDERGRADUATE' result is highlighted, showing the course title 'Principles of Inorganic Chemistry II', the professor 'Prof. Daniel Nocera', and the topics 'Science', 'Chemistry', and 'Inorganic Chemistry'. There is also a 'Feedback' button on the right side of the page.

A la izquierda, se observan varios filtros (**Filters**) con los que se puede restringir la búsqueda al curso que nos interese.

Se puede escoger entre varios:

- Niveles (**Level**): no graduados (*Undergraduate*) o graduados (*Graduate*).
- Temas (**Topics**): ciencia (*Science*), química (*Chemistry*), física (*Physics*), química orgánica (*Organic Chemistry*), química física (*Physical Chemistry*), mecánica cuántica (*Quantum Mechanics*), bioquímica (*Biochemistry*), ingeniería química (*Chemical Engineering*), química analítica (*Analytical Chemistry*), mecánica clásica (*Classical Mechanics*), salud y medicina (*Health and Medicine*), ingeniería biológica (*Biological Engineering*), química inorgánica (*Inorganic Chemistry*), espectroscopía (*Spectroscopy*), etc.
- Características del curso (**Features**): apuntes de clase magistral (*Lecture Notes*), videoclases (*Lecture Videos*), problemas con soluciones (*Problem Sets with Solutions*), exámenes con soluciones (*Exam with Solutions*), conjuntos de

problemas (*Problem Sets*), exámenes (*Exams*), introducción a cursos (*Course Introduction*), vídeos demostración (*Demonstration videos*), etc.

- Departamentos (**Departments**): Ciencia, Tecnología y Sociedad (*Science, Technology, and Society*); Ciencias y Tecnologías de la Salud (*Health Science and Tecnology*); Ciencia y Tecnología de Materiales (*Materials Science and Engineering*); Química (*Chemistry*), Ingeniería Química (*Chemical Engineering*); etc.

The image shows a sidebar with filters and three search result panels. The filters include 'Chemistry x', 'Level' (Undergraduate: 29, Graduate: 18), and 'Topics' (Science: 45, Chemistry: 37, etc.). The 'Features' panel lists items like 'Lecture Notes' (34) and 'Lecture Videos' (13). The 'Departments' panel lists 'Electrical Engineering and...' (248) and 'Urban Studies and Planning' (188).

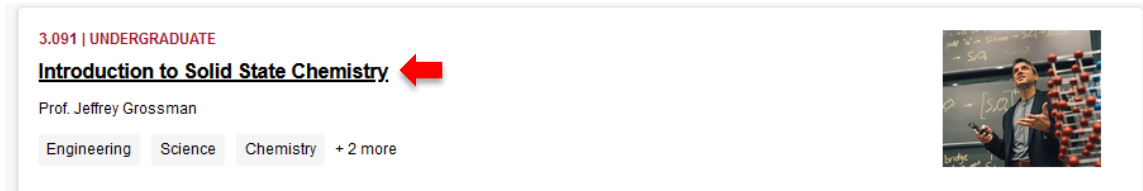
Como ejemplo ilustrativo, buscaremos un curso de Química para nivel no graduado.

### Explore OpenCourseWare

Search for courses, materials & teaching resources

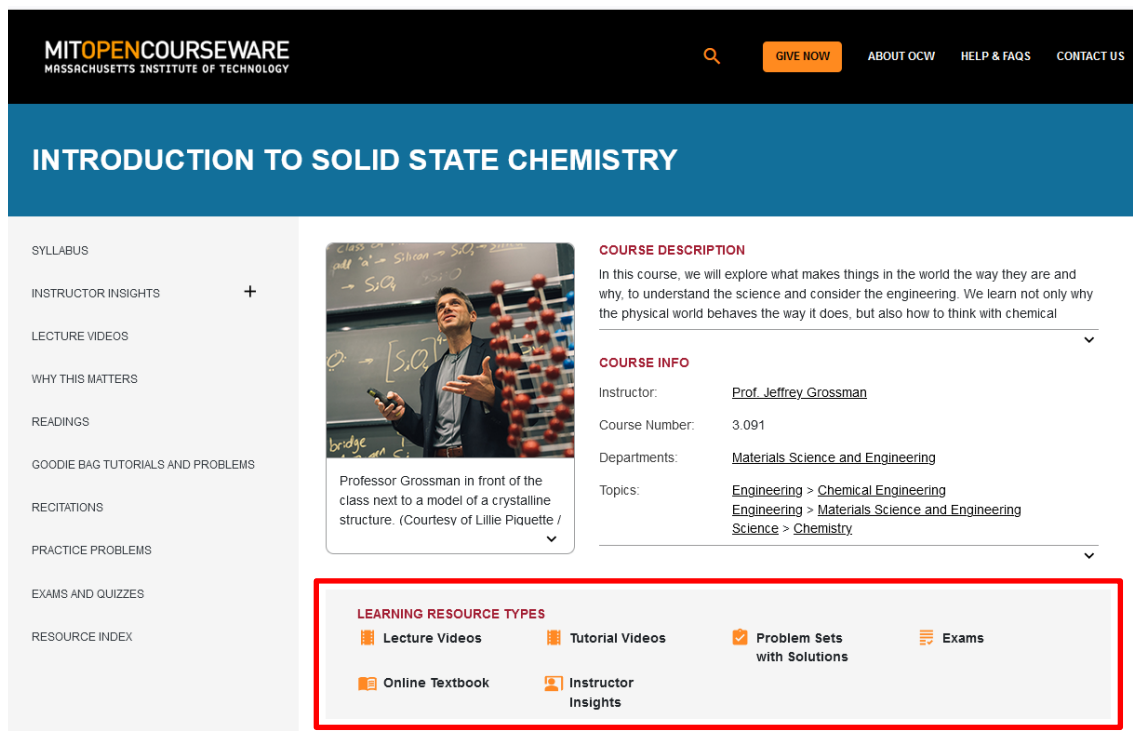
The screenshot shows the OpenCourseWare search interface. The search bar contains 'Search OpenCourseWare' and a 'Search' button. The filters sidebar shows 'Undergraduate x' and 'Chemistry x' selected. Under 'Level', 'Undergraduate' is checked (54 results). Under 'Topics', 'Chemistry' is checked (54 results). The main content area shows search results for 'COURSES' (54 results) sorted by 'MIT course #'. The first three results are: 3.034 | UNDERGRADUATE Organic & Biomaterials Chemistry, 3.052 | UNDERGRADUATE Nanomechanics of Materials and Biomaterials, and 3.063 | UNDERGRADUATE Polymer Physics. The fourth result, 3.091 | UNDERGRADUATE Introduction to Solid State Chemistry, is highlighted with a red box. Red arrows point to the 'Undergraduate' and 'Chemistry' filter options.

- a) Seleccionamos el curso que nos interesa. Por ejemplo, el curso 3.091 de “Introducción a la Química de Estado Sólido” (**Introduction to Solid State Chemistry**), que se ha recuadrado en rojo. Como se observa en la imagen de abajo, el curso lo imparte el Prof. Jeffrey Grossman y su contenido abarca las áreas de ingeniería, ciencia y química, entre otras.



- b) Posicionando el ratón encima del título “**Introduction to Solid State Chemistry**”, se accede al curso, que dispone de recursos (*Learning Resource Types*) de distintos tipos, como puede verse en la zona recuadrada en rojo:

- Información acerca del instructor (*Instructor insights*)
- Videos de clases magistrales (*Lecture Videos*)
- Vídeos tutoriales (*Tutorial Videos*)
- Problemas con soluciones (*Problem Sets with Solutions*)
- Exámenes (*Exams*)
- Libros de texto online (*Online Textbook*)



- c) En el menú de la izquierda, podemos acceder a todos los contenidos disponibles.

- SYLLABUS
- INSTRUCTOR INSIGHTS +
- LECTURE VIDEOS
- WHY THIS MATTERS
- READINGS
- GOODIE BAG TUTORIALS AND PROBLEMS
- RECITATIONS
- PRACTICE PROBLEMS
- EXAMS AND QUIZZES
- RESOURCE INDEX

Estos contenidos incluyen:

- **Programa/Plan de estudios (Syllabus)**

El Syllabus consta de varios apartados:

- Duración y organización del tiempo del curso (*Course meeting times*)
- Prerrequisitos (*Prerequisites*)
- Breve descripción del curso (*Course Description*)
- A quién va dirigido (*Who should take this course?*)
- Bibliografía o libros de texto recomendados (*Textbook*)
- Ejercicios/Deberes (*Homework*)
- Sistema de calificación (*Grading*)
- Cómo tener éxito en el curso (*How to succeed in 3.091*)
- Recursos adicionales (*Additional Resources*)

MIT OPEN COURSEWARE  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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[ABOUT OCW](#)
[HELP & FAQS](#)
[CONTACT US](#)

## INTRODUCTION TO SOLID STATE CHEMISTRY

- SYLLABUS
- INSTRUCTOR INSIGHTS +
- LECTURE VIDEOS
- WHY THIS MATTERS
- READINGS
- GOODIE BAG TUTORIALS AND PROBLEMS
- RECITATIONS
- PRACTICE PROBLEMS
- EXAMS AND QUIZZES
- RESOURCE INDEX

### SYLLABUS

#### COURSE MEETING TIMES

Lectures: 3 sessions / week, 1 hour / session

Recitations: 2 session / week, 1 hour / session

#### PREREQUISITES

There are no prerequisites for this course.

#### COURSE DESCRIPTION

Introduction to Solid-State Chemistry is one of the [GIRs \(General Institute Requirements\)](#) that all MIT undergraduates take in order to have a solid educational foundation for their majors and their future endeavors.

The thesis is that *the electronic structure of the elements holds the key to understanding*. What makes one material different from another? How do properties as diverse as how something tastes to how it behaves in a magnetic field all depend on its chemistry? and how can we manipulate these chemical properties to create new and better uses for these materials?

In this course, we explore what makes things in the world the way they are and why, to understand the science and consider the engineering. We learn not only why the physical world behaves the way it does, but also how to think with chemical intuition, which can't be gained simply by observing the macroscopic world. That's because the chemistry of materials is defined by the interactions between building blocks too small to see or interact with. We encourage you to develop a sense for what's going on in the objects around us at the atomic and molecular scale, which is key to understanding the world as it is and redesigning the world that could be.

*"Why This Matters"* is a brief portion of each lecture focusing on how the topic covered relates to important innovations (and sometimes unexpected consequences) in science and in life, demonstrating real world applications, and suggesting creative directions for research.

#### HIDE COURSE INFO

#### COURSE INFO

Instructor: [Prof. Jeffrey Grossman](#)

Course Number: 3.091

Departments: [Materials Science and Engineering](#)

As Taught In: Fall 2018

Level: [Undergraduate](#)

#### TOPICS

- ▼ [Engineering](#)
- [Chemical Engineering](#)
- [Materials Science and Engineering](#)
- ▶ [Science](#)

#### LEARNING RESOURCE TYPES

- [Lecture Videos](#)
- [Tutorial Videos](#)
- [Problem Sets with Solutions](#)
- [Exams](#)
- [Online Textbook](#)
- [Instructor Insights](#)

- **Información acerca del instructor/docente (Instructor insights).**  
Presenta brevemente al docente, incluyendo su CV y sus criterios de evaluación, información para el estudiante y la distribución temporal de la asignatura.
- **Vídeos de clases magistrales (Lecture Videos).**

The screenshot shows a course page for "INTRODUCTION TO SOLID STATE CHEMISTRY". On the left is a navigation menu with options like SYLLABUS, INSTRUCTOR INSIGHTS, LECTURE VIDEOS (highlighted), WHY THIS MATTERS, READINGS, GOODIE BAG TUTORIALS AND PROBLEMS, RECITATIONS, PRACTICE PROBLEMS, EXAMS AND QUIZZES, and RESOURCE INDEX. The main content area is titled "LECTURE VIDEOS" and lists seven lectures with thumbnail images and titles: Lecture 1: Introduction, Lecture 2: The Periodic Table, Lecture 3: Atomic Models, Lecture 4: Atomic Spectra, Lecture 5: Shell Models and Quantum Numbers, Lecture 6: Electron Shell Model, Quantum Numbers, and PES, and Lecture 7: Aufbau Principle and Atomic Orbitals. On the right, a "COURSE INFO" sidebar provides details: Instructor: Prof. Jeffrey Grossman, Course Number: 3.091, Departments: Materials Science and Engineering, As Taught In: Fall 2018, Level: Undergraduate. It also lists "TOPICS" (Engineering, Chemical Engineering, Materials Science and Engineering, Science) and "LEARNING RESOURCE TYPES" (Lecture Videos, Tutorial Videos, Problem Sets with Solutions, Exams, Online Textbook, Instructor Insights).

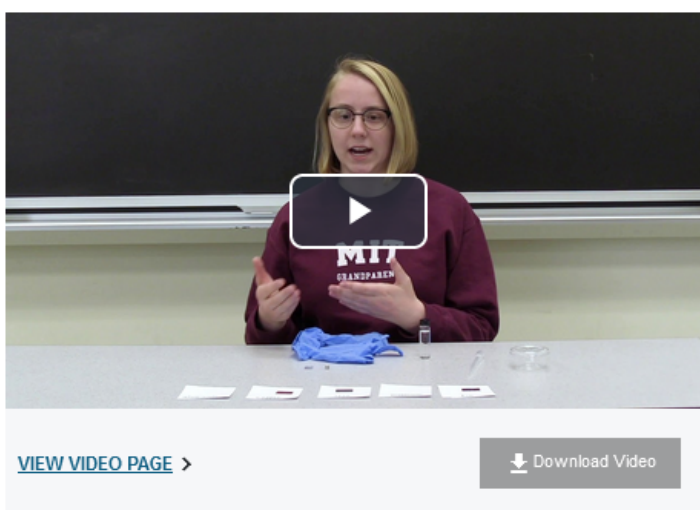
Cada vídeo presenta una breve descripción de lo que se va a tratar en él y el vídeo en sí para reproducirlo ([Play](#) ) , descargarlo ([Download](#)) e incluso su transcripción ([Download Transcription](#)).

The screenshot shows the "LECTURE 1: INTRODUCTION" page. At the top is a blue header with "SOLID STATE CHEMISTRY". Below it is the section "Lecture Videos" and "LECTURE 1: INTRODUCTION". A description reads: "Description: This lecture covers which elements comprise specific materials, how these elements interact with one another, how they are structured, and how the material was processed to achieve this structure." The instructor is listed as "Instructor: Jeffrey C. Grossman". The main content is a video player titled "Origins of Chemistry" featuring images of Plato (400 BC) and Aristotle (350 BC) with a play button in the center. Below the video player are two buttons: "Download Video" and "Download Transcription".

- **Razones por las que cada lección es importante (Why this matter?)**
- **Lecturas recomendadas y notas adicionales (Readings)**  
Con enlaces para descargar esa bibliografía.
- **Videotutoriales y problemas de miniexperimentos**, para explorar un concepto clave o resolver problemas relacionados con éste (**Goodie Bag Tutorials and Problems**).  
Recoge una serie de videoexperimentos, cada uno de los cuales lleva asociado un archivo .pdf (➡) con problemas a resolver.

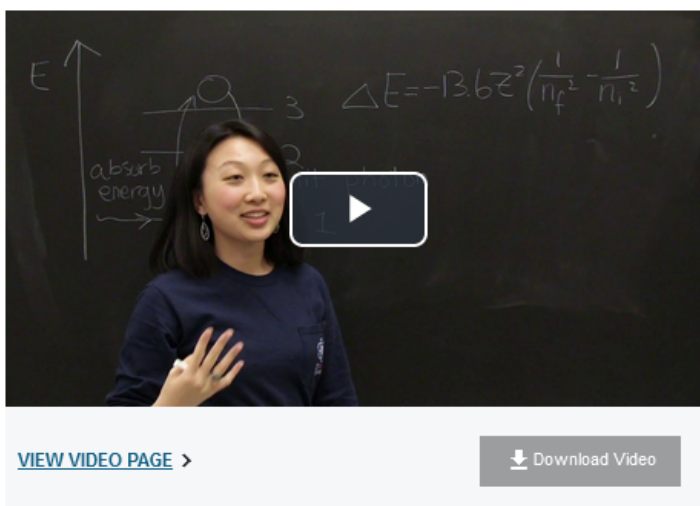
### GOODIE BAG 1: ATOMS AND REACTIONS

➡ [Goodie Bag 1: Atoms and Reactions - Problems \(PDF\)](#)



### GOODIE BAG 2: ELECTRONIC TRANSITIONS

➡ [Goodie Bag 2: Electronic Transitions - Problems \(PDF\)](#)



- **Recitaciones (Recitations).**  
Documentos (generalmente en formato .pdf) donde se explican varios conceptos que se abordan durante el trascurso del curso.

## INTRODUCTION TO SOLID STATE CHEMISTRY

SYLLABUS

INSTRUCTOR INSIGHTS

+

LECTURE VIDEOS

WHY THIS MATTERS

READINGS

GOODIE BAG TUTORIALS AND PROBLEMS

RECITATIONS

PRACTICE PROBLEMS

EXAMS AND QUIZZES

RESOURCE INDEX

## RECITATIONS

[Recitation 1: Balancing Reactions, Yield, and Limiting Reagents \(PDF\)](#)[Recitation 2: Avogadro and Moles, Periodic Table, Isotopes, and Combustion \(PDF\)](#)[Recitation 3: Waves, Photons, and Bohr Model \(PDF\)](#)[Recitation 4: Energy, Frequency, Wavelength, and Ionization \(PDF\)](#)[Recitation 5: Quantum Numbers \(PDF\)](#)[Recitation 6: Aufbau Principle, Electron Filling, Box Notation, and Photoelectron Spectroscopy \(PDF\)](#)[Recitation 7: Periodic Trends, Lewis Dot Diagrams, and Formal Charge \(PDF\)](#)[Recitation 8: Resonance, and Formal Charge \(cont.\) \(PDF\)](#)[Recitation 9: VSEPR and Polarity \(PDF\)](#)[Recitation 10: Hybridization, Atomic Orbitals, and Molecular Orbital Theory \(PDF\)](#)[Recitation 11: More Molecular Orbital Theory and Intermolecular Forces \(PDF\)](#)[Recitation 12: Band Diagrams, Semiconductors, and Doping \(PDF\)](#)

Algunos ejemplos de Recitación. Recitación 1. Balance de reacciones. Rendimiento y agentes limitantes.

## Recitations

## RECITATION 1: BALANCING

Resource Type: Recitations

Download File

1 de 3 Tamaño automático

**3.91**  
Do yourself a solid.

3.091: Introduction to Solid State Chemistry  
Maddie Sutula, Fall 2018  
Recitation 1

### 1 Balancing reactions

A chemical reaction involves rearranging elements in compounds to make different substances. They are usually written as a sum of reactants, which when combined yield a sum of products:

$$A + B \rightarrow C + D$$

Here, A, B, C, and D represent chemical compounds. The fundamental principle guiding the process of balancing a reaction is *conservation of mass*: a chemical reaction cannot create or destroy mass! This has several implications that can be used to determine whether a reaction is valid:

1. The mass of the reactants must equal the mass of the products
2. Every element that is in a reactant must be in a product
3. The number of each type of atom in the reactants must equal the number of each type of atom in the products

**Example:** Ethylene and oxygen gas are combined to make water and carbon dioxide. If you start with 4 moles of  $O_2$  gas, how many moles of water and carbon dioxide can you make? The unbalanced equation is given below:

$$C_2H_4 + O_2 \rightarrow CO_2 + H_2O$$

First, we must balance the reaction. One method to do this is by using a table:

	C	H	O	C	H	O
Initial (unbalanced):	2	4	2	1	2	3
Need: even number of oxygens						
Try: $2 \times H_2O$ on the right	2	4	2	1	4	4
Need: even number of carbons						
Try: $2 \times CO_2$ on the right	2	4	2	2	4	6
Need: more oxygen on the left						
Try: $3 \times O_2$ on the left	2	4	6	2	4	6

- **Problemas prácticos (Practice Problems)**

Contiene varios ficheros .pdf para practicar problemas, que permiten afianzar los conocimientos adquiridos en el curso/asignatura.

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- **Exámenes y cuestionarios (Exams and Quizzes)**

Dispone de varios cuestionarios y exámenes, y en cada uno de ellos se especifica los temas (topics) que abordan.

The screenshot displays the 'EXAMS AND QUIZZES' section. It features a large heading 'EXAMS AND QUIZZES' followed by a sub-heading 'QUIZZES'. Below this is a table with two columns: 'QUIZZES' and 'TOPICS'. The table lists six quizzes, each with a PDF link and a list of topics it covers.

QUIZZES	TOPICS
<a href="#">Quiz 1 (PDF)</a>	<ul style="list-style-type: none"> <li>• Moles, counting atoms, isotopes</li> <li>• Balancing rxns, limiting reagents</li> </ul>
<a href="#">Quiz 2 (PDF)</a>	<ul style="list-style-type: none"> <li>• e<sup>-</sup>/photon energies, Bohr model</li> <li>• Power, ionization, number of photons</li> </ul>
<a href="#">Quiz 3 (PDF)</a>	<ul style="list-style-type: none"> <li>• Orbital levels, filling, quantum numbers</li> <li>• Ionic radius (both neutral atoms and ions)</li> <li>• Ionic solids, lattice energy, basic Lewis structures</li> </ul>
<a href="#">Quiz 4 (PDF)</a>	<ul style="list-style-type: none"> <li>• VSEPR and shapes of molecules</li> <li>• Molecular orbitals</li> </ul>
<a href="#">Quiz 5 (PDF)</a>	<ul style="list-style-type: none"> <li>• Intermolecular forces</li> <li>• Phases</li> </ul>
<a href="#">Quiz 6 (PDF)</a>	<ul style="list-style-type: none"> <li>• Semiconductors, doping, carriers</li> <li>• Metals</li> <li>• Crystal structures, packing</li> </ul>



- **Índice de recursos (Resource Index).**

Por último, casi todo el material está ordenado en un índice, que brinda a los usuarios el acceso a la mayoría de los recursos del curso en una única ubicación. Este apartado permite ver fácilmente qué apuntes, videotutoriales, recitaciones, problemas de prácticas y/o exámenes van asociados a una determinada vídeoclase. Ejemplo:

## RESOURCE INDEX

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This resource index gives users access to most of the course resources in a single location.

**LECTURE VIDEOS:**

1. [Introduction](#)

**LECTURE NOTES:**

[CHEMATLAS Unit 1 \(PDF - 2.3MB\)](#)

**GOODIE BAGS:**

1. [Atoms and Reactions Video Tutorial](#)

[Atoms and Reactions - Problems \(PDF\)](#)

**PRACTICE PROBLEMS:**

A: [Atoms \(PDF\)](#)

**RECITATIONS:**

1. [Balancing Reactions, Yield, and Limiting Reagents \(PDF\)](#)

**EXAMS:**

[Exam 1 \(PDF\)](#)

En este caso particular, la vídeoclase (Lecture video) 1 de Introducción, llevaría vinculada: (a) los apuntes (Lectura notes) de ChemAtlas de la Unidad 1, (b) el videotutorial (Goodie Bags) 1 titulado “Átomos y reacciones”, (c) los problemas (Practice problems) A titulados “Átomos”, (d) la recitación (Recitations) 1 “Balance de Reacciones. Rendimiento y Reactivos Limitantes” y (e) el examen (Exam) 1.