1- An Introduction to Scientific English

INTRODUCTION

English for specific purposes (ESP) refers to language research and instruction التعليمي that focuses يركز on the specific communicative needs and practices التواصلية المحددة والممارسات الاحتياجات of particular social groups. groundbreaking work nearly 40 years ago, ESP started life as a branch of English language teaching, promising a stronger descriptive foundation for pedagogic materials. In the years since, ESP has consistently been at the cutting-edge of both theory development and innovative practice in applied linguistics, making a significant contribution to our understanding of the varied ways language is used in particular communities. Drawing on a range of interdisciplinary بين التخصصات influences تأثير for its research methods لطرق البحث, theory, and practices, ESP has consistently provided grounded insights into the structures and meanings of texts, the demands placed by academic or workplace contexts on communicative behaviors, and the pedagogic practices by which these behaviors can be developed.

SOME INFLUENCES ON ESP

It is its interdisciplinarity, an openness to the approaches and insights of other fields, which helps distinguish ESP and underlies its understandings and practices. Its closest connections, of course, are to applied linguistics and particularly to discourse analysis. We can, however, also see strong links between ESP and pragmatics, communicative language teaching, corporate communications, writing across the curriculum, rhetoric, critical literacy, sociocognitive theory, and the sociology of scientific knowledge. This willingness to embrace and unite different disciplinary perspectives gives ESP its distinctiveness and helps to identify what it stands for.

Introduction EST in the context of ESP. EST belongs to ESP approach, which started soon after the Second World War when a large expansion in scientific, technical and economic activity began. The world was dominated by technology and commerce. The aim of states and educational institutions was to develop

English for Science and Technology (EST)

Introduction

people who wanted to learn English. They knew what they would use the knowledge of special English for "Learners were seen to have different needs and interests, which would have an important influence on their motivation to learn and therefore on the effectiveness of their learning" (Hutchinson and Waters, 1992). The area of EST "is known to have been developed especially rapidly. English for Science and Technology has always set and continues to set the trend in theoretical discussion, in ways analysing language and the variety of actual teaching materials" (Swales, 1985). Many practicians and theorists started producing EST courses and syllabuses, which would give priority to the language, students might meet in their research and future work and which would be more relevant to learners' needs. Thus ESP, and its branch EST are the approaches to language learning/ teaching in which the choice of the content and techniques are based on the learner's reasons to study. "Much of the demand for ESP has come from scientists and technologists who need to learn English for a number of purposes connected with their specialisations. It is natural, therefore, that English for Science and Technology (EST) should be an important aspect of ESP programmes" (Kennedy and Bolitho, 1990).

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Regular and Irregular Verbs
الافعال القياسية والشاذة

Verbs are of two kinds: regular verbs and irregular ones. To form the past and past participle of a regular verb, add "ed" or "d" to the infinitive.

The following list shows the past and past participle of irregular verbs. They should be learnt by heart.

تُقسم الافعال من حيث التصريف الى قسمين افعال قياسية وافعال شاذة .

وفيما يلي جدول بالافعال الشاذة والتي تستعمل كثيراً ويجب أن تحفظ بصورة جيد

فاذا كان لديك فعل مضارع (مصدر) واردت الحصول على الماضي واسم المفعول فسيجده في الجدول التالي .

واذا لم تجده فهو فعل قياسي . وللحصول على الماضي واسم المفعول للفعل القياسي ، اضف الى نهاية الفعل المضارع ed (واذا كان الفعل منتهياً بـ e أضف d) . مثل :

work يعمل	working	worked	worked
live يعيش	liv ing	lived	lived
serve يخدم	serv ing	served	served
end ينتهي	end ing	ended	ended

تنبيه : اذا انتهى الفعل القياسي بالحرف y وكان قبل الحرف y احد حروف العلة : u, o, i, e, a فعند إضافة ed لا يتغير الـ y . لاحظ اذا انتهى الفعل بـ y فعند اضافة ing يبقى ألـ y . مثل :

play playing played played; obey obeying obeyed obeyed; enjoy enjoying enjoyed enjoyed

اما اذا كان الحرف y مسبوقا بحرف صحيح فعند اضافة ed الى نهايته يحذف الـ y وتضاف ied . مثل :

study يَدْرس	studying;	studied	studied
copy ينسخ	copying;	copied	copied
carry يحمل	carrying;	carried	carried

لاحظ اذا إنتهى الفعل بحرف صحيح وجاء قبله حرف علة واحد وكان ذا مقطع واحد يضاعف الحرف الاخير عند اضافة ed و ing . مثل :

drop يُسقط dropping dropped dropped
step يخطو stepping stepped stepped
beg يرجو begging begged begged
rob يسلب robbing robbed robbed
plan يخطط planning planned planned

stop يوقف stopping stopped stopped
rub يدلك rubbing rubbed rubbed
clap يصفق clapping clapped clapped

وكذلك الأفعال

travel يسافر travelling travelled travelled
control يراقب controlling controlled controlled

تنبيه: إذا أنتهى الفعل بحرف صحيح يسبقه حرف علة واحد و كان الفعل ذا مقطع واحد فإن الحرف الأخير يُضاعف عند إضافة ing مثل:
put: putting; cut: cutting; get: getting; run: running; win: winning; sit: sitting; shut: shutting; swim: swimming; dig: digging; hit: hitting …

و كذلك الفعل begin: beginning

لاحظ عند إضافة ing إلى فعل ينتهي بـــ ie أحذف ie و أضف ying . مثل:
die: dying; lie: lying; tie: tying; vie: vying يتنافس

لاحظ أن الأفعال في العمود الأول هي في زمن المضارع و تسمى مصدراً infinitive و تستخدم كأفعال أمر .
و الأفعال في العمود الثاني هي في زمن الماضي .
و في العمود الثالث تجد التصريف الثالث للفعل pp و تسمى كذلك أسم المفعول .

Irregular Verbs (الشاذة) الأفعال غير القياسية

1 **Present** المضارع **Infinitive (base)** المصدر المجرد / فعل أمر	2 **Past** الماضي	3 **Past Participle** **pp** التصريف الثالث أسم المفعول
ينشأ arise arising	arose	arisen

تنبيه: إذا إنتهى الفعل بالحرف e و كان الـــ e لا يُلفظ silent e فإن الـــ e يُحذف عند إضافة ing .

يحمل bear	bore	borne
تلد bear	bore	born

تنبيه: كما تُلفظ كلمة beet يُلفظ الفعل beat في المضارع و الماضي و التصريف الثالث:

يضرب/يهزم	beat	beat	beaten
يصبح	become becoming	became	become
يبدأ	begin beginning	began	begun
يلوي، يثني ، يحني	bend	bent	bent
يراهن	bet betting	bet	bet

كما تُلفظ كلمة mind يُلفظ الفعل bind و كما تُلفظ كلمة round يُلفظ الفعل bound :

يربط/يجلد (كتاباً)	bind	bound	bound
يعض، يلدغ	bite biting	bit	bitten

The biter bitten. المخادع يُخدع

يترف	bleed	bled	bled
يهب/ ينفخ	blow	blew	blown
يكسر	break	broke	broken
يربي	breed	bred	bred
يجلب	bring	brought	brought

يذيع	broadcast	BROADCAST	BROADCAST
يبني	build	built	built
يحرق، يشتعل	burn	burnt (or) burned	burnt (or) burned
ينفجر	burst	burst	burst

تنبيه: إذا أنتهى الفعل بـ y و عند إضافة ing يبقى أل y سواءً كان قبل ألـ y حرف علة أو حرف صحيح

يشترى	buy buying	bought	bought

لاحظ أنك تجد بين الخطين المائلين كيف تلفظ الكلمة:

يمسك	catch	caught /ko:t/	caught /ko:t/
يختار	choose choosing	chose	chosen
يأتي	come coming	came	come
يُكلف	cost	cost	cost
يقطع، يقص	cut cutting	cut	cut
يتعامل	deal	dealt	dealt
يحفر	dig digging	dug	dug
يعمل	do	did	done
يرسم/يسحب	draw	drew	drawn
حلم	dream	dreamt (or) dreamed	dreamt (or) dreamed
يشرب	drink	drank	drunk
يسوق	drive driving	drove	driven
يأكل	eat	ate	eaten
يقع	fall	fell	fallen
يُطعم	feed	fed	fed
يشعر	feel	felt	felt
يقاتل، يحارب	fight	fought	fought
يجد	find	found	found

تنبيه: إذا أنتهى الفعل بـ e و كان آل e يُلفظ فعند إضافة ing يبقى ألـ e :

يهرب	flee fleeing	fled	fled
يطير	fly flying	flew	flown
يمنع	forbid forbidding	forbade	forbidden
ينسى	forget forgetting	forgot	forgotten
يسامح يغفر، يعفو	forgive forgiving	forgave	forgiven
يتجمد	freeze freezing	FROZE	frozen

يحصل	get	getting	got	got
يُعطي	give	giving	gave	given
يذهب	go		went	gone
يطحن/يحد(السكين)	grind		ground	ground
ينمو، يزرع، يصبح	grow		grew	grown
يُعلق (الشيء)	hang		hung	hung
امتلك	have	having	had	had

كما تُلفظ كلمة near يُلفظ الفعل hear و كما تُلفظ كلمة bird يُلفظ الفعل heard :

يسمع	hear		heard	heard
يُخفي، يختبئ	hide	hiding	hid	hidden
يضرب	hit	hitting	hit	hit
	hold		held	held
يؤذي	hurt		hurt	hurt
يحفظ / يستمر	keep		kept	kept

لا يُلفظ الحرف k في بداية الفعلين kneel ، know :

يركع	kneel		knelt	knelt
يعرف	know		knew	known
يضع	lay	laying	laid	laid
يقود	lead		led	led
يتكئ ، يميل	lean		leant (or) leaned	leant (or) leaned
يتعلم	learn		learnt (or) learned	learnt (or) learned
يترك ، يغادر	leave	leaving	left	left
يُقرض (المال)، يُعير	lend		lent	lent
يسمح ، يدع	let	letting	let	let
يضطجع	lie	lying	lay	lain
يُشعل ، يُضيء	light		lit	lit
يخسر ، يُضيع ، يفقد	lose	losing	lost	lost
يعمل / يجعل	make	making	made	made
يعني ، يقصد	mean		meant	meant

يُلاقي، يُصادف، يُقابل	meet		met	met
يُخطئ	mistake	mistaking	mistook	mistaken
يز ، يتفوق على	outshine	outshining	outshone	outshone
يتغلب على	overcome	overcoming	overcame	overcome
يدفع (النقود)	pay	paying	paid	paid
يضع	put	putting	put	put

كما تُلفظ كلمة reed يُلفظ الفعل read في المضارع و كما تُلفظ كلمة red يُلفظ الفعل read في الماضي و التصريف الثالث :

يقرأ	read		read	read
يركب (الدراجة، الحصان)	ride	riding	rode	ridden
يدق (الجرس)، يرن/ يخابر	ring		rang	rung
يشرق/ يرتفع/ ينهض/ ينبع	rise	rising	rose	risen
يركض/ يُدير	run	running	ran	run
يقول	say	saying	said	said
يرى	see	seeing	saw	seen
يبحث عن	seek		sought	sought
يبيع	sell		sold	sold
يُرسل	send		sent	sent
يغرب	set	setting	set	set

تنبيه: كما يُلفظ الفعل sow يُلفظ الفعل sew:

يُخيط	sew		sewed	sewn
يهتز، يرتعش، يرتجف	shake	shaking	shook	shaken
ذرف (الدمع)/يسفك (الدم	shed	shedding	shed	shed
يضيء / يلمع	shine	shining	shone	shone
يُطلق (النار أو السهم) / يقذف (الكرة)	shoot		shot	shot
يَعْرض ، يُري	show		showed	shown
يُغلق	shut	shutting	shut	shut
يُغنّي	sing		sang	sung
[illegible]	sink		sank	sunk
	sit	sitting	sat	sat

ينحر، يذبح	slay	slaying	slew	slain
ينام	sleep		slept	slept
يشم	smell		smelt (or) smelled	smelt (or) smelled
يذر (البذور)	sow		sowed	sown
يتكلم	speak		spoke	spoken
يتهجى	spell		spelt (or) spelled	spelt (or) spelled
يقضي / يصرف	spend		spent	spent
يسكب	spill		spilt (or) spilled	spilt (or) spilled
يبصق	spit	spitting	spat	spat
ينتشر	spread		spread	spread
يقف	stand		stood	stood
يسرق	steal		stole	stolen
يلصق	stick		stuck	stuck
يلسع، يلدغ	sting		stung	stung
يضرب	strike	striking	struck	struck
يحلف، يُقْسِم	swear		swore	sworn
يكنس	sweep		swept	swept
يسبح	swim	swimming	swam	swum
يأخذ	take	taking	took	taken

كما يُلفظ الفعل bought يُلفظ الفعل taught لاحظ أن بين الخطين المائلين كيف تلفظ الفعل:

يُدرّس،يُعلّم	teach	taught /to:t/	taught /to:t/

كما تُلفظ كلمة care يُلفظ الفعل tear :

يُمزق	tear	tore	torn
يقول، يُخبر	tell	told	told
يُفكر، يعتقد	think	thought	thought
يرمي	throw	threw	thrown
يطأ، يدوس	tread	trod	trodden
يفهم	understand	understood	understood

يتعهد. يتولى	undertake	undertaking	undertook	undertaken
يستيقظ، يوقظ	wake	waking	woke	woken
يلبس، يرتدي	wear		wore	worn
ينسج	weave	weaving	wove	woven
يبكي	weep		wept	wept

تنبيه: كما تُلفظ كلمة one يُلفظ الفعل won :

يفوز، يربح	win	winning	won	won
ينسحب	withdraw		withdrew	withdrawn
يكتب	write	writing	wrote	written

The use of the prefixes 'un,im,in'and'dis'

un,im,in,dis استعمال الإضافات الأولية

When 'un,im,in' or 'dis' is added in front of a word it means 'not' or 'do the opposite of '.

عند إضافة dis,in,im,un في بدء كلمة فان تلك الكلمة تتحول إلى العكس من حيث المعنى.

1. 'Un' is added in front of the following: تضاف unفي بدء الكلمات الآتية:

able, armed(adj), bearable, believable, certain, comfortable, common, conditional, conscious, countable, dated, dress, educated, employment, equal, expected, fair, faithful, fasten, finished, fit, fold, forgettable, fortunately, friendly, furnished, grateful, happy, healthy, hurt, important, inhabited, interesting, just, kind, known, like(adj), limited, lock, lucky, married, necessary, paid, paved, ripe, safe, seen, selfish, skilled, stable, successful, tidy, touched, trained, true, usual, well, willing, wise, ...

2. 'Im' is added in front of the following: تُضاف im في بدء الكلمات الأتيه:

moral, partial, patient, perfect, polite, possible, probable, proper, pure...

3. "IN" IS ADDED in front of the following words:-

توضع in في بدء الكلمات التالية :

ACCURATE active, appropriate, attentive, capable, complete, comprehension, CONVENIENT correct, credible, curable, decision, direct, effective, efficient, EQUALITY, EXPNSIVE, EXPERIENCED , formal, frequent, human, justice, sane, secure,SEPARABLE, significant, security, sincere, sufficient, visible. . .

4 "Dis" is added in front of the following words:-

توضع dis في بدء الكلمات التالية :

ADVANTAGE appear, approve, arm (v.), believe, comfort, connect, content, CONTINUE credit, honest, join, like (v.), loyal, obey, order (n.), orderly, please, respect, satisfaction, satisfied, trust, used. . .

تنبيه :- لاحظ الكلمات التالية ومعاكساتها (أضدادها)

legal: illegal; regular: irregular; responsible: irresponsible; lead: mislead; understand: misunderstand

What are Prefixes and Suffixes?

Prefixes and suffixes are grammatical and lingual "affixes." Prefixes are affixed before and suffixes after a base word or word stem to add information. For example, with the word "prehistoric," the prefix is "pre-" meaning "before," the base word is "history" meaning "recorded events and knowledge", and the suffix is "-ic" meaning "relating to the science of."

In other words, "prefix" simply refers to an attachment before or in front of, in this case, a shorter word or stem. In lingual terms, a "stem" is the main part of a word to which prefixes and suffixes can be added and may not necessarily be a word itself, such as "dod" in "doddle."

Similarly, "suffix" refers to an attachment after the end of an existing word or stem, serving to form a new word or functioning as an inflectional ending, for example, “s” or “es” to make for plurality.

Is an Affix a Single Syllable?

No, a prefix or suffix can be one or more syllables, depending on the root word from Latin or Greek or from any one of a host of other English lingual influences.

Inflectional Suffixes:

Are Endings such as "-ed," "-ing," and "-s" Suffixes?

Yes, endings that are creating different forms of the same word are called "inflectional suffixes." There are very few inflectional suffixes but they occur rather frequently. They are:

(1)	–s/ -es/ -ies	plural	Boys, cars/ dresses, mixes, watches/ studies, files, copies
(2)	-s	3rd person singular present	Layla's book, Ali's pensile
(3)	-ed	past tense	Called, lived, ended
(4)	-en	past participle	Bitten, broken, beaten
(5)	-en	plural (irregular)	Children, women
(6)	-ing	progressive/continuous	Going, washing, coming
(7)	-er	comparative	Smaller, cooler
(8)	-est	superlative	Tallest, biggest, longest
(9)	-n't	negative (contraction)	Dose'nt, wouldn't, can't

Derivational Suffixes:
Are Endings such as "-ism," "-ful," and "-fy" Suffixes?
Endings that change the meaning of the word are called "derivational suffixes." Some are:

(10) -ism	**forms a noun**	**Tourism, mechanism**
(11) -ist	**noun**	**Dentist, chemist, socialist**
(12) -ful	**noun**	**Careful, beautiful, harmful**
(13) -able	**adjective**	**Portable, remarkable, movable**
(14) -ation	**noun**	**Combination, precipitation, crystallization**
(15) -ness	**noun**	**Brittleness, happiness**
(16) -ment	**noun**	**Movement, government**
(17) -ify	**verb**	**Simplify, qualify**
(18) -fy	**adjective**	**Satisfy, purify**
(19) -ity	**noun**	**Security, activity, generosity, ability**
(20) -ly	**adverb**	**Firmly, warmly, openly, lonely**
(21) -ise, -ize	**verb**	**Compromise**

Derivational suffixes can combine, providing flexibility in creating other words, but such activity can lead to spelling complications. For example, "-ity" can combine with "-able," but the result is "-ability" (*desirability, predictability*), and when "-ly" is added to a word ending in "-ic" to make an adverb, the result is usually "-ically" (*historically, mechanically*).

Tenses

1- The Present Simple Tense:

a. This tense is used to express a fact:

- **Stars shine at night.**
- **A cow gives milk.**
- **January is the first month of the year.**

b. It is also used to express a general habit. The following adverbs are usually used with this tense:
(every morning, every day,…..etc)

- **My father goes to the office every day.**
- **This pilot flies to Paris twice a week.**

2- The past Simple Tense:

This tense is used to express an event that happened in the past. The following adverbs are used with the past tense:
(yesterday, ago, last week, in the past…etc)

a. I bought this mobile yesterday.
b. Two weeks ago Wisam was in Kuwait.
c. Tom and Mary were not at the party last Sunday.
d. I did not meet him at the station yesterday.
e. Where were you last night?
f. Did Mr. black leave for India last summer?

3- The Future Simple Tense:

a. To form this tense, 'shall' or 'will' is used followed by base:
(shall go, will have, will be, will not do...etc)

b. The future simple tense is used to show that an action will happen in the future. The following adverbs are used with the future tense to express futurity:
(tomorrow, next week, soon, in the future….etc)

- **He will work (or: He is going to work) in Kuwait next year.**
- **We shall not visit (or: We are not going to visit) Beirut next summer.**

4- <u>The Present Continuous (or: Progressive) Tense</u>:

a. To form this tense, "am, is" or "are" is used followed by present participle.

- **I am waiting for him.**
- **He is sitting at the table.**
- **They are working.**

b. The present continuous is used to describe an action that is taking place now and not yet complete. (now, at the moment, today, at present)

5- <u>The Past Continuous (or: Progressive) Tense</u>:

a. To form this tense, "was" or "were" is used followed by present participle. (was reading, were sitting…etc).

b. The past continuous is used to describe an action that was going on at a certain time in the past. The conjunctions "when, while, as" are normally used with this tense.

- **When I arrived, he was still sleeping.**
- **While he was running after the train, he fell down.**
- **It begun to rain as they were playing football.**
- **What were you doing when I phoned you last night?**

6- <u>The Present Perfect Tense</u>:

a. To form this tense, "have" or "has" is used followed by the past participle of the verb.

- **I have eaten an apple.**
- **He has written a letter.**
- **We have played volleyball.**

b. The present perfect tense is used:

1- To describe an action that finished in the past without mentioning an adverb of the past.

- **I have finished my work.**
- **The train has arrived.**
- **It has become hot.**
- **You have made a mistake.**
- **He has taken his medicine.**

2- **To describe an action that has just finished. The adverbs "just, already, yet" are usually used with this form:**
- **I have just written him a letter.**
- **The rain has just stopped.**
- **I have found my lost watch already.**
- **The police have not caught the thief yet.**

3- **To express an action that began at some point of time in the past and extends until the present. "Since" and "for" are usually used with this form.**
- **I have not seen a good film since last month.**
- **He has been in Egypt for the last two months.**

7- <u>The Present Perfect Continuous Tense</u>:

a. **To form this tense, "have been" or "has been" is used followed by present participle. (have been working, has been waiting)**
b. **The present perfect continuous is used to show that an action began in the past and is still going on at present. "Since" or "for" is usually used with this tense.**
   - **It has been raining since yesterday.**
   - **They have been swimming for the last two hours.**

8- <u>The Past perfect Tense</u>:

a. **To form this tense, "had" is used followed by past participle. (had been, had put, had sold…etc).**
b. **When two actions happen in the past, the past perfect is used for the first action and the past tense for the second.**
   - **After I (put) out the light, I went to bed.**
     After I had put out the light, I went to bed.
   - **He (leave) for London after he (get) the passport yesterday.**
     He left for London after he had got the passport yesterday.

Passive Voice

1- First Pattern: (Present)

- **They sell eggs at this shop. (active voice)**
  Eggs are sold at this shop. (Passive voice)
- **People drink a lot of water in summer.**
  A lot of water is drunk in summer.

2- Second Pattern: (Past)

- **A thief stole her hand bag yesterday.**
  Her hand bag was stolen yesterday.
- **The hunter killed two lions.**
  Two lions were killed by the hunter.

3- Third Pattern: (future)

- **They will send him to London next month.**
  He will be sent to London next month.
- **They are going to sell the flat next year.**
  The flat is going to be sold next year.

4- Fourth Pattern: (Continuous)

a. If the active verb is in the present continuous tense:

- **She is washing up the dishes now.**
  The dishes are being washed up now

b. (past continuous tense)

- **He was feeding the chickens.**
  The chickens were being fed.

5- Fifth Pattern: (Present Perfect)

- **He has grown some flowers in the garden.**
  Some flowers have been grown in the garden.
- **They have repaired your car.**
  Your car has been repaired.

EXERCISES

Supply the correct tense for the verbs in brackets:

ضع الافعال بين القوسين في الزمن الصحيح :

1 . While I (read) the paper, the door bell (ring).

2 . I (meet) an old friend as I (walk) along the road.

3 . The train (leave) the station now.

4 . He usually (wear) a brown coat, but today he (wear) a white one.

5 . When Selma (see) the thief, she (phone) the police at once. في الحال

6 . While I (return) home, it (get) cloudy and (start) raining.

7 . A thief (steal) her hand - bag while she (do) her shopping.

8 . He (work) with his father at present.

9 . While I (be) on my way home. I (come) across Samir and (break) the news to him.

10 . The pupils (make) noise when the teacher (come) in.

11 . Father (hurt) his hand as he (try) to start the engine.

12 . Look! Smoke _____ out of that building. (come)

13 . The bus started while a woman (get) on.

Put the verbs in the correct tense: الافعال في الزمن الصحيح :

1 . The plane for Basrah just (take) off.

2 . My brother (work) in this bank since last year.

3 . We (live) in this house for the last seven years.

4 . The film (start) yet?

5 . My sister (join) the university quite recently.

6 . The bell (not ring) yet.

7 . I just (have) a letter from him saying that he (arrive) next week.

8 . The pupils (sit) for the examination since eight o'clock.

9 . We (wait) for you for half an hour.

10 . Yes, mother is at home. She just (arrive).

11. Mr. Nabeel (receive) the visitors every Friday.

12 . We haven't visited her since she (recover).

13 . My brother never (be) to Paris.

14 . Mother (hide) the gold ring in the drawer already.

15 . You ever (hear) such an amusing story?

16 . It (be) hot in recent weeks.

17. The holiday usually (begin) in June.

18. I (draw) the money from the bank tomorrow.

19 . We (know) each other for years.

20 . I (not see) you for ages. لوقت طويل

the words in brackets instead of the words in bold type and make any essary changes:

استعمل الكلمات بين القوسين بدلا من الكلمات البارزة واعمل التغييرات الضرورية :

mple a . I **always** go to school by bus. (yesterday)

b . I went to school by bus yesterday.

. Mr. Yousif arrived in Kuwait **yesterday**. (tomorrow)

. The class **usually** begins at eight o'clock. (last n nth)

. We **sometimes** visit Babylon. (lately)

. She had a tooth pulled out **yesterday**. (next week)

. It is possible to get meat at this shop **every day**. (last week)

. They came here **last week**, didn't they? (tomorrow)

. Maha had milk for supper **last night**, (every evening)

. He **often** makes mistakes. (when he was at school)

. Did you go for a walk **yesterday afternoon?** (tomorrow evening)

. The girls sang some old songs **yesterday**. (now)

. She took her medicine **ten minutes ago**. (just)

. There are a lot of people at the station **today**. (yesterday)

. I have drawn this picture **already**. (a couple of days ago).

. Jane played with her cat **yesterday**. (every day)

. Does your sister **always** go to bed early? (last night)

. They will have a tea party **tomorrow**. (last Thursday)

. Prices have gone up **during the last few weeks**. (next month)

. They have **just** done the work. (three hours ago)

. It didn't cost too much **a week ago**. (tomorrow)

. We've **already** climbed the mountain. (tomorrow morning)

Put the verbs in the right tense: ضع الافعال في الزمن الصحيح :

1 . My cousin (study) medicine in Baghdad next year.
2 . Mr Brown normally (open) his shop at nine.
3 . It (be) cold since yesterday.
4 . Suha (not do) her duty yet.
5 . My father (buy) this pen three days ago and I (use) it already.
6 . It (rain) heavily when they (set) out for the village. قرية
7 . The next plane for Rome (leave) tomorrow.
8 . The police (catch) the thief before he (get) away. هرب
9 . Mr. Nabeel (go) to the seaside every summer.
10 . When he saw me, he (not know) me because he (not wear) his glasses.
11 . I usually (take) my lunch at home.
12 . How often you (speak) to him recently?
13 . You ever (be) to the zoo? Yes, I (be) there last Friday. I (go) there nearly every month.
14 . He (find) his lost watch ten minutes ago.
15 . A bird (lay) eggs.
16 . Your brother (get) a job yet?
17 . I (call) on you last night but you (be) out.
18 . My father usually (have) milk for breakfast but today he (have) coffee.
19 . Last year they (buy) this house and (live) in it.
20 . He (not send) me a letter since he (leave) Iraq.
21 . No, she isn't at home. She just (go) out.

Supply the right tense: ضع الزمن الصحيح للافعال :

1 . I (see) your sister yesterday. She (look) at the shop windows.
2 . --- the plane from Kuwait --- yet? (land)
3 . We (sit) for the final examination next week .
4 . Tom (grow) very tall lately. حديثاً
5 . I (sit) in the garden yesterday when the servant (come) and (say) that a visitor (wait) for me.
6 . Where you (be) yesterday?
7 . We (go) for a walk after the rain (stop) yesterday .
8 . As Tom (ride) his bicycle, he (fall) down and (hurt) his hand.
9 . Who you (see) at the party last night?
10 . Before you arrived, I (finish) reading the book.
11 . Look! A man (run) after the bus. He (want) to catch it.

Choose the right answer: اختر الجواب الصحيح :

1 . My uncle --- for Jeddah last Monday. (a) leaves (b) will leave (c) left (d) is leaving.

2 . I just --- him about it. (tell, have told, telling, tells)

3 . Mother --- some meat already. (a) buys (b) will buy (c) has bought (d) buy.

4 . A couple of days ago we --- a tea party. (have, had, will have, are having).

5 . Letters ----- usually sent by air. (is, am, was, are)

6 . The telephone (rang, ring, rung, is ringing) now.

7 . People --- thin clothes in summer. (a) wear (b) wears (c) to wear (d) are wearing

8 . Yesterday there (was, will be, are, were) a lot of people at the stadium. الملعب

9 . The guests --- yet. (a) will arrive (b) have arrived (c) haven't arrived (d) arrives

10 . The milkman --- to our house every morning. (come, comes, to come, coming)

11 . He usually --- to the office by bus. (go, is going, have gone, goes)

12 . I (not call, will not call, have not called, do not call) on him since he (lives, lived, live, will live) near our house.

13 . What is the lawyer doing now? He --- the papers.
(a) will study (b) studies (c) is studying (d) has studied

14 . --- you listen to the news on the radio last night? (were, do, did, have)

Change into the passive voice: حوّل الجُمل التالية الى المبني للمجهول :

1 . They make these cars in Japan.
2 . We saw him sitting by the river.
3 . I know his address.
4 . You can buy newspapers at this shop.
5 . People use boats for travelling.
6 . The farmers are gathering the oranges now.
7 . He could save the child from the river.
8 . She cut the apple with this knife.
9 . We should write letters in ink.
10 . She read the letter aloud.
11 . He advises me to go by air.
12 . Iraq exports a lot of oil to Europe.
13 . They provided the new house with furniture.
14 . You must bring those chairs inside.
15 . I can answer this question in another way.
16 . They were singing an old song when I arrived.
17 . He shut the door noisily. بضوضاء
18 . We heard a loud cry in the middle of the night.
19 . You ought to sign this paper.
20 . People wear woollen clothes in winter.
21 . This film will amaze them.
22 . They serve fish at this restaurant. مطعم
23 . They did the work rather badly.
24 . Two days ago a thief robbed my uncle of his watch.
25 . They dig wells to get water.
26 . Someone put the kettle on the fire.
27 . I have lost the key of the door.
28 . Somebody has spilt a lot of ink on the floor.
29 . People speak English all over the world.
30 . He wrote this letter last night.

Exercise 55

Turn the following sentences into the passive voice:

حوّل الجُمل التالية الى المبني للمجهول :

1 . You must study these papers carefully.
2 . On Thursdays he pays the workers.
3 . He spread the files on the table.
4 . Those teachers have set the questions.
5 . They washed the fruit and ate it.
6 . She spent all the money on clothes.
7 . He tore the old papers.
8 . The police will catch the thief sooner or later. عاجلاً او آجلاً
9 . He shot two birds.
10 . Someone hit him hard on the head.
11 . They teach driving cars at this office.
12 . Someone left the light on all night.
13 . They cross busy streets with care.
14 . People will laugh at you if you wear a hat like that.
15 . They call this river the Tigris. نهر دجلة

Change the following sentences into the passive voice:

حوّل الجُمل التالية الى المبني للمجهول :

1 . You must not throw away empty bottles.
2 . Butchers do not sell bread.
3 . Close all the windows.
4 . They did not allow the children to go alone.
5 . If you do not carry it carefully, you will drop it. (two passives)
6 . When do the farmers usually cut the dates?
7 . Have they questioned him yet?
8 . Post this letter today.
9 . When will they rent the new house?
10 . Did they ask you to get four tickets?
11 . We must not light a fire here.
12 . Who brought these books here?
13 . Where did he leave the keys?
14 . Can you reach that high branch? غُصن
15 . Where do they sell post cards?
16 . May you explain this subject again?
17 . He did not do it on purpose. عمداً
18 . How often must he take this medicine? دواء
19 . They do not allow you to park here.
20 . He will not send it tomorrow.

THE UNIVERSE

The universe is commonly defined as everything that exists. It includes all kinds of physical matter and energy, the planets, stars, galaxies, and all the contents of space. Earlier stages in the development of the universe can be seen at great distances. Observations suggest that the universe has been governed by the same physical laws and constants throughout most of its extent and history.

In recorded history, various cosmologies have been proposed to account for what people saw in the sky. Most early models thought the Earth was the centre of the Universe. Some ancient Greeks thought that the Universe has infinite space and has existed forever. They thought it had a set of spheres which corresponded to the fixed stars, the Sun and various planets. The spheres circled about a spherical but unmoving Earth.

The invention of the telescope in the Netherlands, 1608, was a milestone in astronomy. By the mid-19th century they were good enough for other galaxies to be distinguished. The modern optical (uses visible light) telescope is still more advanced. Meanwhile, the Newtonian dynamics (equations) showed how the Solar System worked.

The word Universe comes from the Old French word Univers, which comes from the Latin word universum. The Latin word was used by Cicero and later Latin authors in many of the same senses as the modern English word are used. A different interpretation (way to interpret) of unvorsum is "everything rotated as one" or "everything rotated by one". This refers to an early Greek model of the Universe. In that model, all matter was in rotating spheres centered on the Earth; according to Aristotle, the rotation of the outermost sphere was responsible for the motion and change of everything within. It was natural for the Greeks to assume that the Earth was stationary and that the heavens rotated about the Earth, because careful astronomical and physical measurements (such as the Foucault pendulum) are required to prove otherwise.

The Universe is huge and possibly infinite in volume. The matter which can be seen is spread over a space at least 93 billion light years across. For comparison, the diameter of a typical galaxy is only 30,000 light-years, and the typical distance between two neighboring galaxies is only 3 million light-years. As an example, our Milky Way Galaxy is roughly 100,000 light years in diameter, and our nearest sister galaxy, the Andromeda Galaxy, is located roughly 2.5 million light years away. There are probably more than 100 billion (10^{11}) galaxies in the observable universe. Typical galaxies range from dwarf galaxies with as few as ten million (10^{7}) stars up to giants with one trillion (10^{12}) stars, all orbiting the galaxy's center of mass. Thus, a very rough estimate from these numbers would suggest there are around one sextillion (10^{21}) stars in the observable universe; though a 2003 study by Australian National University astronomers resulted in a figure of 70 sextillion (7×10^{22}). The universe is thought to be mostly made of dark energy and dark matter, both of which are not understood right now. Less than 5% of the universe is ordinary matter. The matter that can be seen is spread throughout the universe, when averaged over distances longer than 300 million light-years. However, on smaller length-scales, matter is observed to form 'clumps', many atoms are condensed into stars, most stars into galaxies, most galaxies into galaxy groups and clusters and, lastly, the largest-scale structures such as the Great Wall of galaxies.

Exercises:

A) Answer the following questions:

1- What is the Universe?
2- What are the observations suggest?
3- What was the ancient Greeks think about Universe?
4- Where the name of Universe came from?
5- What was the important invention in astronomy?
6- How much the diameter of our Milky Way galaxy is?

B) <u>Vocabulary</u>:

Planets **Newtonian dynamics**

(equation)

Galaxy **Solar System**

Telescope **Dwarf Galaxy**

Astronomy

C) Fill in the blanks with the most correct words from the list below:

(astronomy, observations, telescope, energy, typical galaxy, dark energy, Cicero, infinite)

1- It includes all kinds of physical matters and ---------?

2- ---------- suggest that the Universe has been governed by the same physical laws?

3- The invention of the ---------- in the Netherlands was a milestone in ----------?

4- The Universe is huge and possibly ---------- in volume?

5- The Latin word was used by ---------- and later Latin authors in many of the same senses as the modern English word are used?

6- The Universe is thought to be mostly mad of ---------- and dark matter?

7- The diameter of a ---------- is only 30,000 light years?

TYPES OF MICROSCOPES

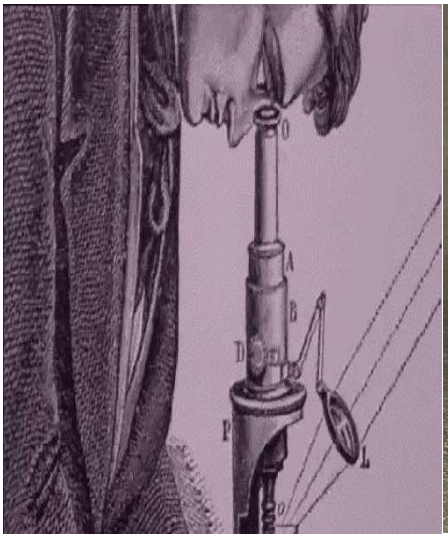
- Early Microscopes
- Modern Microscopes
- Magnification
- Nature of Light
- Optical Designs

Earliest Microscopes

•1590 -Hans & Zacharias Janssen of Middleburg, Holland manufactured the first compound microscopes

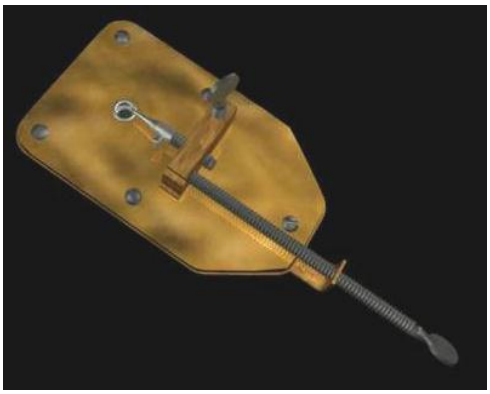
•1660-Marcello Malpighi(1628-1694),was one of the first great microscopists, considered the father embryology and early histology -observed capillaries in 1660 . Italian professor of medicine. Anatomist. First to observe bordered pits in wood sections. Gave first account of the development of the seed.

•1665 - Robert Hooke (1635-1703)- book Micrographia, published in 1665, devised the compound microscope most famous microscopical observation was his stud of thin slices of cork. Named the term “Cell” - He wrote:




The Royal Society of London founded in 1616 during the reign of King James I

•1673 - Antioni van Leeuwenhoek (1632-1723) Delft, Holland, worked as a draper (a fabricmerchant); he is also known to have worked as a surveyor, a wine assayer, and as a minorcity official.
•Leeuwenhoek is incorrectly called "*the inventor of the microscope*" .
•Created a "simple" microscope that could magnify to about 275x, and published drawings of microorganisms in 1683 .
•Could reach magnifications of over 200x with simple ground lenses – however compoundmicroscopes were mostly of poor quality and could only magnify up to 20-30 times. Hookeclaimed they were too difficult to use - his eyesight was poor.
•Discovered bacteria, free-living and parasitic microscopic protists, sperm cells, blood cells, microscopic nematodes .
•In 1673, Leeuwenhoek began writing letters to the Royal Society of London - published in *Philosophical Transactionsof the Royal Society* .
•In 1680 he was elected a full member of the Royal Society, joining Robert Hooke, Henry Oldenburg, Robert Boyle,Christopher Wren .



Screwbarrel Microscope - 1720

• Made by Charles Culpeper

Secondary Microscopes

• **George Adams Sr.** made many microscopes from about 1740-1772 but he was predominantly just a good manufacturer notinventor (in fact it is thought he was more than a copier!)

Modern Microscopes

• Early 20th Century Professor Köhler developed the method of illumination still called "Köhler Illumination"

• Köhler recognized that using shorter wavelength light (UV) could improve resolution .

• Köhler illumination creates an evenly illuminated field of view while illuminating the specimen with a very wide cone of light

• Two conjugate image planes are formed– one contains an image of the specimen and theother the filament from the light .

Magnification

• An object can be focussed generally no closer than250 mm from the eye (depending upon how oldyou are!)

• this is considered to be the normal viewingdistance for 1x magnification

• Young people may be able to focus as close as 125mm so they can magnify as much as 2x becausethe image covers a larger part of the retina - that is it is "magnified" at the place where the image is formed

There are two different types of microscopes: **light** and **electron**. **Light microscopes** have glass lenses which magnify objects, and use light to illuminate the objects being examined. You will be using two different kinds of light mi croscopes in this lab, the compound microscope and the dissecting microscope.
Electron microscopes use beams of electrons to examine incredibly small objects (like the components of an individual cell) that have been specially prepared. The different microscopes are explained in more detail below.
The Dissecting Microscope

Dissecting microscopes:-are used to observe material that is either too thick or too large to be viewed with the compound light microscope. With these microscopes, you see the surface of things that reflect the light. While the magnification and depth of field are smaller in the dissecting scope, the field of view is much larger. As its name implies, the dissecting scope is often used to look at plants as you dissect them, since it allows for manipulation of material. Since most of the parts of the dissecting microscope are the same as the compound microscope, they will not be reviewed here.
Electron Microscopy:- In these microscopes a beam of electrons (in place of light) and circular magnets (in place of glass lenses) permit the resolution of structures in much finer detail than in an optical microscope. There are two electron microscopes. The first is a"traditional" **transmission electron microscope (TEM)** in which an electron beam passes through the specimen. **The second is the scanning electron microscope (SEM)** in which a beam of electrons scans the surface of an opaque object and produces an image of that
surface. The images are viewed on a cathode tube, or in pictures taken with the microscope. Many of the photographs of cell structure used in your text were taken with an electron microscope. FIU hosts the Florida Center for Analytical Electron Microscopy, which has an SEM.

RULES FOR USE OF THE MICROSCOPE THE TEN COMMANDMENTS
1. Always carry the microscope in a straight upright position with one hand around the arm and the other hand under the base. The eyepieces are not attached and will fall out if the microscope is carried at an angle or upside down.
2. Check out the microscope to make sure all the lenses are clean and the mechanical parts are in working order. Report any malfunction to the instructor sothat it may be remedied.
3. Keep the microscope clean. When anything is spilled or otherwise gets on the microscope, clean it up immediately.
4. When using the microscope start with the low power lens and work up to the desired

magnification. These microscopes are parfocal, which means that all powers should be in focus when the turret is rotated.

5. Never move the stage upwards with the coarse adjustment while viewing through the eyepieces. Get the lens close to the slide while viewing from the side to make sure that they never touch. Then move the stage downward with the coarse adjustmentwhile viewing through the lense. This will prevent the possibility of ramming the lens into the slide, thereby ruining a slide you have just made and, quite possibly, damaging the lens.

6. Moist, living or preserved materials must be observed through a coverslip. This protects the lens as well as tends to make the object under view optically flat. Be sure to maintain a safe distance between the coverslip and the objective lenses.

7. Clean the lenses with lens paper only. **DO NOT CLEAN THE LENSES WITH HANDKERCHIEFS, FACIAL TISSUES, PAPER TOWELS, ETC.--**they will scratch the lenses. If your lenses are very dirty, obtain some lens cleaning solvent from the instructor.

8. If you cannot obtain clear focus or good lighting, or if your microscope seems not to be working properly, **IMMEDIATELY CALL YOUR INSTRUCTOR.** He/she can either assist you or see that the microscope is repaired.

9. Return your scope to the cabinet with light cord wrapped around its bas and with the lowest power objective lens in position.

THE PARTS OF A COMPOUND MICROSCOPE

1. The microscope has two magnifying lenses: the eyepiece or ocular lens and the objective lenses on a turret which revolves above the stage. The eyepiece lenses are usually 10X and are moveable so that they can be adjusted to the distance between the pupils of each viewer. The objective lenses (there are four: 4X, 10X, 40X and 100X) rotate on the nosepiece. By changing the objectives the effective power of magnification is changed. The total magnifi-cation observed is the product of the power of magnification of the eyepiece and the objective. Only the 100X objective is used immersed in a drop of special oil (between the lens and the slide; all others are designed to be used with air between the object and lens surface. The 100X objective will not be used in this course. The power of magnification is clearly indicated on each lens along with the numerical aperture of each lens. Depending upon their design and quality, different objectives have different resolving distances. The latter is the smallest distance between two points that allows both points to be viewed as separate. This resolving distance is dependent upon the wavelength of light used as well as the construction of the lens.

2. Microscopes contain elements designed to project parallel beams of light through the specimen and into the objective. These include the projection lens which focuses light onto the condenser lens. The condenser lens focuses light onto the object. To get the condenser lens in focus, place a slide containing a wax pencil mark on the stage. Focus on it with the lowest power objective lens and turn the iris diaphragm to the smallest opening. Then focus the condenser up and down until the edges of the iris diaphragm come into sharp focus without using the objective focusing adjustments. The condenser is now in focus.

3. The focusing knobs move the lens assembly up and down to bring the object in focus. The coarse adjustment should only be used with the shortest, low power objective lens.The fine adjustment (smaller knob) brings the object into critical focus. Notice that all objects are projected upside down in the microscope field. It takes a little practice in using the mechanical stage to move the slide where you want it.

USING THE COMPOUND MICROSCOPE

1.Use both hands to carry the microscope to yourseat. Place the microscope on the table in front of you and position yourself so that you are comfortably seated while looking through the microscope.

2.If necessary, clean the lenses with lens paper only. Do not use anything else, like Kim Wipes or your shirt to clean the lenses--this will damage the microscope.

3. Place a slide of the 'letter e' on the stage. If your microscope has a built in light, plug in the scope and turn the light on. If not, bring a lamp to your table and position it so that the light shines above the object being viewed.

4.Turn the nosepiece so that you are using the lowest power objective lens. You should always use the lowest power objective when you begin viewing an object. While looking through the ocular lenses with both eyes, begin to focus on the object by turning the focus adjustment on the side of the microscope arm. If you see two images of the object or the reflection of your own eye/eyelashes, you probably need to adjust the ocular lenses. These lenses can be moved together or apart to better match the distance between your eyes.

5. Once the object is in focus, increase the magnification by rotating the nosepiece. Adjust the focus by using the fine adjustment knob only. Make sure that the objective lens does'nt come in contact with the slide.

6. Examine different parts of the object by moving it around the stage. Notice the direction
that the image moves when the object is moved from left to right. Change the light level and observe differences in the way the image appears.

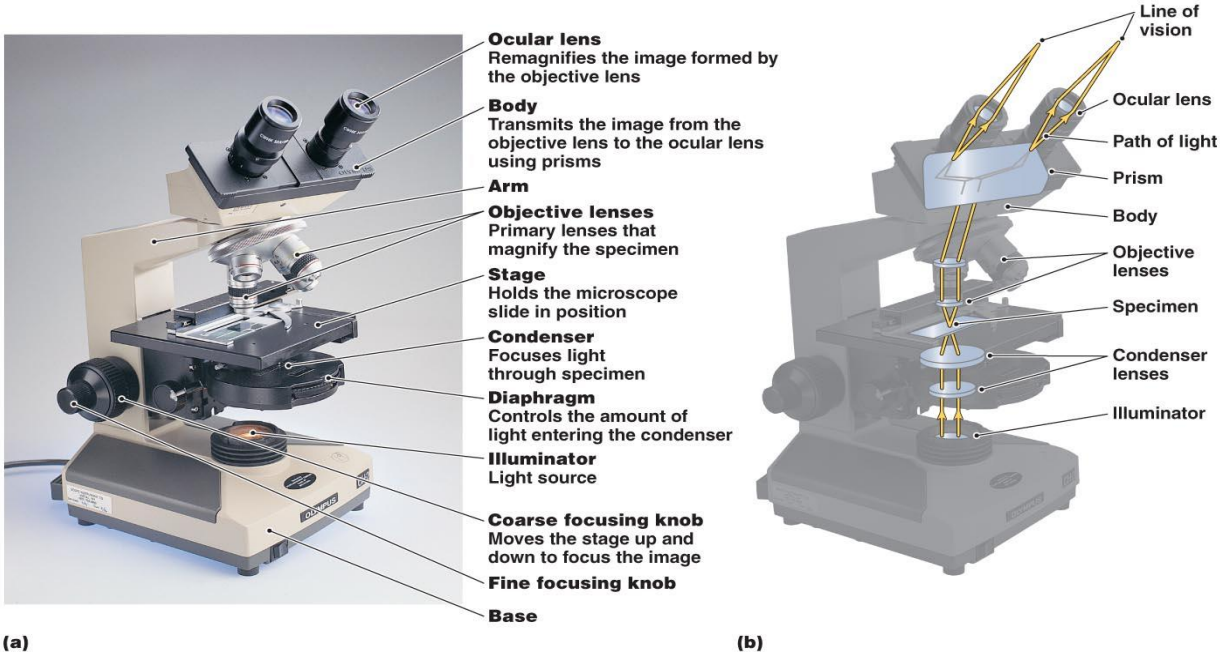
ADDITIONAL CONCEPTS

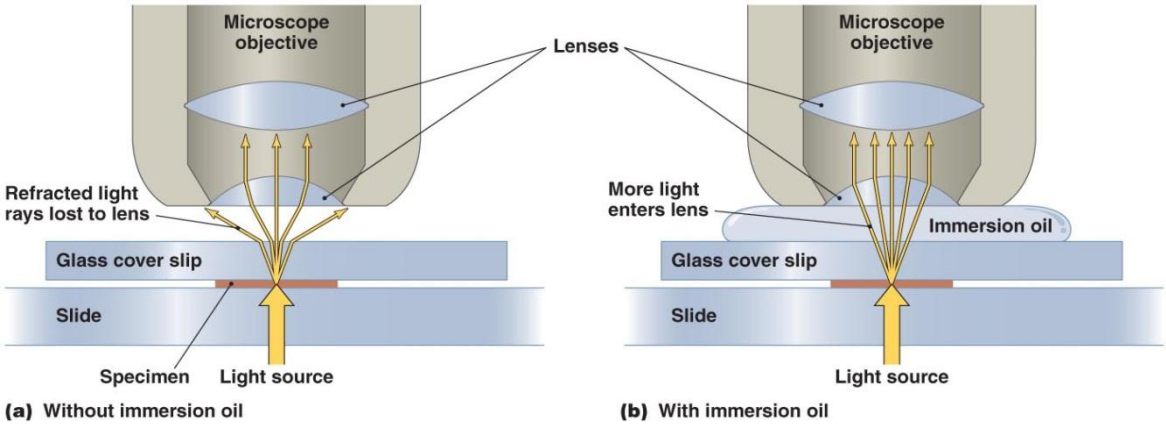
1. The field of view is the area visible when you look through the microscope. Knowing the size of the field of view will enable you to determine the size of the object you are observing. Special rulers are used to determine the field of view and measure objects under the microscope. Accurate measuring can be very important when identifying plants or plant structures.

2.Drawing Objects To Scale: In drawing objects that you have seen with the microscope it is important to describe how large they actually are. The actual magnification will depend upon whether you have drawn "little" or "big" (you should draw "big"). The way to estimate the actual size of the object is by knowing how wide the microscope's field of view is. This can be estimated by using a scale that has been etched on a microscope slide. Using this scale we have measured the width of each field for your microscopes:

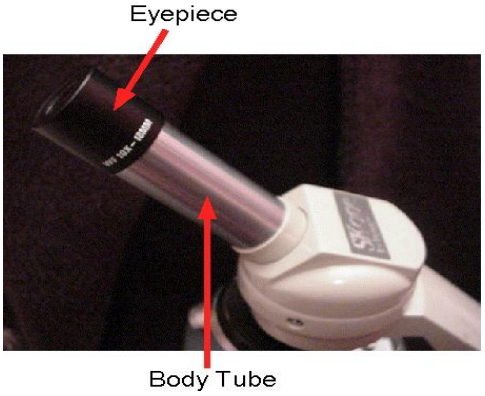
44X = 4.6 mm, 4600 um

100X = 1.8 mm, 1800 um
440X = 0.46 mm, 460 um

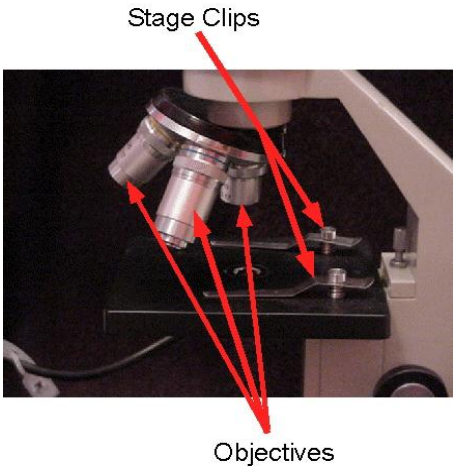




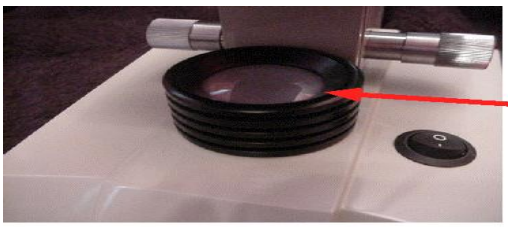
The effects of immersion oil on resolution



- The eyepiece contains the ocular lens which magnifies objects a given amount that is listed on the eyepiece.
- The body tube supports the eyepiece and objectives.
- How much do our microscopes magnify?



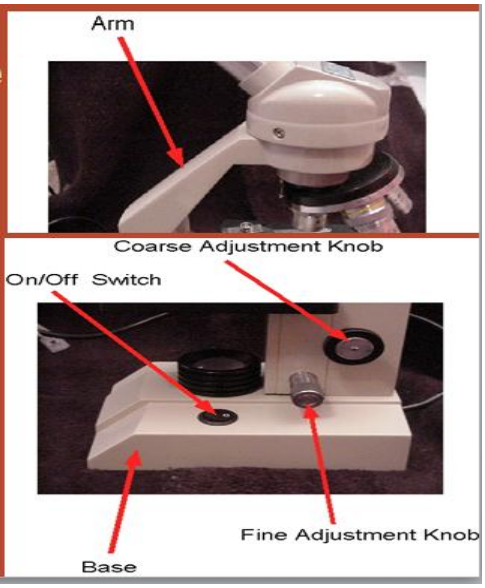
- The *nosepiece* holds the 3 objectives.
- The *objective lenses* range in magnification from 4X, 10X, and 40X.
- The *stage clips* holds the slide in place.



- The stage supports the slide being viewed.
- The light source projects upward through the diaphragm, the specimen, and the lenses.
- The diaphragm regulates the amount of light on the specimen.

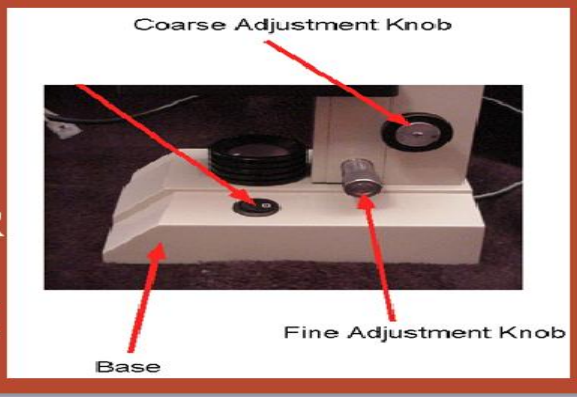
Arm and Base

- The *arm* is used to support the microscope when it is carried.
- The *base* supports the microscope.



Coarse Adjustment Knob

- Moves the stage up and down for focusing.
- NOT TO BE USED WITH ANY OTHER OBJECTIVE BUT THE 4X



Fine Adjustment Knob

- Moves the stage slightly to sharpen the image.
- Used with the 10X and 40X objective to focus.

Light Microscopy : The purpose of the microscope is to create **magnification** so that structures can be resolved by eye and to create **contrast** to make objects visible.

Modern microscope component identification

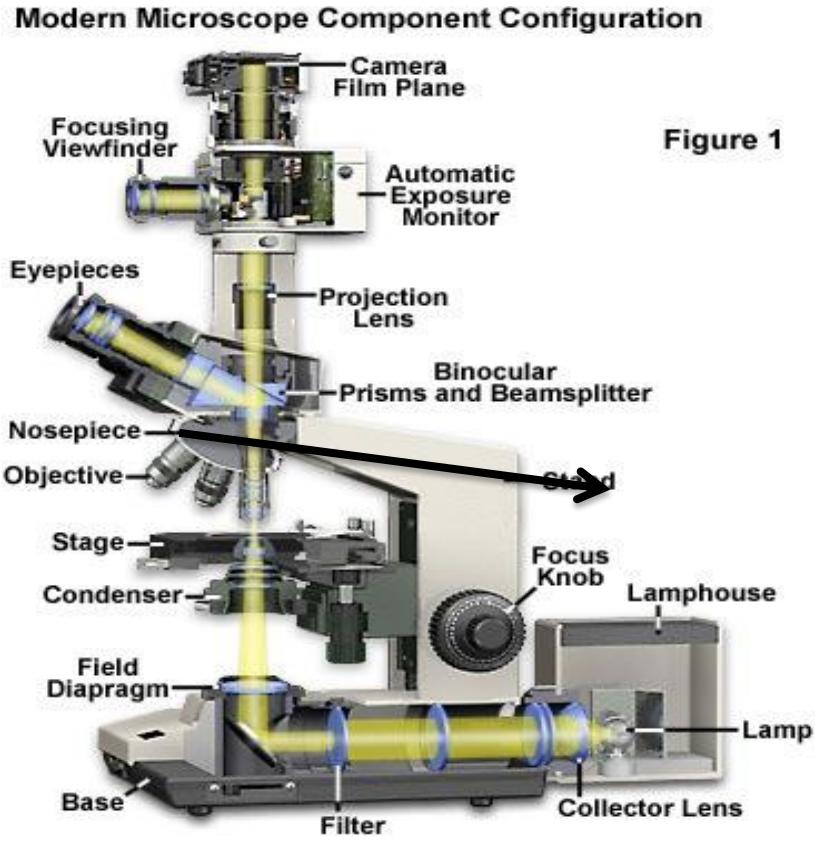


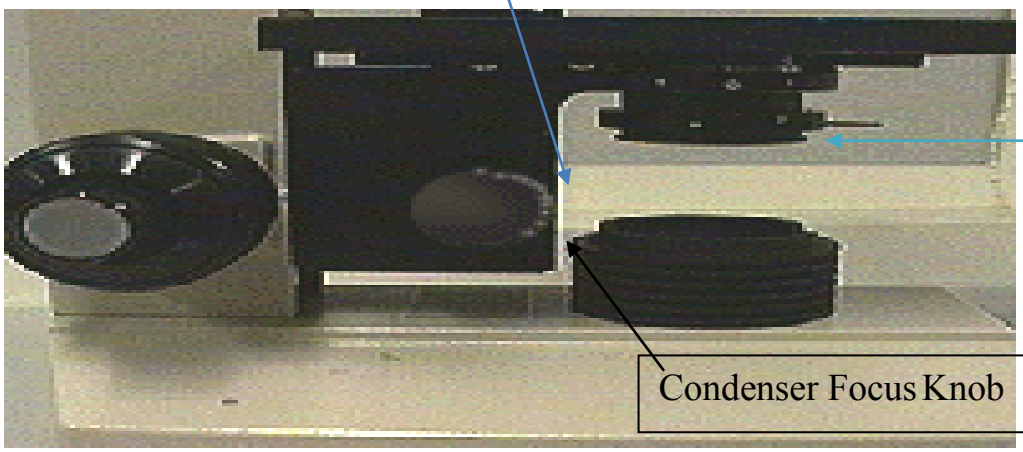
Figure 1

Prisms Used to Re-Direct Light In Imaging Path While Mirrors Are Used in Illumination Path

Objective Specifications

Figure 1

Condenser is Translated Along Optical Axis to Bring Field Diaphragm into Focus

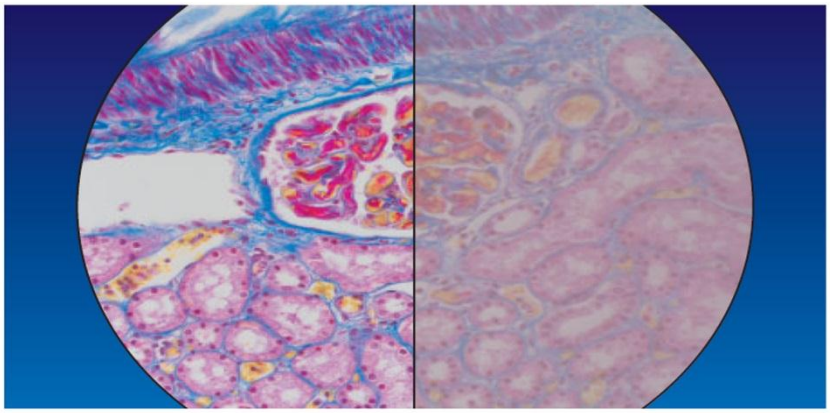


Condenser X-Y Translation Screws Are Used to Center Image of Field-Diaphragm

The Condenser Diaphragm Controls the Illumination NA

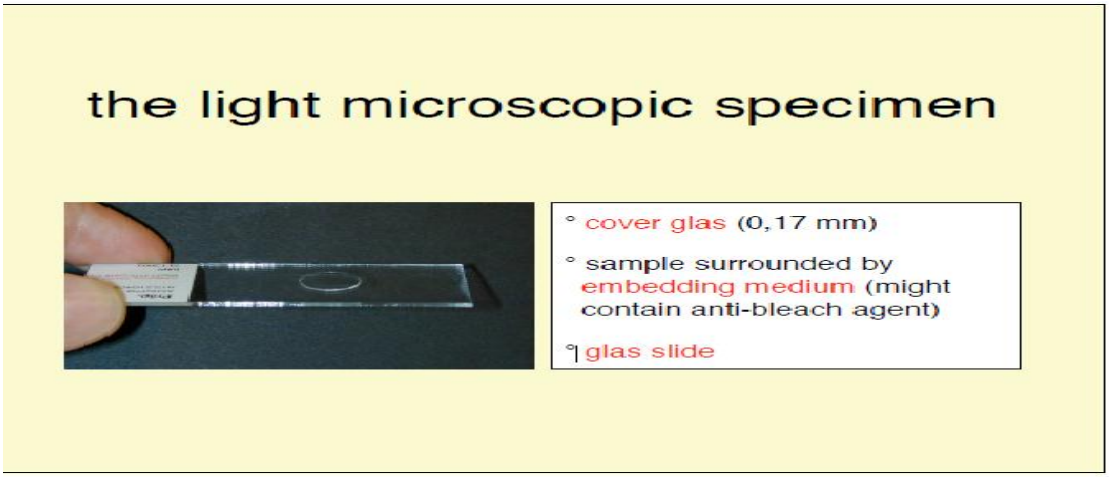
A practical note: cleaning microscope optics

Effect of dirty optics…..



Clean (left) and oil contaminated (right) objective front lens. Toad, kidney, stained with Trichrome. Planapo 20/0.80. Bright field

http://www.zeiss.de/courses, The Clean Microscope



Taking care of microscope optics

Never “dry” clean a lens

- Use a solvent like Windex that will remove most everything. Use xylene under a hood as last resort.
- Use best quality lens tissue available [e.g Kodak].
- Clean in swirl pattern from center out.
- Remove immersion oil after use to prevent seepage

- **Probe Microscopy**
  - Magnifies more than 100,000,000 times
  - Two types
    - Scanning tunneling microscopes
    - Atomic force microscopes

The Electron Microscope

- Microscopes allow us to see living organisms which are too small to be seen by the naked eye
- The electron microscope uses beams of electrons rather than light to illuminate the specimen
- A beam of electrons has an effective wavelength of less than 1 nm so it can be used to resolve small sub-cellular ultra-structure
- The development of the electron microscope allowed biologists to view the organelles within a cell for the first time

- **Electron Microscopy**
  - Light microscopes cannot resolve structures closer than 200 nm
  - Electron microscopes have greater resolving power and magnification
  - Magnifies objects 10,000X to 100,000X
  - Detailed views of bacteria, viruses, internal cellular structures, molecules, and large atoms

There are two types of electron microscope

The transmission microscope. (TEM)

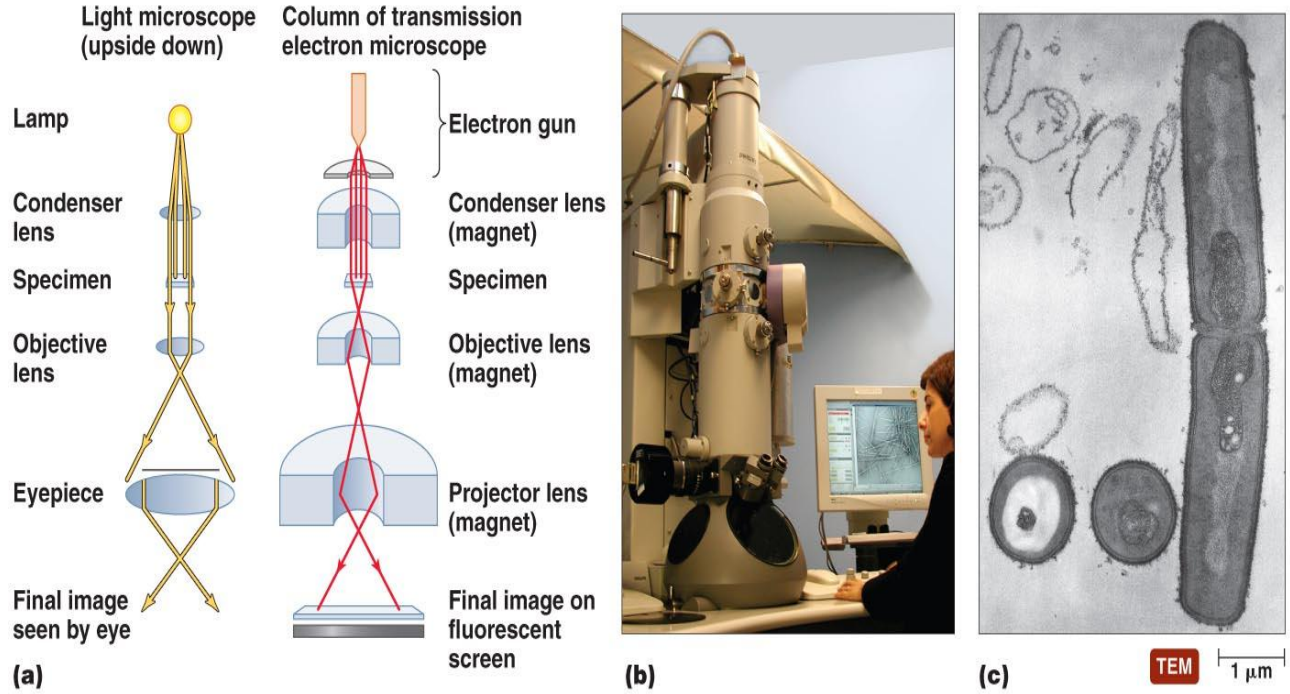
- Works like a light microscope, it transmits a beam of electrons through a thin specimen
- Then focussing the electrons to form an image on a screen
- This is the most common form of electron microscope and gives good resolution.

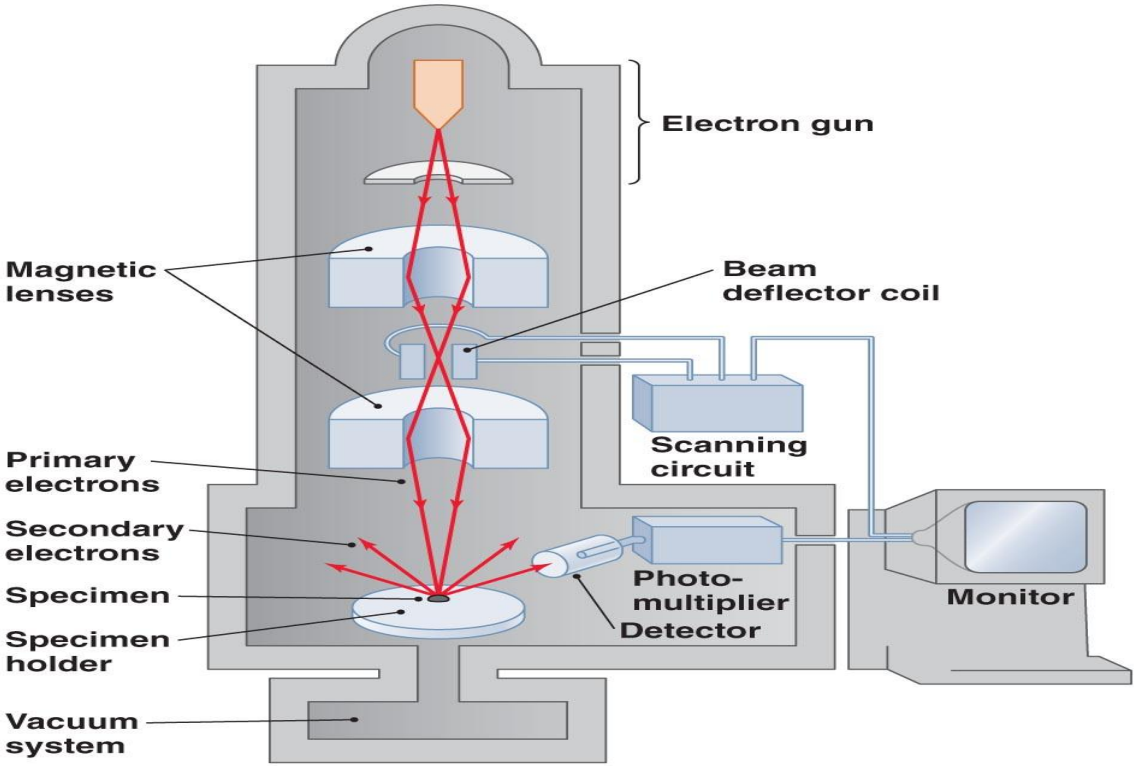
The scanning electron microscope (SEM)

- This scans a fine beam of electron onto specimen and collects electrons scattered by surface
- This has poor resolution but gives good 3-D images

Disadvantages of the Electron Microscope

- The specimens must be fixed in plastice and viewed in a vacuum and so they must be dead
- Sometimes specimens can be damaged by the electron beam and must be stained with an electron-dense chemical





Introduction

Spectrophotometers : are instruments that measure the amount of light absorbed that passes through (is transmitted through) a sample.by solutions. **or** "Spectrophotometer analyze the concentration of solute in a solution by measuring the intensity of a particular light beam after it is directed through and emerges from it."

[The absorption of light is directly proportional to the concentration of the absorbing species in the solution.] ***(aka-gives a linear relationship)***

- ***Also measure % transmittance, but does not give a linear relationship***

TWO DIFFERENT TYPES OF SPECTROPHOTOMETER:

- Ultraviolet (UV) Spectrophotometers.
  - Uses ultraviolet light of wave lengths from 200 nm to 350 nm.

- Visible (VIS) Light Spectrum Spectrophotometers.
  - Uses visible light (white light) of wave lengths from 350 nm to 700 nm.

BLANK

- In order to effectively use a spectrophotometer we must first zero the machine, we do this using "the blank."
- The blank contains everything except the compound of interest, which absorbs light. Thus, by zeroing the machine using "the blank," any measured absorbance is due to the presence of the solute of interest.

ABSORPTION SPECTRUM

- Different compounds having dissimilar atomic and molecular interactions have characteristic absorption phenomena and absorption spectra, which differ.
- The point (wavelength) at which any given solute exhibits maximum absorption of light (the peaks on the curves on the figure below) is defined as that compounds particular λmax.

Cuvettes

A cuvette is a kind of cell usually a small square tube, sealed at one end, made of Plastic, glass or optical grade quartz and designed to hold samples for spectroscopic experiments. Cuvette should be as clear as possible, without impurities that might affect a spectroscopic reading. Like a test-tube, a cuvette may be open to the atmosphere on top or have a glass or Teflon cap to seal it shut.

Quartz Cells

170-2700 nm wavelength range

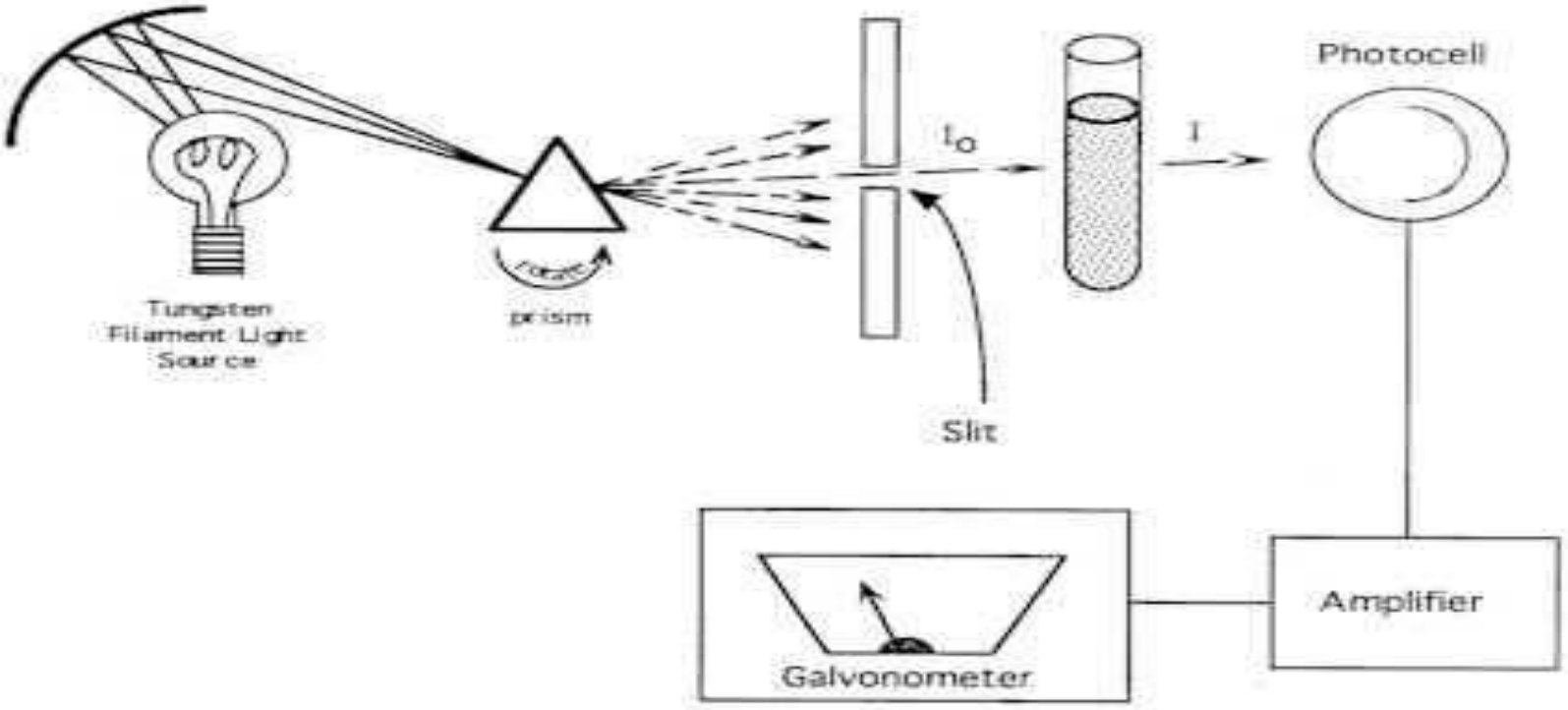
Disposable Cuvettes

UV-Cuvettes for the range between 220-900 nm

VIS-Cuvettes for the range 350-900 nm

What are Spectroscopy and Spectrophotometry??

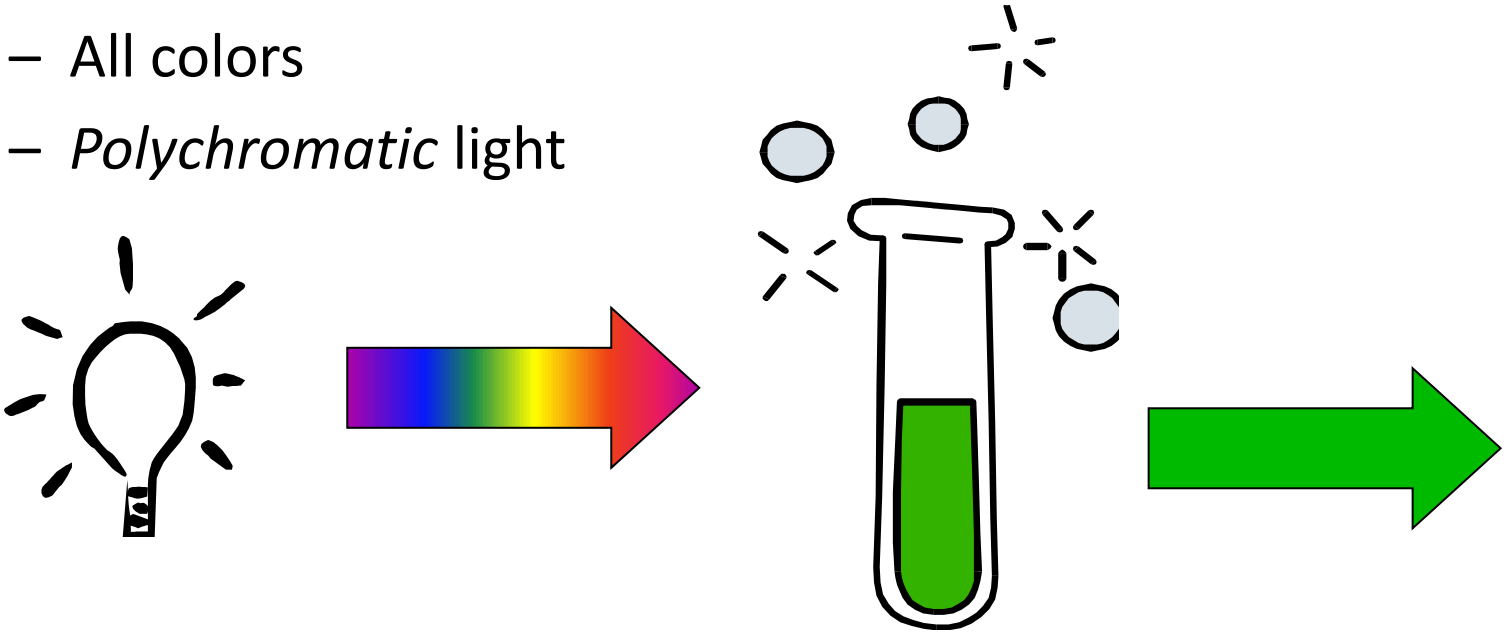
- Light can either be *transmitted* or *absorbed* by dissolved substances
- Presence & concentration of dissolved substances is analyzed by passing light through the sample
- Spectroscopes measure electromagnetic ***emission***
- Spectrophotometers measure electromagnetic ***absorption***



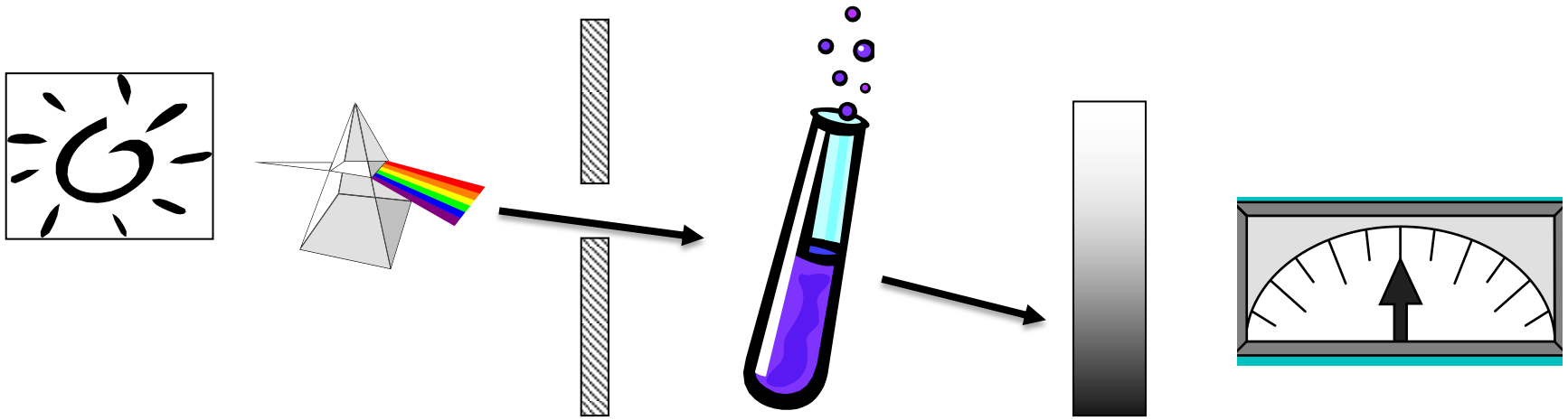
- Uses a type of light to detect molecules in a solution
- Light is a type of energy, and the energy is reported as wavelengths, in nanometers (nm).

Absorption of Light

- White light
  - All colors
  - *Polychromatic* light



The Spectrophotometer



Definitions & Symbols

- Intensity (I)
- Transmittance (T)
  - It's also referred to as %T or T x 100
  - $T = I/I_o$
    - Where I_o is the intensity of the blank

Graphical Relationship

- **% transmission and % absorption are not linearly related to concentration**
- **For a graph to be useful, a straight line is needed**
- **ABSORBANCE = log(1/T) = -log(T)**

Beer's Law

- The intensity of a ray of monochromatic light decreases exponentially as the concentration of the absorbing medium increases.
- More dissolved substance = more absorption and less transmittance

Standardization Graph

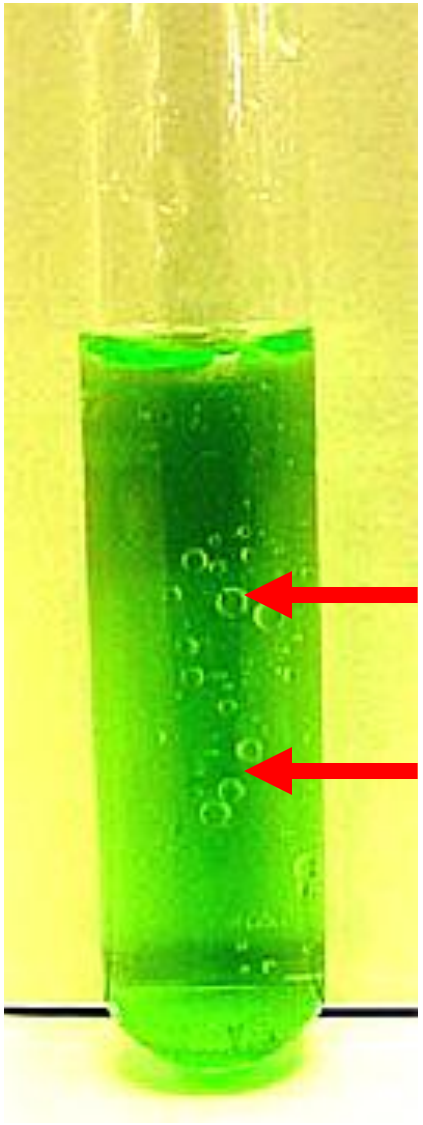
- **Standards** (solutions of known concentration) of the compound of interest are made, treated, and their absorbances (ABS) and concentration values are used to create a **Standardization Graph**.

Reading the Meter

The LED displays both below, but pushing the mode button changes between the two.

- **Percent Transmittance--the portion of incident light passing through the sample**
- **Absorbance--the portion of incident light absorbed by the sample.**

Remove Trapped Air Bubbles



Tapping to remove bubbles

Clean Cuvettes with Kimwipes

Clean Cuvettes with Goggle Cleaning Paper—ONLY!!

- **It is important to clean the outside, lower portion of a cuvette before taking any readings.**
- **Fingerprints, liquid droplets, and smudges on the cuvette surface can give false absorbance readings.**
- **Wipe the cuvette first with a goggle cleaning paper and then with a dry one.**
- **After cleaning handle cuvettes only by their tops.**

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